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RESEARCH ARTICLE

# The effect of unemployment, human development, and government expenditure on economic growth in Sumatra: Foreign direct investment as a moderating variable

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## ABSTRACT

This study examines the effect of unemployment, human development, and government expenditure on economic growth in Sumatra, Indonesia, while analyzing the moderating role of foreign direct investment (FDI). Using panel data from ten provinces in Sumatra covering the period 2011–2024, the study employs the fixed effect model (FEM) and moderated regression analysis (MRA). The findings indicate that unemployment has a negative and statistically significant impact on economic growth, whereas human development shows no significant effect. Government expenditure negatively and significantly affects economic growth. Furthermore, the moderation analysis reveals that FDI significantly strengthens the effect of government expenditure on economic growth, but does not moderate the effects of unemployment or human development. These results underscore the strategic importance of integrating investment inflows with effective fiscal policies to stimulate regional economic growth.

## KEYWORDS

Unemployment; human development; government expenditure; economic growth; foreign direct investment

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## 1. Introduction

Economic growth is the main indicator in assessing the success of a country or region in increasing the production capacity of goods and services. This indicator not only reflects an increase in national income, but is also closely related to job creation, reducing poverty, increasing people's income, and improving people's welfare. According to Rapanna & Sukarno (2017), economic growth is the result of the interaction of various factors such as natural resources, capital, technology, and

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the quality of government policies. One of the most commonly used approaches to measure economic growth is the rate of Gross Regional Domestic Product (GRDP) on a constant currency basis, which reflects the growth of real production quantity over time.

In the context of regional development, Sumatra Island is a strategic region that has great economic potential. However, disparities among provinces are still high, especially in terms of unemployment rate, quality of human resources, effectiveness of government spending, and investment distribution. This causes sharp variations in economic growth in the region. These inequalities need to be analyzed in depth to formulate an inclusive and sustainable development strategy.

Although various determinants have been identified theoretically and empirically, the dynamics of economic growth in Sumatra Island still show complex variations among provinces. Imbalances in fiscal capacity, weak synergies between investment and human resource development, and the suboptimal role of local governments are challenges that must be overcome. In this context, evaluating the extent to which investment variables can strengthen or moderate the influence of independent variables on economic growth is important (Baltagi, 2021). Therefore, interaction or moderation analysis is important in understanding the more complex relationship between development indicators in Sumatra. The following illustrates the average economic growth by island in Indonesia from 2019 to 2023 (see Figure 1).

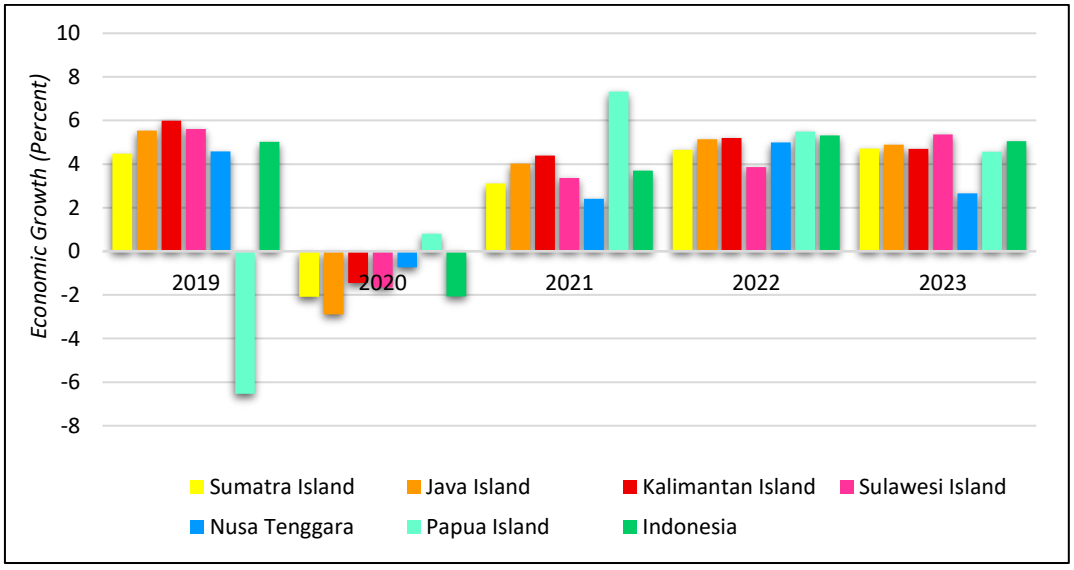


**Figure 1.** Economic Growth by island in Indonesia 2019-2023

The average economic growth data between islands in Indonesia during the period 2019 to 2023 shows diverse dynamics. 2019 recorded positive growth on all islands with Kalimantan and Sulawesi occupying the highest positions. However, the COVID-19 pandemic in 2020 triggered economic contraction, especially in Java and Sumatra, although Papua Island recorded positive growth. Lectures began to appear since 2021 with Papua Island, Kalimantan Island, and Sulawesi Island recording high growth followed by stable growth in Java Island and an increase in Sumatra Island until 2023. This inequality reflects differences in economic structure, fiscal effectiveness, and investment competitiveness between regions. Based on growth theory, economic factors such as models, labor, technology as well as institutional and social factors influence the growth rate.

One of the main factors affecting economic growth is the open unemployment rate. The high open unemployment rate indicates inefficiency in the utilization of labor as a factor of production. According to Irawan & Hoirudin (2024), open unemployment can reduce people's purchasing power and economic productivity, thus inhibiting growth. Tesalonika (2022) and Prabowo et al. (2023) also found a significant negative relationship between open unemployment rate and regional economic growth in Central Kalimantan and West Java. However, high unemployment in the midst of steady economic growth also indicates the phenomenon of jobless growth, which is growth that is not accompanied by an increase in decent employment.

In addition to unemployment, the quality of human resources as reflected in the Human Development Index (HDI) also plays an important role in driving economic growth. A high HDI indicates that people are healthier, more educated, and have a better standard of living. Fadillah et al. (2024) and Dira et al. (2023) stated that an increase in HDI contributes to economic growth, both conventionally and in the context of a green economy. However, in some regions in Sumatra Island, the increase in HDI has not always been in line with the increase in economic output, indicating the challenge of integrating human development into the productive sector.

Government spending is also an important instrument in fiscal policy to stimulate economic growth. In Keynesian theory, government spending can increase aggregate demand and boost economic activity. However, the effectiveness of public spending is highly dependent on its allocation and implementation. Research by Awaludin et al. (2021) and Salihin (2020) show that

government spending focused on infrastructure and public services can have a positive impact on growth. On the other hand, unproductive government spending can lead to inefficiency and fiscal burden.

Investment, especially Foreign Direct Investment (FDI) is considered an important variable that can drive growth through capital investment, job creation, and technology transfer. FDI in Sumatra Island plays a role in strengthening economic transformation in strategic sectors such as industry, mining, and infrastructure (Purba, 2020). Therefore, investment is also used as a moderating variable in this study to test the extent to which investment is able to strengthen the relationship between the open unemployment rate, Human Development Index, and government spending on economic growth.

Economic growth is one of the main indicators to measure the progress of a region's economic development. According to Rapanna & Sukarno (2017), economic growth describes the extent to which economic activity generates additional public income in a certain period which is usually measured through Gross Domestic Product (GDP) or Gross Regional Domestic Product (GRDP). Sari (2021) added that economic growth not only reflects the output of goods and services, but also the purchasing power of the community in accessing them. Factors that influence economic growth include investment, consumption, government spending, export-import, and labor productivity. Inequality in access to production factors is often an obstacle to equitable growth.

The open unemployment rate reflects the proportion of the labor force that is actively seeking work but has not yet found a job. Unemployment is an important issue because it reflects inefficiency in the utilization of human resources. According to Prabowo et al. (2023), unemployment is a condition in which a person wants to work but cannot find a job. Keynes' theory states that unemployment is caused by weak aggregate demand which results in a reduction in output and labor. Okun's Law developed by Athur Okun also explains the negative relationship between economic growth and unemployment, i.e. every 2 percent increase in growth will reduce unemployment by about 1 percent.

The Human Development Index (HDI) is a composite measure that reflects the quality of life of people from three main dimensions, namely health (longevity), education, and decent living standards. Elistia & Syahzuni (2018) state that the HDI is an indicator of a country's progress in the perspective of human development. UNDP (1990) defines human development as the process of expanding people's

life choices and achievements from this process. Endogenous growth theory asserts that investment in human capital through education and health is the main driver of long-term economic growth.

Government spending serves as a fiscal instrument to promote economic growth mainly through improving infrastructure and public services. According to Wu et al. (2010) public goods and services such as education and health greatly contribute to the process of economic development. Weriantoni & Novita (2024) argued that based on Wagner's Law, economic growth will be followed by an increase in government spending to meet the demand for public services. In addition, in Keynesian theory, increased government spending can boost aggregate demand, production, and investment.

Investment is the activity of placing capital in assets that are expected to generate income in the future. Wulandari et al. (2024) explain that investment can be in the form of physical capital formation such as infrastructure and public facilities that encourage growth and welfare. In Solow-Swan theory, investment plays a role in capital accumulation that increases long-term output, while in endogenous theory, investment in human resources is considered vital in increasing productivity and innovation. Investment is also divided into Foreign Direct Investment (FDI) and Domestic Direct Investment (DDI), both of which play an important role in economic development on the island of Sumatra.

## 2. Methods

### 2.1. Data and variables

The data used for this research study is secondary data. The whole data is in the form of panel data, namely by combining cross section data with time series data for the period 2011-2024 (Silvia, 2020). The data were collected by referring to reports containing information on the variables studied, such as data on the open unemployment rate, HDI, economic growth, and investment sourced from the Central Bureau of Statistics (BPS) and government expenditure sourced from the Ministry of Finance (MoF). The regions used as the focus of analysis in this study were taken from 10 provinces on the island of Sumatra with a total of 140 panel data.

This research is a type of quantitative research with the object of research is the island of Sumatra. The variables used in this study amounted to 5 (five) variables consisting of 3 independent variables, 1 dependent variable, and 1 moderating

variable. The scope of independent variables in this study is the open unemployment rate, human development index, government spending, the dependent variable is economic growth, and the moderating variable is foreign investment. This study will present several models to be tested and analyzed. First, see how the effect of open unemployment rate, Human Development Index (HDI), government spending on economic growth in Sumatra Island. Second, see how the role of foreign investment in moderating the level of open unemployment, Human Development Index, government spending on economic growth on the island of Sumatra.

**Table 1.** Description of variables

| Status | Variable | Measurement | Source |
|---|---|---|---|
| Dependent | Economic Growth (EG) | Percent | Statistics Indonesia (BPS) |
| Independent | Open Unemployment Rate (OUR) | Percent | Statistics Indonesia (BPS) |
| | Human Development Index (HDI) | Index | Statistics Indonesia (BPS) |
| | Government Expenditure (GE) | Billion Rupiah | Ministry of Finance |
| Moderation | Foreign Direct Investment (FDI) | Billion Rupiah | Statistics Agency |

## 2.2. Methods

This study uses a quantitative method with a panel data regression analysis model used to analyze the effect of the open unemployment rate, human development index and government spending on economic growth. This study uses multiple linear regression analysis models in the form of panel data (pooled data) which is a combination of time series data with cross section data. Time series data includes one object, while cross section data consists of several or many objects (Silvia, 2020).

The analysis technique used in this study includes 2 regressions, the first is panel data and the second is Moderated Regression Analysis (MRA). panel data regression method to identify the effect of each independent variable on economic growth and moderation of foreign investment. In addition, a classical assumption test was conducted to ensure the validity and reliability of the research results. And continued with the Moderated Regression Analysis (MRA) test to see if foreign investment can moderate existing variables. The data that has been collected is then processed using statistical software to obtain more accurate findings in explaining the factors that affect economic growth on the island of Sumatra.

Panel data regression is used in this study because this method is able to capture differences in characteristics between provinces (heterogeneity) on the island of Sumatra and control for unobserved variables that have the potential to affect economic growth. The regression model used is tested with the Fixed Effect Model (FEM) approach where the selection of the best model is determined through the Hausman Test. In addition, to ensure validation of the estimation results, classical assumption tests such as Multicollinearity and Heteroscedasticity Tests were also conducted. This method provides more accurate and reliable analytical results in examining the effect of open unemployment rate, human development index and government spending on economic growth, as well as the role of foreign investment as a moderating variable in Sumatra Island.

This study uses the Moderated Regression Analysis (MRA) approach to test whether foreign investment acts as a moderating variable in the relationship between the open unemployment rate, human development index and government spending on economic growth in Sumatra Island. MRA is done by forming interaction variables between each independent variable and economic growth. the MRA equation can be formulated by Ghozali (2011) as follows:

$$EG_{it} = \alpha + \beta_1 OUR_{it} + \beta_2 HDI_{it} + \beta_3 GE_{it} + \varepsilon \quad (1)$$

$$EG_{it} = \alpha + \beta_1 OUR_{it} + \beta_2 HDI_{it} + \beta_3 GE_{it} + \beta_4 (OUR_{it} \times FDI_{it}) + \beta_5 (HDI_{it} \times FDI_{it}) + \beta_6 (GE_{it} \times FDI_{it}) + \varepsilon \quad (2)$$

where EG denotes economic growth, α represents the constant term, and $\beta_1$, $\beta_2$, and $\beta_3$ denote the regression coefficients of the independent variables. OUR refers to the open unemployment rate, HDI stands for the Human Development Index, GE represents government expenditure, and FDI denotes Foreign Direct Investment. The symbol ε indicates the error term, while i and t represent the region and the time period, respectively.

## 3. Results and Discussion

### 3.1. Descriptive Statistics

Based on the results of descriptive statistics, it is known that the average economic growth in the Sumatra Island region during the 2011-2024 period was recorded at 4.31 percent with a maximum value of 7.86 percent and a minimum value of -3.80

percent. The standard deviation of 2.09 shows high inter-regional fluctuations. The skewness value of -1.48 indicates a left-skewed distribution, while the kurtosis of 5.48 indicates leptokurtic, which shows the concentration of data around the average but there are still provinces with sharp fluctuations.

**Table 2.** Descriptive statistics

| | EG (Percent) | OUR (Percent) | HDI (Index) | GE (Billion) | FDI (Billion) |
|---|---|---|---|---|---|
| Mean | 4.310000 | 5.486929 | 70.27257 | 23551.91 | 6935.528 |
| Median | 4.710000 | 5.315000 | 70.70000 | 21478.36 | 1997.241 |
| Maximum | 7.860000 | 10.34000 | 77.97000 | 60909.21 | 40889.66 |
| Minimum | -3.800000 | 2.600000 | 20.01000 | 4407.850 | 171.0150 |
| Std. Dev. | 2.091942 | 1.568651 | 5.041742 | 13432.03 | 9064.993 |
| Skewness | -1.477708 | 0.836205 | -7.089793 | 0.731611 | 1.775178 |
| Kurtosis | 5.475720 | 3.661890 | 71.79816 | 2.829401 | 5.794494 |
| Observations | 140 | 140 | 140 | 140 | 140 |

Source: Authors calculation

The Open Unemployment Rate (OUR) has an average of 5.49 percent with a maximum value of 10.34 percent and a minimum value of 2.60 percent. The standard deviation of 1.57 indicates disparity between provinces. Skewness of 0.84 indicates a right-skewed distribution and kurtosis of 3.66 indicates a leptokurtic distribution, which means that most values of the open unemployment rate are concentrated around the average although there are some provinces with high unemployment.

The average Human Development Index is 70.27 points with a minimum of 20.01 points, and a maximum of 77.97 points. The standard deviation of 5.04 reflects the variation between regions. Skewness of -7.09 indicates a left-skewed distribution, and kurtosis of 71.80 indicates a highly leptokurtic distribution, reflecting that most HDI values are concentrated, but there are some extreme values possibly due to data outliers.

The average government expenditure is 2,355.91 billion rupiah, the maximum value is 60,909.21 billion rupiah and the minimum is 4,407.85 billion rupiah with a standard deviation of 13,432.03 indicating inequality in expenditure allocations between provinces. The skewness value of 0.73 reflects a right-skewed distribution, and the kurtosis of 2.83 indicates a platikurtic distribution, meaning that the data is spread more evenly and not too concentrated at one point.

Meanwhile, the average investment is 6,935.53 billion rupiah, the maximum value is 40,889.66 billion rupiah, and the minimum is only 171.02 billion with a standard deviation of 9,064.99 billion rupiah. The skewness of 1.76 indicates a sharp right-skewed distribution, while the kurtosis of 5.79 indicates a leptokurtic distribution. This reflects that most provinces have low investment values, but there are some provinces with very high investment realization.

**Table 3.** Results of the first Chow, Hausman, and LM tests

| | Effects Test | Statistic | d.f | Prob |
|---|---|---|---|---|
| Chow Test | Cross-section F | 7.048028 | (10,126) | 0.0000 |
| | Cross-section Chi-square | 62.199225 | 10 | 0.0000 |
| Hausman Test | Cross-section random | 24.741163 | 3 | 0.0000 |

Source: Authors calculation

The Chow test is conducted to determine the best model between the *Common Effect Model (CEM)* and *the Fixed Effect Model (FEM)* which will be used to estimate panel data. Based on Table 4.2, the prob value of the Cross-section Chi-square is smaller than alpha (α) (0.0000 <0.05), so H0 is rejected. This means that *Fixed Effect* is better than *Common Effect* based on the chow test. The next test is the hausman test. This test aims to select the most appropriate model between *Fixed Effect* and *Random Effect* which will be used to estimate panel data. Table 4.2 shows that the prob value at Cross-section random is smaller than alpa (α) (0.0000 <0.05) which means that H0 is rejected, so it is confirmed that FEM is more appropriate to use than REM. The Fixed Effect Model (FEM) is used when there is an assumption that each cross-section unit (in this case the provinces on the island of Sumatra) has special characteristics that can affect the dependent variable and these characteristics cannot be observed directly but remain constant over time. By using FEM, the analysis can control for unmeasured fixed factors so as not to cause bias in the estimation of regression coefficients. FEM addresses inter-unit heterogeneity by allowing different intercepts for each individual or province. Therefore, this model is considered more appropriate than Common Effect and Random Effect in this study.

Based on Table 4, it can be seen that in the Chow Test, the *Fixed Effect Model* is better used to estimate panel data, because the prob value of the Cross-section Chi-square obtained is smaller than (α) (0.000 < 0.05), so H0 is rejected. This means that FEM is better to use than CEM. The next test is the Hausman test. This

test aims to select the most appropriate model between *Fixed Effect* and *Random Effect* which will be used to estimate panel data. Table 4.3 shows that the prob value at Cross-section random is smaller than alpa (α) (0.0002 <0.05) which means H0 is rejected, so it is confirmed that FEM is more appropriate to use than REM.

**Table 4.** Results of the second Chow, Hausman, and LM tests

| | Effects Test | Statistic | d.f | Prob |
|---|---|---|---|---|
| Chow Test | Cross-section F | 9.817871 | (10,122) | 0.0000 |
| | Cross-section Chi-square | 82.658589 | 10 | 0.0000 |
| Hausman test | Cross-section random | 28.488046 | 7 | 0.0002 |

Source: Authors calculation

**Table 5.** Results of the first Multicollinearity test

| | OUR | HDI | GE |
|---|---|---|---|
| OUR | 1 | 0.08809 | 0.22304 |
| HDI | 0.08809 | 1 | -0.02790 |
| GE | 0.22304 | -0.02790 | 1 |

Source: Authors calculation

Multiconearity occurs when there is a strong linear relationship between the independent variables in the regression model. One way to detect multicollinearity is by looking at the correlation value between independent variables. If the correlation value is smaller than 0.900, it can be concluded that there is no multicollinearity in the model. Based on the results in table 4.5, the correlation value between OUR and HDI is 0.08809 between OUR and G is 0.22304 and between HDI and G is -0.0279. All of these correlation values are far below the threshold of 0.900, so it can be concluded that there is no multicollinearity problem in this first regression model. With no classical assumption violations related to multicollinearity, the first regression model is suitable for further analysis.

Multicollinearity test is conducted to determine whether there is a strong linear relationship between independent variables in the second regression model. This model has included a moderating variable, namely investment (INV), as well as three interaction variables between investment and each independent variable, namely open unemployment rate with investment, Human Development Index with investment, and government spending with investment. One of the ways used in detecting multicollinearity is by looking at the correlation value between

independent variables. In this study, the threshold used is 0.900. If the correlation value between two independent variables exceeds 0.900, then there is an indication of multicollinearity. Conversely, if the value is below 0.900, it can be concluded that there is no multicollinearity.

**Table 6.** Results of the second multicollinearity test

| | OUR | HDI | GE | FDI | OUR x FDI | HDI x FDI | GE x FDI |
|---|---|---|---|---|---|---|---|
| OU | 1 | | | | | | |
| HDI | 0.0880 | 1 | | | | | |
| GE | 0.2230 | 0.0279 | 1 | | | | |
| FDI | 0.0847 | 0.0800 | 0.4028 | 1 | | | |
| OUR x FDI | 0.2856 | 0.1218 | 0.3482 | 0.9405 | 1 | | |
| HDI x FDI | 0.0933 | 0.2236 | 0.3765 | 0.9873 | 0.9342 | 1 | |
| GE x FDI | -0.0031 | -0.0249 | 0.6455 | 0.8926 | 0.7833 | 0.8631 | 1 |

Source: Authors calculation

The correlation between the original variables shows that the correlation value between OUR and HDI is 0.0880, between OUR and G is 0.2230, and between HDI and G is 0.0848, HDI and FDI is 0.0800, and G and FDI is 0.4028. All correlation values between these original variables are far below 0.900, so they do not show any symptoms of multicollinearity. Meanwhile, the correlation between interaction variables such as OURxFDI (0.9405), HDIxFDI (0.9873), and GExFDI (0.8926) is close to or exceeds the limit, but this is a normal condition. The high correlation occurs because the interaction variable is formed from the multiplication of two variables, so technically a strong relationship between these variables is inevitable and does not necessarily reflect the presence of multicollinearity that is harmful to the model.

Thus, it can be concluded that the second regression model does not experience multicollinearity problems between independent variables. This indicates that the relationship between variables in this model is quite independent, so the model is suitable for further analysis. Although there is a high correlation in the moderation variable, this does not necessarily indicate a multicollinearity problem that can interfere with the main regression results. Experts such as Hair *et* al. (2010) also state that multicollinearity in interaction variables can be tolerated as long as the main purpose is to test the moderation effect. Thus, since there are no indications of classical assumption deviations on

the main independent variables, the regression analysis can proceed to the next stage.

**Table 7.** Results of the first heteroskedasticity test

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -0.777415 | 1.708656 | -0.454986 | 0.6499 |
| OUR | 0.350823 | 0.104890 | 3.344673 | 0.0011 |
| HDI | -0.013187 | 0.020739 | -0.635869 | 0.5260 |
| GE | 3.94E-05 | 1.62E-05 | 2.433961 | 0.0163 |

Source: Authors calculation

The results of the heteroscedasticity test on the first regression model in Table 7 heteroscedasticity test using the *Panel Least Squares* method with the dependent variable absolute residual value obtained an F-Statistic probability value of 0.101577 which is greater than the 5 percent significance level (0.05). This indicates that simultaneously there are no symptoms of heteroscedasticity in the first regression model. However, when viewed partially, the variables of open unemployment rate (OUR) and government expenditure (GE) show a probability of 0.0011 and 0.0163 respectively which are smaller than 0.05, this means that individually the two variables are indicated to have symptoms of heteroscedasticity while the human development index (HDI) variable shows no indication of heteroscedasticity because its probability value is 0.5260. Thus, it can be concluded that although in general the model is free from symptoms of heteroscedasticity, there are still indications of partial heteroscedasticity in several independent variables.

**Table 8.** Results of the second heteroskedasticity test

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | -2.838641 | 4.259378 | -0.666445 | 0.5064 |
| OUR | 0.356755 | 0.136813 | 2.607618 | 0.0503 |
| HDI | 0.016937 | 0.061349 | 0.276078 | 0.7830 |
| GE | 2.65E-05 | 2.43E-05 | 1.087182 | 0.2791 |
| FDI | 0.000108 | 0.000214 | 0.504072 | 0.6151 |
| OUR x FDI | 0.00000413 | 0.00000980 | 0.421429 | 0.6742 |
| HDI x FDI | -0.00000146 | 0.00000279 | -0.523750 | 0.6014 |
| GE xFDI | 0.000000000107 | 0.00000000133 | 0.080079 | 0.9363 |

Source: Authors calculation

Based on Table 8 which shows the results of the heteroscedasticity test on the second regression model, it can be concluded that this model does not experience

heteroscedasticity problems. This is indicated by the probability value (p-value) of each independent variable, including the three moderating variables, which are all above the 5 percent significance level (0.05). For example, the OUR variable has a probability of 0.0503, HDI of 0.7830, government spending (G) of 0.2791, and investment (INV) of 0.6151. Meanwhile, the three moderating interaction variables each have a probability of open unemployment rate with investment of 0.6742, Human Development Index with investment of 0.6014, and government spending with investment of 0.9363.

Furthermore, the F-Statistic probability value of 0.1731 is also greater than 0.05 which indicates that simultaneously there is no significant effect of the independent variables on the absolute residual value. Thus, this second regression model has fulfilled the assumption of homoscedasticity where the variance of the residuals is constant. This is important because it fulfills one of the classical assumptions in regression which means that the regression model is efficient and the estimation results can be relied upon for further interpretation. Thus, there are no symptoms of heteroscedasticity that can damage the validity of the model, so this regression model is suitable for further hypothesis testing.

## 3.2. Research results

**Table 9.** Results of the first regression model test (OLS)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 0.798292 | 0.138800 | 5.751399 | 0.0000 |
| PD | 0.000848 | 0.000311 | 2.731980 | 0.0071 |
| DS | -9.68E-06 | 0.000173 | -0.055969 | 0.9554 |
| HDI | -0.007416 | 0.002007 | -3.694352 | 0.0003 |
| R-squared | 0.643194 | | F-statistic | 9.734283 |
| Adjusted R-squared | 0.577119 | | Prob(F-statistic) | 0.000 |

Source: Authors calculation

The first hypothesis of this study states that local taxes (PD) have a significant positive effect on income inequality in Aceh Province. With a t-statistic value of 2.731980 greater than the t-table and a probability of 0.0071 (<0.05), this variable is statistically significant. The coefficient of the village fund variable (DS) of -9.68 indicates that every 1 percent increase has the potential to increase income inequality by -9.68 percent. However, the t-statistic value of -0.055969 is smaller

than the t-table, and the probability is 0.9554 (>0.05). This indicates that the village fund variable has no significant effect on income inequality in Aceh Province. The coefficient of human development index (HDI) of -0.007416 indicates that a 1 percent increase in HDI will decrease income inequality by -0.007 percent. With a t-statistic value of -3.694352 greater than the t-table and a probability of 0.0003 (<0.05), this variable has a negative and significant effect on income inequality in Aceh province.

Based on the Ordinary Least Squares (OLS) regression test results shown in Table 9, it is known that the variables of local tax revenue (PD), village funds (DS), and human development index (HDI) simultaneously have a significant effect on income inequality. This is indicated by the F-statistic value of 9.734 and the Prob(F-statistic) value of 0.000 which is far below the 5% significance level (0.05). Thus, this regression model is statistically acceptable because it is able to explain the relationship between the independent variables and the dependent variable together. In addition, the R-squared value of 0.643 indicates that 64.3% of the variation in income inequality can be explained by the three independent variables in the model, while the remaining 35.7% is explained by other factors outside the model. The Adjusted R-squared value of 0.577 also indicates that after considering the number of variables in the model, the explanatory power of the model is still relatively strong. In other words, the model has a fairly good level of fit in explaining variations in income inequality in the region under study.

**Table 10.** Results of the second regression model test (MRA approach)

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| C | 39.00333 | 5.850502 | 6.666663 | 0.0000 |
| OUR | -0.950693 | 0.187920 | -5.059030 | 0.0000 |
| HDI | -0.372375 | 0.084267 | -4.418998 | 0.0000 |
| GE | -0.000117 | 0,0000334 | -3.494193 | 0.0007 |
| FDI | -0.001484 | 0.000295 | -5.036847 | 0.0000 |
| OUR x FDI | -0.0000206 | 0,0000135 | -1.532701 | 0.1279 |
| HDI x FDI | 0.0000194 | 0.00000384 | 5.060033 | 0.0000 |
| GE x FDI | 0.00000000473 | 0.00000000183 | 2.588174 | 0.0108 |
| R-squared | 0.5748858 | F-statistic | | 9.703719 |
| Adjusted R-squared | 0.515617 | Prob(F-statistic) | | 0.000000 |

Source: Authors calculation

This interaction model tests the moderating effect of investment on the relationship between the open unemployment rate, the Human Development Index, and government spending on economic growth. The results show that the interaction of the open unemployment rate with investment has a coefficient of -0.0000206 with a probability value of 0.1279 which means it is not statistically significant. This finding shows that investment has not been able to strengthen the effect of open unemployment on economic growth, possibly because incoming investment has not been directed at labor-intensive sectors or has not been able to absorb a large number of workers.

In contrast, the interaction between HDI and investment has a positive and significant effect with a coefficient of 0.0000194 and a probability value of 0.0000. This result shows that investment is able to moderate the relationship between the quality of human resources and economic growth. The higher the HDI accompanied by an increase in investment, the greater the contribution to economic growth.

The interaction between government spending and investment also shows a positive and significant effect with a coefficient of 0.00000000473 and a probability of 0.0108. This means that investment strengthens the relationship between government spending and economic growth, especially if investment is allocated to productive sectors that synergize with public spending such as infrastructure development or strategic government projects.

## 3.3. Model Selection

The selection of the most appropriate estimation model in panel data analysis is carried out through a series of tests, one of which is the Chow test. This test aims to determine whether the Commen Effect or Fixed Effect model is more appropriate to use. In the test, the null hypothesis (H0) states that the common effect (pooled least square) model is the most appropriate, while the alternative hypothesis (H1) states that the fixed effect model is more appropriate. The decision-making criteria are based on the probabilistic value of the F-statistic where if the probability value is smaller than 0.05 then H0 is rejected and H1 is accepted. Based on the Chow test results, the F-statistic value is 7.048028 with a probability of 0.0000 and a degree of freedom (df) of (10,126). Since the probability value is below the 5 percent significance level, H0 is rejected. Thus, the

FEM model is the most appropriate model to use in estimating panel data in this study.

The Hausman test is conducted to determine whether the fixed effect or random effect model is most appropriate to use in panel data analysis. The null hypothesis (H0) states that the random effect model is the appropriate model, while the alternative hypothesis (H1) states that the fixed effect model is more appropriate. Based on the test results, the statistical value is 24.741163 with a probability value of 0.0000. Since the probability value is smaller than the 5 percent significance level (0.05), H0 is rejected and H1 is accepted. Thus, the fixed effect model.

## 3.4. Classical assumption test

Before conducting regression analysis, a classical assumption test is performed to ensure the validity of the model. The normality test is used to assess whether the residuals are normally distributed even though there is a large sample, violation of this assumption is not a serious problem. This multicollinearity test is carried out by looking at the VIF and Tolerance values to ensure that there is no high correlation between the independent variables. The heteroscedasticity test aims to test whether the residual variance is constant. Meanwhile, the autocorrelation test is not required in panel models such as fixed effect and random effect, because it can still provide consistent estimates even though there are deviations in the errors (Ghozali, 2011). With this union, the model is expected to be free from bias and fulfill the basic assumptions of regression.

## 3.5. Discussion

The results showed that the Open Unemployment Rate (OOP) has a negative and significant effect on economic growth in Sumatra Island. This finding is reinforced by Prabowo et al. (2023), Thessalonika (2022), and Irawan & Khoirudin (2024) who stated that high unemployment reduces purchasing power, productivity, and undermines economic stability. Unemployment becomes a socio-economic burden that disrupts sustainable development.

The Human Development Index (HDI) also has a positive and significant effect on economic growth. this research is consistent with the results of Prabowo et al.

(2023), Irawan & Khoirudin (2024), and Elistia & Syahzuni (2018) which state that improving the quality of human resources drives economic growth. Similar findings were also presented by Damanik & Lubis (2022) and Dira et al. (2023) which emphasize the contribution of HDI to conventional and green economic growth.

Government Expenditure (G) is proven to have a positive and significant influence on economic growth. This result is supported by research by Awaluddin et al. (2021), Salihin (2020), and Munzir et al. (2017) which emphasize the importance of government spending in spurring development, especially through the infrastructure sector and public services. Support is also obtained from Wu et al. (2010) and Ashari & Siwi (2022) which emphasize the effectiveness of fiscal policy in promoting economic growth.

In the moderation test, the interaction of open unemployment rate with investment is not significant, indicating that investment has not been able to strengthen the relationship between unemployment and economic growth. This is presumably because investment has not been directed to labor-intensive sectors that are able to absorb labor significantly.

The interaction of Human Development Index with investment has a positive but insignificant effect. This means that investment has not fully optimized the impact of improving the quality of human resources on economic growth. This finding is in line with Mahendra (2020) which states that economic growth is not always effective in moderating the relationship between education and health spending on HDI, depending on the effectiveness of sectoral policies.

In contrast, the interaction of government spending with investment shows a positive and significant effect, indicating that investment is able to strengthen the effect of government spending on economic growth. This indicates that collaboration between public spending and investment can create synergies in promoting regional economic development. This finding is consistent with the research of Chandana et al. (2021) which states that public spending combined with investment has a productive effect on economic growth.

## 4. Conclusion

This study aims to analyze the effect of open unemployment rate, Human Development Index, and government spending on economic growth in Sumatra Island by using panel data regression approach and investment as a moderating

variable. Based on the results of data analysis for the period 201 to 2024, the following conclusions are obtained:

The results showed that the open unemployment rate had a negative and significant effect on economic growth, reflecting the non-optimal utilization of labor in driving output and consumption. The Human Development Index shows a positive but statistically insignificant effect, indicating that improvements in the quality of life have not been fully integrated with productive sectors. In contrast, government expenditure has a significant negative effect on economic growth, possibly due to the low efficiency of public expenditure allocation. Moderation analysis shows that investment has not been able to significantly moderate the relationship between the unemployment rate and the Human Development Index on economic growth. However, the interaction between government spending and investment shows a positive and significant effect, indicating that investment is able to strengthen the impact of public spending on economic growth in Sumatra Island.

Suggestions to local governments in Sumatra Island are expected to increase the effectiveness of job creation policies, especially by strengthening labor-intensive sectors and providing access to relevant job skills training. Increasing the Human Development Index (HDI) needs to be synergized with economic development policies, especially through investment in the education, health and welfare sectors oriented towards increasing productivity. Thus, HDI can have a more tangible impact on economic growth. Local governments need to evaluate and improve the management of public expenditure so that government spending is more focused on productive sectors that have a multiplier effect on the regional economy. Optimizing public spending will improve budget efficiency and encourage sustainable economic growth. The strategy of strengthening investment needs to be directed to better support the main variables of development, especially in overcoming unemployment, increasing HDI, and optimizing government spending. A well-targeted investment policy is needed so that its role as a moderating variable is truly effective in driving growth in Sumatra Island.

## Conflict of interest

The authors declare that there are no conflicts of interest regarding this publication.

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