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The Effect of Infrastructure Investment on Economic Growth in Rural Areas: Case Study in Papua Province

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Abstract

This study examines the state of infrastructure and economic dynamics in Papua Province from 2016 to 2020, focusing on domestic investment, foreign investment, household consumption, and Gross Domestic Product (GDP). The data used comprises the value of domestic investment (Invs_DN), foreign investment (Invs_LN), household consumption (Kons_RT), and GDP for each year during the period. Descriptive analysis reveals that domestic and international investment fluctuated significantly, whereas household consumption steadily increased. GDP swings reflect the region's economic fragility. A correlation analysis reveals a very poor association between investment (both domestic and foreign) and GDP, as well as a slightly stronger but still weak relationship between household consumption and GDP. The linear regression model used to assess the impact of these variables on GDP reveals that the three variables make little contribution to explaining differences in GDP. These findings suggest that variables other than investment and household spending may have a larger impact on GDP in Papua Province. As a result, Papua Province requires more comprehensive and concentrated policies to stabilize and enhance investment, as well as discover and optimize other elements that can encourage long-term economic growth.

Keywords: Papua Province, Domestic investment, Foreign investment, Household consumption, Gross Domestic Product (GDP).

Introduction

Sustainable and inclusive economic growth in rural areas, especially in countries like Indonesia, faces challenges due to inadequate infrastructure development (Sofia Elena Colesca, 2023). Access to important infrastructure such as roads, bridges, electricity, clean water and communication facilities is very important for economic progress and improving the quality of life in rural communities (Ahmad Saifullah Kamaludin, 2023). Studies show that investment in village resources and development can significantly contribute to local economic activity and growth, emphasizing the importance of infrastructure in driving economic progress (Yuniarto Hadiwibowo, 2023). In addition, addressing problems such as early marriage in rural areas, influenced by socio-economic background and lack of educational aspirations, is critical to promoting sustainable development and ensuring equal opportunities for all members of society (Iklasiah Dalimoenthe, 2023). By focusing on improving infrastructure and addressing social issues, rural areas can pave the way for sustainable economic growth and improved livelihoods.

E-ISSN: 3026-3239
Vol. 3, No. 2, July - December (2024), pp. 310-326

Papua Province, with its challenging topography and limited accessibility, is one of the areas that really needs infrastructure investment. This region consists of many remote areas with difficult access, which results in high transportation costs, limited access to basic services, and low levels of community welfare. Infrastructure development plays an important role in the Indonesian government's agenda to improve the welfare of rural communities and bridge regional development gaps. Various studies emphasize the importance of infrastructure in various aspects of rural development. Research highlights the importance of infrastructure in accelerating economic growth (Nova Nevila Rodhi, 2023), improving ecotourism management (Eko Budi Santoso, 2023), increasing inter-regional connectivity (Wirman Syafri, 2023), fighting rural poverty through access to education and health facilities (March Priyanta, 2023), and handles legal aspects for effective infrastructure development (Himawan, 2023). By focusing on building and maintaining infrastructure such as roads, schools, health facilities, and waste management systems, the government aims to uplift rural areas, empower communities, and create sustainable development pathways to reduce regional disparities and improve overall prosperity.

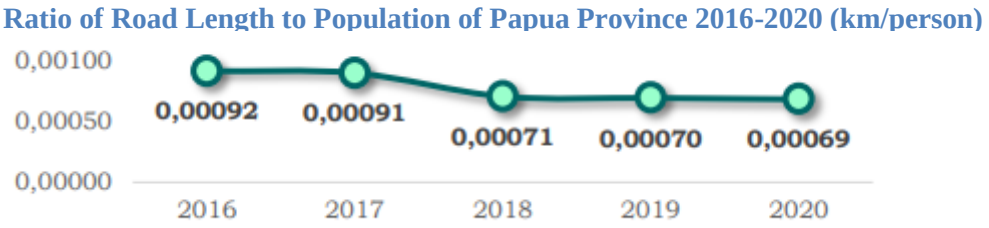
Investments in rural infrastructure play an important role in driving local economic growth and improving the quality of life of rural residents. Studies have shown that rural infrastructure, including elements such as irrigation facilities, agricultural markets, and road networks, significantly impacts agricultural output, thereby creating new opportunities for agriculture and small industry (Olga Pashkevich, 2023). In addition, the provision of social infrastructure in rural areas, such as education and health services, is critical to improving the welfare of rural residents and ensuring sustainable development (Kirandeep Kaur, 2023). While rural areas often face neglect in infrastructure investment, collaborative community efforts have been identified as key in overcoming infrastructure deficiencies and sustaining rural infrastructure needs (Ayobami Abayomi Popoola,2023). Overall, investment in rural infrastructure not only improves connectivity and accessibility but also increases productivity across various economic sectors, contributing to overall economic development and improving living conditions in rural areas.

Infrastructure investment plays an important role in driving economic growth in rural areas, as proven by various studies. In Papua, Indonesia, where poverty levels are high (Candra Fajri Ananda, 2023), improving road infrastructure has been shown to have a positive impact on household welfare, especially among poor and remote households, leading to higher levels of consumption, quality of housing better, and reduce dependence on subsistence farming (Ayobami Abayomi Popoola, 2023). Additionally, collaborative community efforts in

E-ISSN: 3026-3239
Vol. 3, No. 2, July - December (2024), pp. 310-326

infrastructure provision by rural residents have been identified as an adaptive response to poor service delivery, emphasizing the importance of local involvement in sustaining rural infrastructure needs (Daud Nawir, 2023). Additionally, public infrastructure such as roads and bridges have been found to have a significant positive effect on economic growth in Indonesia, highlighting the importance of appropriate infrastructure development in driving economic growth in rural areas such as Central Papua Province (J. C Karay, 2022).

Graphic image of the Trans Papua road



Source: BPS Papua Province, 2021

The research papers collectively highlight the critical role of infrastructure in the economic development of rural areas and offer valuable policy recommendations to increase the benefits of infrastructure investment. Studies emphasize the importance of rural infrastructure, such as roads, irrigation facilities, electricity supplies, and agricultural markets, in driving agricultural growth and overall economic development (Ayobami Abayomi Popoola,2023). Additionally, collaborative community efforts by rural residents play a key role in addressing infrastructure deficiencies and encouraging communal infrastructure projects, underscoring the importance of local engagement in sustaining rural infrastructure needs (Kirandeep Kaur, 2023). Additionally, the impact of rural infrastructure on the socio-economic development of rural communities is evident, with factors such as water facilities and infrastructure maintenance significantly affecting the socio-economic lives of rural residents (Ajai Pal Sharma, 2023). These findings collectively underscore the important link between infrastructure development and economic progress in rural areas, emphasizing the need for targeted policies to optimize infrastructure investment for sustainable rural development.

Research on economic development in Papua, especially Papua Province, contributes significantly to studies of regional development and rural economics (Candra Fajri Ananda, 2021). By utilizing methods such as Klassen Typology and Location Quotient analysis, this research identifies underdeveloped sectors such as agriculture, forestry and fisheries in Papua, emphasizing the need for targeted economic policies based on regional potential (Candra Fajri Ananda, 2023). Apart from that, the formation of new provinces in Papua, such as Central Papua Province, has been proven to increase economic output, added value and employment, which ultimately increases regional prosperity and competitiveness while reducing national

E-ISSN: 3026-3239
Vol. 3, No. 2, July - December (2024), pp. 310-326

economic inequality (Ade Ayu Astuti, 2023). Furthermore, analysis of the financial performance of the Papua Provincial Government highlights good instructive and efficient patterns in generating income and managing expenditure, indicating room for improvement and growth in regional income and expenditure (Yaya Sonjaya, 2023). These findings not only offer practical insights for policymakers and local stakeholders but also enrich the scientific literature by exploring the complex relationship between infrastructure development and economic growth in rural areas.

Literature Review

Economic Growth Theory

Economic growth theory has become the main basis for understanding the factors that influence an increase in a region's economic output. Classic growth models such as Solow-Swan (1956) emphasize the importance of the accumulation of physical capital and technology in driving economic growth. Infrastructure, as part of physical capital, plays a crucial role in increasing economic productivity and efficiency. Endogenous theory (Romer, 1986; Lucas, 1988) further emphasizes that investment in infrastructure can produce positive spillover effects, increasing innovation and productive capabilities in a sustainable manner.

Economic growth theory has developed over the centuries, with Adam Smith's emphasis on specialization and efficiency influencing modern theories (Neri Salvadori, 2003). Explanations of growth range from the role of productive ideas to the impact of incentives on hard work and enterprise, highlighting the importance of policies and institutions in shaping growth (Boyan Jovanovic, 2001). Technical progress is identified as a central mechanism that drives economic growth, with a focus on its components and implications for economic policy, especially in increasing international competitiveness (Jonas Schmitt, 2016). Theoretical discussions also emphasize the relationship between market size, specialization, and wealth accumulation, underscoring the complex dynamics that drive economic development and prosperity (György Simon, 2012). Overall, economic growth theory explores the complexity of economic systems, technological advances, and policy frameworks that support sustainable and inclusive growth trajectories.

The Role of Infrastructure in Economic Development

Infrastructure plays an important role in economic development by increasing productivity and facilitating growth. Studies highlight the positive impact of infrastructure development on economic outcomes at national and regional levels (Alma Mačiulytė-Šniukienė,2022). Infrastructure improvements, such as transportation, ICT, electricity, and telecommunications,

E-ISSN: 3026-3239
Vol. 3, No. 2, July - December (2024), pp. 310-326

have been shown to have significant long-term positive effects on GDP, especially in developing countries (Govinda R. Timilsina, 2023). Additionally, the complementarity of skilled labor and infrastructure contributes to skill-biased economic growth, widening income inequality globally (Satyaki Mitra, 2022). In rural areas, the development of economic and social infrastructure is critical to raising living standards and improving human well-being, as seen in initiatives such as the Rural Infrastructure Development Fund in India. Overall, investment in infrastructure is a key strategy for driving economic growth, reducing regional disparities, and improving overall quality of life.

Infrastructure plays an important role in economic development by providing essential services necessary for economic activity. Research has shown that various types of infrastructure, such as communications, electricity, education, health, transportation, and ICT, have a significant impact on GDP growth (Olayide Olayinka Olaoye,2023). For example, research shows that electricity infrastructure has a very strong positive influence on GDP in both the short and long term (Govinda R. Timilsina, 2023). In addition, the quality of infrastructure, including roads and internet connectivity, is linked to increased production output at the regional level (Alma Mačiulytė-Šniukienė ,2022). Additionally, the state of infrastructure, including roads, clean water, and electricity, has been found to have a simultaneous effect on economic growth, emphasizing the importance of a well-developed infrastructure network for overall economic progress. According to the World Bank (1994), adequate infrastructure can increase economic efficiency, reduce transaction costs, and expand access to markets and public services. Transport infrastructure, for example, reduces logistics costs and opens access to new markets (Aschauer, 1989). Energy and clean water infrastructure, on the other hand, increases the productivity of the agricultural and industrial sectors (Calderón & Servén, 2004).

Infrastructure and Development of Rural Areas

Limited infrastructure in rural areas significantly hinders their economic development, as highlighted in various research papers. Studies emphasize the importance of improving social and technical infrastructure in rural areas to improve the quality of life, reduce poverty, and stimulate economic growth (Onggarbek Alipbeki, 2023). Factors such as poor road connectivity, inadequate water supply, substandard sewage systems, lack of waste disposal facilities, and inadequate access to electricity hamper rural development (M. Khalitova, 2023). Moreover, migration of rural residents to urban areas due to insufficient social infrastructure exacerbates this problem, emphasizing the need for state intervention and innovative solutions

E-ISSN: 3026-3239
Vol. 3, No. 2, July - December (2024), pp. 310-326

to promote effective employment and entrepreneurship in villages (Ajai Pal Sharma, 2023). Embracing digital technology and implementing marketing strategies in the agricultural sector can also play an important role in enhancing rural economic activities and connecting farmers with consumers, thereby contributing to overall rural development. Research by Khandker, Bakht, and Koolwal (2009) shows that infrastructure investments in rural areas it can increase agricultural productivity, create jobs and increase household income. Road infrastructure, for example, not only improves accessibility but also reduces transportation time and costs (Fan & Chan-Kang, 2005). Investments in electricity and clean water are also important to improve the quality of life and economic productivity in rural areas (Dinkelman, 2011).

Empirical Study of the Impact of Infrastructure in Indonesia

Several empirical studies have examined the impact of infrastructure investment in Indonesia. A study by Sahoo, Dash, and Nataraj (2010) shows that infrastructure investment has a significant positive impact on economic growth in Indonesia. Other research by Resosudarmo and Yusuf (2009) found that infrastructure development in underdeveloped areas can reduce regional disparities and improve community welfare. The unique socio-economic conditions and geographic challenges of Central Papua Province require detailed analysis for effective development planning. Studies highlight the high level of poverty in Papua, emphasizing the need for targeted economic policies based on regional characteristics (Candra Fajri Ananda, 2023). The formation of a new autonomous region in Papua aims to accelerate equitable economic development, with a significant impact on economic output, added value and employment opportunities (Fadhli Zul Fauzi, 2023).

Furthermore, research on inequality in Papua Province reveals varying levels of development between districts, indicating the importance of understanding and addressing disparities for balanced growth (Winardi Winardi, 2023). In addition, challenges in Papua's development include issues related to land acquisition, access difficulties, and communication system integration, underscoring the complexity of the regional development process (Ade Ayu Astuti, 2023). A comprehensive analysis that considers these factors is essential for a tailored strategy to promote sustainable development in Central Papua Province.

Infrastructure and Economic Dynamics in Central Papua Province

Central Papua, especially Papua province, is characterized by challenging topography and substantial accessibility limitations (Y. Jacquemart, 2022). The region's varied terrain includes swampy lowlands, hills, plateaus, and steep mountains, making transportation services minimal

E-ISSN: 3026-3239
Vol. 3, No. 2, July - December (2024), pp. 310-326

and often dependent on air travel due to isolation (Dina Yuliana, 2019). This difficult topography contributes to high transportation costs, which causes price differences in the Central Highlands of Papua (James Stiefvater,2023). In addition, the mountainous nature of the region in Papua results in limited accessibility for people and goods, relying heavily on air transportation due to inadequate infrastructure and facilities (Richard Doyle, 2012).

These factors highlight the unique challenges faced in Central Papua, impacting various aspects of development and daily life in the region. Infrastructure development in the region faces different challenges compared to other regions in Indonesia. Research by Widodo et al. (2017) highlight that infrastructure development in Papua must be adapted to the local context to achieve optimal results. In addition, local community participation in planning and implementing infrastructure projects can increase the effectiveness and sustainability of investments (Putra & Suhardi, 2019).

The Influence of Infrastructure on Local Economic Growth

Infrastructure development has been studied extensively over the years, revealing a wide range of impacts that vary based on infrastructure type and regional context (Yi Yun Tu, 2023). Research shows that infrastructure projects can significantly reduce transaction costs, increase market integration, improve living standards, and promote industrial development within the country (Anandari Desriliana Fredynasari Hidayat, 2023). In addition, studies emphasize the importance of evaluating the economic results of infrastructure development at national and regional levels to ensure efficient investment allocation and growth (Alma Mačiulytė-Šniukienė ,2022).

In particular, the findings show that certain types of infrastructure, such as roads and internet connectivity, have a positive relationship with production output, while the quality of government and the level of corruption play an important role in influencing the effectiveness of infrastructure investment at the regional level. This comprehensive analysis underscores the need for tailored infrastructure strategies that take into account the specific characteristics and needs of each region to maximize the benefits of development initiatives. In rural areas, transportation infrastructure often has a greater impact on economic growth than other infrastructure (Donaldson, 2018). However, the combination of different types of infrastructure can also create greater synergies, increasing overall productivity (Eberts, 1990).

E-ISSN: 3026-3239
Vol. 3, No. 2, July - December (2024), pp. 310-326

Methods

This research uses secondary data sourced from the Papua Province Central Statistics Agency for the 2016-2020 period. Economic growth is proxyed using Gross Regional Domestic Product as the dependent variable, while the independent variables are Domestic Investment, Foreign Investment Value. This research also includes a control variable, namely Household Consumption. The analysis technique used in this research is panel data regression analysis. Panel data is data that is the result of observations in several cross-sections and time series (Setiawan & Kusrini, 2010). Some of the advantages of using panel data include the following: (1) Panel data is able to accommodate the level of heterogeneity of variables not included in the model, (2) is able to reduce collinearity between variables, (3) can minimize bias produced by individual aggregation due to data units more (Baltagi, 2005).

Results and Discussion

Results

Descriptive Analysis

a. Mean (Average)
    1. Invs_DN (Domestic Investment): Average domestic investment is around 137,470,760.4. This shows that in general domestic investment is at this figure, but with extreme values in certain years (for example, 2017 with very high values), this indicates significant variations.
    2. Invs_LN (Overseas Investment): The average overseas investment is 611,125,680.2, which shows that in general foreign investment is at that figure. As with domestic investment, the existence of extreme values in a particular year also affects the average.
    3. Kons_RT (Household Consumption): Average household consumption is 1,268,428.8. This figure is more stable compared to investment, indicating that household consumption is more consistent from year to year.
    4. GDP (Gross Domestic Product): Average GDP is 37,569.2. This value shows significant fluctuations from year to year, with a sharp decline in 2017.

b. Median
    1. Invs_DN (Domestic Investment): Median domestic investment is 59,483,954.0, indicating that half of the domestic investment value is below this figure. This indicates that some very high values (such as 2017) may be outliers.

E-ISSN: 3026-3239
Vol. 3, No. 2, July - December (2024), pp. 310-326

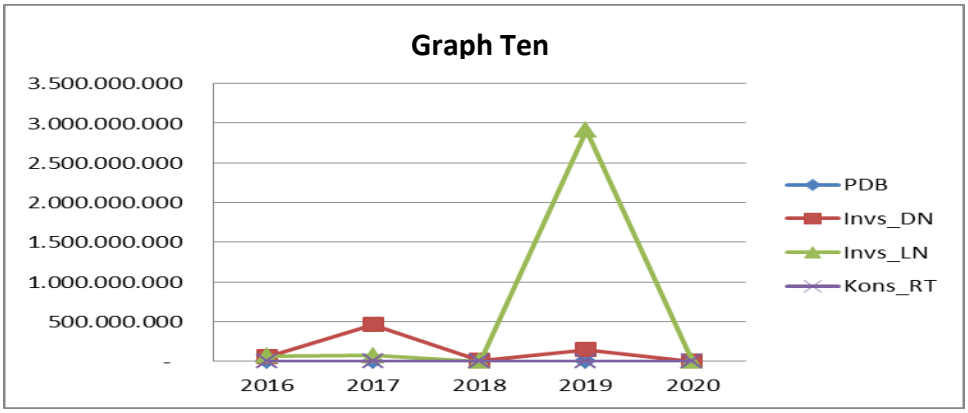
2. Invs_LN (Overseas Investment): Median overseas investment is 70,370,818.0, which is lower than the average, indicating the presence of some very high values.
3. Kons_RT (Household Consumption): The median household consumption is 1,309,714.0, which is very close to the average, indicating that the distribution of household consumption data is quite symmetrical.
4. GDP (Gross Domestic Product)**: Median GDP is 45,772.0, which is higher than the average, indicating a sharp decline in certain years.

c. Standard Deviation

1. Invs_DN (Domestic Investment): The standard deviation is 192,487,800.0, indicating that there is a very large variation in the value of domestic investment from year to year.
2. Invs_LN (Overseas Investment): The standard deviation is 1,286,840,000.0, which is very large, indicating extreme variations in the value of overseas investments.
3. Kons_RT (Household Consumption): The standard deviation is 161,568.4, indicating that household consumption is more stable and has smaller variations compared to investment.
4. GDP (Gross Domestic Product): Standard deviation is 18,652.99, indicating significant variation in GDP from year to year.

Trend Analysis

Trend Visualization



E-ISSN: 3026-3239
Vol. 3, No. 2, July - December (2024), pp. 310-326

Annual Growth Calculation

Annual Growth

Table.Growth Data

In %

Years	Ins_DN	Ins_LN	Kons_RT	PDB
2016	-	-	-	-
2017	683,07	1,34	4,13	-90,31
2018	97,75	-98,41	29,76	961,06
2019	1324,34	25603,14	-10,24	-15,52
2020	-98,17	-80,52	4,47	11,09

Trend Analysis Results

Trend Visualization

The resulting graphs show how each variable changes from year to year:

1. In the Domestic Investment variable (Invs_DN), there was a significant increase in 2017, followed by a drastic decrease in 2018, an increase again in 2019, and again a drastic decrease in 2020.
2. In Foreign Investment (Invs_LN), the value of foreign investment was relatively stable until 2018, then experienced a large spike in 2019, and fell again drastically in 2020.
3. In Household Consumption (Kons_RT), household consumption shows a relatively consistent increase from year to year, with a slight decrease in 2019 and an increase again in 2020.
4. In terms of GDP, GDP experienced a drastic decline in 2017, then recovered and increased in 2018, decreased again in 2019, and increased slightly in 2020.

Analysis of Relationships Between Variables

Correlation

From the correlation matrix, we can see the Pearson correlation values between the following variables :

E-ISSN: 3026-3239
Vol. 3, No. 2, July - December (2024), pp. 310-326

	Years	Invs_DN	Invs_LN	Kons_RT	PDB
Tt Years	-	0,186	0,218	0,536	-0,073
Invs_DN	0,186	-	0,276	0,178	-0,274
Invs_LN	0,218	0,276	-	-0,113	-0,111
Kons_RT	0,536	0,178	-0,113	-	0,092
PDB	-0,073	-0,274	-0,111	0,092	-

Source : SmartPls 3 Data Processing Results

Interpretation:

1. Correlation between GDP and Invs_DN: -0.274, indicating a weak negative relationship.
2. Correlation between GDP and Invs_LN: -0.111, indicating a very weak negative relationship.
3. Correlation between GDP and Kons_RT: 0.092, indicating a very weak positive relationship.

Regression

A summary of the regression results will show how much influence the independent variables (Invs_DN, Invs_LN, Kons_RT) have on the dependent variable (GDP).

OLS Regression Results

```
==============================================================================
Dep. Variable:                    PDB   R-squared:                       0.794
Model:                            OLS   Adj. R-squared:                  0.588
Method:                 Least Squares   F-statistic:                     3.867
Date:                Tue, 20 Jun 2023   Prob (F-statistic):              0.279
Time:                        18:36:39   Log-Likelihood:                -33.003
No. Observations:                   5   AIC:                             72.01
Df Residuals:                       2   BIC:                             70.83
Df Model:                           2
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const       3.327e+04   7574.219      4.392      0.048    3.62e+03    6.29e+04
Invs_DN    -2.788e-05      0.011     -0.002      0.998      -0.041       0.041
Invs_LN    -3.098e-06      0.002     -0.002      0.998      -0.006       0.006
Kons_RT        0.0093      0.010      0.933      0.444      -0.041       0.060
==============================================================================
Omnibus:                        0.924   Durbin-Watson:                   1.923
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E-ISSN: 3026-3239
Vol. 3, No. 2, July - December (2024), pp. 310-326

Prob(Omnibus):	0.630	Jarque-Bera (JB):	0.574
Skew:	0.740	Prob(JB):	0.750
Kurtosis:	2.062	Cond. No.	2.75e+06

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Interpretation:

1. R-squared: 0.794 indicates that approximately 79.4% of the variation in GDP can be explained by the independent variables (Invs_DN, Invs_LN, Kons_RT).
2. Invs_DN: The coefficient of -2.788e-05 shows that the effect on GDP is very small and negative.
3. Invs_LN: The coefficient of -3.098e-06 shows that the effect on GDP is very small and negative.

GDP is small and positive.

Trend Visualization

1. Domestic Investment (Invs_DN)
   Plot: Line graph showing domestic investment trends from 2016 to 2020.
2. Overseas Investment (Invs_LN)
   Plot: Line graph showing overseas investment trends from 2016 to 2020.
3. Household Consumption (Kons_RT)
   Plot: Line graph showing household consumption trends from 2016 to 2020.
2. Gross Domestic Product (GDP)
   Plot: Line graph showing GDP trends from 2016 to 2020.

Discussion

Correlation & Regression Analysis

1. Correlation, the relationship between GDP and other variables (Invs_DN, Invs_LN, Kons_RT) is weak, both positive and negative.
2. Regression, The regression model shows that the independent variables have a small influence on GDP, with a fairly high R-squared (0.794) but with a very small coefficient, indicating that although the model can explain variations in GDP, the contribution of each the independent variable on GDP is very minimal.

Trend Analysis

1. Domestic and Overseas Investment, Both types of investment show high volatility with large fluctuations from year to year. 2019 was a year with very high growth in foreign investment.

E-ISSN: 3026-3239
Vol. 3, No. 2, July - December (2024), pp. 310-326

2. Household consumption, more stable than investment, shows a consistent increase with little fluctuation.
3. GDP, Showing significant fluctuations, with a sharp decline in 2017 and recovery in subsequent years.

Descriptive Analysis

1. Investment, Both domestic and foreign investment show very large variations from year to year, with some extreme values greatly affecting the average.
2. Household Consumption, More stable and shows less variation compared to investment, indicating a more consistent consumption pattern.

GDP, shows significant variations, with some years showing sharp declines, especially in 2017.

Conclusion

1. Investment and Household Consumption Trends
   a. Domestic Investment (Invs_DN)

      Domestic investment trends show significant fluctuations from 2016 to 2020. Domestic investment experienced a large spike in 2017, decreased drastically in 2018, increased again in 2019, and then decreased sharply in 2020. These fluctuations indicate instability in domestic investment in Papua Province.
   b. Overseas Investment (Invs_LN)

      Overseas investment experienced a very large increase in 2019 compared to other years, but again decreased drastically in 2020. This significant increase shows the interest of foreign investors in 2019, but this interest is not sustainable.
   c. Household Consumption (Kons_RT)

      Household consumption showed a stable upward trend from 2016 to 2020. This shows that despite fluctuations in investment, household consumption tends to increase consistently, reflecting people's increasing purchasing power or growing consumption needs.

2. Gross Domestic Product (GDP) Trends

   GDP showed significant fluctuations during the period. 2017 experienced a sharp decline compared to the previous year, followed by recovery in 2018, a decline again in 2019, and recovery in 2020. These fluctuations reflect economic instability in Papua Province which may be influenced by various external and internal factors.

E-ISSN: 3026-3239
Vol. 3, No. 2, July - December (2024), pp. 310-326

3. Correlation Analysis

   The correlation between GDP and investment and household consumption variables shows a weak relationship. The very weak negative correlation between GDP and domestic and foreign investment indicates that an increase or decrease in investment does not significantly affect GDP. In contrast, household consumption has a very weak positive correlation with GDP, indicating little positive relationship.

4. Regression Analysis

   The regression results show that the variables domestic investment, foreign investment and household consumption have a very small influence on GDP. The regression coefficient for each variable shows an insignificant impact, and the R-squared of 0.794 indicates that the model can explain about 79.4% of the variation in GDP, but the individual contribution of each independent variable is very small.

5. Visualization of Residuals

   The residuals plot shows that there is no particular significant pattern, indicating that the regression model used is quite good at modeling the data even though it is not perfect. The distribution of residuals which tends to be normal supports the validity of the regression model used.

Overall, the data shows that domestic and foreign investment in Papua Province is very volatile and unstable. Even though household consumption has consistently increased, investment does not have a significant impact on GDP. This suggests that other factors beyond domestic and foreign investment, as well as household consumption, may have a greater influence on GDP in Papua Province. The government and stakeholders need to consider these other factors and take steps to stabilize and increase investment in order to achieve sustainable economic growth in Papua Province.

E-ISSN: 3026-3239
Vol. 3, No. 2, July - December (2024), pp. 310-326

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Vol. 3, No. 2, July - December (2024), pp. 310-326

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