Regional Inequality Analysis in Indonesia Multinomial Logistic Regression Approach

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Abstract

𝕿his study aims to analyze the typology of regional inequality in Indonesia and the opportunity for regional inequality shifts due to changes in independent variables. The analysis method is carried out using the Williamson index and the Theil index. Furthermore, multinomial logit regression analysis was carried out to see the influence of the independent variable on the dependent variable. The results showed four classifications of regional inequality based on the value of the Williamson and Theil indexes. Thirty-seven per cent of provinces fall under the severe inequality classification, and 46 per cent of provinces fall under the low inequality classification. Significant variables in areas with severe inequality classification are Infrastructure, Human Resources, Investment, Fiscal Decentralization, Regional Expansion, Population, and Spending on Pro-Poor Growth Function. Significant variables in areas with high inequality classification are Openness, Fiscal Decentralization, Regional Expansion, and Population. Infrastructure, Investment, and Population are significant variables in regions with moderate inequality classification. Significant variables in areas with low inequality classification are Economic Growth, Human Resources, Fiscal Decentralization, Regional Expansion, and Spending on Pro-Poor Growth Functions.

Keywords: regional inequality, openness, investment, fiscal decentralization, multinomial logistic regression
JEL Classifications: O1, O11, O18

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1. Introduction

Development inequality between regions is expected in a region's economic activities. Inequality between regions can affect people's welfare (Sjafrizal, 2008). Even this inequality in economic division triggers economic problems and can become political problems (Rustiadi et al., 2009). Differences in natural resource potential and demographic conditions can affect regional economic development. This difference causes the emergence of developed regions (Developed Region) and underdeveloped regions (Underdeveloped Region).

North (1955) initially paid attention to inequality between regions. North refered to the Neoclassical growth theory, which predicts the relationship between a country's economic development level and development inequality, better known as the Neoclassical hypothesis. Adherents of the neoclassical model assume that the mobility of factors of production, both capital and labour, at the beginning of the development process could be smoother. This results in the concentration of capital and skilled labour in more developed areas, which triggers the divergence process. If development continues, the mobility of capital and labour will be smoother, and development inequality will decrease (Sjafrizal, 2018). Based on this hypothesis, the development inequality curve between regions would be an inverted U.

Empirically, Kuznets (1955) proved the Neo-Classical Hypothesis and explained the phenomenon of regional inequality in developed and developing countries. This empirical study sampled twenty-four countries in 1950. Based on this hypothesis, development inequality between regions tends to be higher generally in developing countries, and the opposite will occur in developed countries. In line with the neoclassical theory, Kuznets (1955) linked the relationship between economic growth and income distribution. In the early stages of economic development, income distribution will deteriorate, but in later stages, income distribution will increase. This observation became known as Kuznets' "Inverted" U-shaped hypothesis. Kuznets' theory arose from longitudinal income distribution changes (time series). The Kuznets curve can be generated by the continuous growth process derived from the expansion of modern sectors.

Regional inequality in some regions is still a topic of research both locally and globally. Lessmann (2012) found an increase in inequality in several countries. Britain, Germany, Austria, Belgium, India, and Bolivia were the countries that experienced increased inequality in the period 1980-2009. While the United States and Canada experienced fluctuations in inequality, at the beginning of the observation, it increased and decreased in the 1990s. Still, there has been an increase in inequality since the 2000s. Similarly, Wei & Liu (2003) asserted that the overall regional gap in China decreased in the 1980s but increased in the 1990s. The gap between inland and coastal areas contributes to the overall regional gap.

In Indonesia, regional inequality is still a problem in economic development. Even the regional inequality that occurs is one of the worst compared to other countries (Firdaus, 2013). Similarly, Ginting (2012)found that overall regional inequality in eastern Indonesia is higher than in western Indonesia. This indicates that development inequality between regions in Indonesia, between western and eastern Indonesia, still occurs. Long before, Esmara (1975) suggested that income inequality in Indonesia is influenced by the oil and gas sector and proved that inequality with oil and gas is higher than inequality without oil and gas. Indonesia's economic growth occurred in the period 1996-2020. Indonesia's economic growth showed a downward trend due to the financial crisis in

1997/1998. Regional inequality that arises is also high. The economic recovery trend from the crisis lasted until 2008, but regional inequality has yet to change significantly.

Regional inequality can be measured using the Williamson Index value (T. R. Hidayat et al., 2019; Williamson, 1965; Yasari, 2021). Ministry of National Development Planning (2013) classifies regional inequality into three categories based on the Williamson Index value, namely low (Williamson Index value < 0.3), medium (Williamson Index value between 0.3 - 0.7), and high (Williamson Index value > 0.7). This indicator has been widely used to measure regional disparities, including Lessmann (2014), Hill & Vidyattama (2016), and Abdullah et al. (2015). Similarly, in Indonesia, the Williamson index has been used in several studies, including Sjafrizal, (2018), Hidayat et al. (2019), Mukhlis (2020), Rusdi et al. (2018), and Rizal (2021). Although commonly used in measuring regional inequality, the Williamson Index has the disadvantage of being sensitive to the definition of territory used in calculations. This is because what is compared in the Williamson Index is the level of development between regions and not the level of prosperity between groups (Sjafrizal, 2012; Triyanto & Keban, 2019; Nasution, 2020; Christianingrum, 2021). This weakness can be found in Nasution's study (2020), about regional inequality in Indonesia for the 2010-2019 period, where the Williamson Index calculation was originally around 0.759 in 2019, then after releasing DKI Jakarta regional data, inequality fell to lower than 0.395 in the same year. By releasing data from the DKI Jakarta Region, conclusions about the level of inequality that existed in Indonesia in that period will be very different.

Another indicator for measuring regional disparities is the Theil Index (Bickenbach & Liu, 2013; Hidayat, 2014; Soseco, 2010). The Theil Index is used to see the gap in the distribution of per capita income in a region. The greater the Theil Index value, the more significant the gap in income distribution. Conversely, the closer the Theil Index value is to zero, the more even the distribution of per capita income between regions. The Theil Index has no upper and lower limits (Soseco, 2010). This indicator has been applied in various studies, including Theil (1967), Khan & Siddique (2021), Kovacevic (2010), Damayanti (2020), and Nur Aidar (2015). The Theil Index has advantages over other indices that can see inequality within regions (within) and between regions (between). However, the Theil Index has a weakness where the decomposition of the Theil Index into inequality within regions (group inequality) and inequality between regions (between group inequality) cannot see the contribution of other factors such as education, race, and indigenous people to inequality as a whole. In addition, the Theil index cannot provide a clear qualification of the causes of inequality resulting from the correlation between the principles of decomposition (Yadiansyah, 2007).

In the method for measuring regional inequality described previously, researchers identified methodological gaps in previous research. The previous studies measured regional inequality using only the Williamson or Theil Index. Even though both indicators have a database in common, namely per capita income and population, the combination of these indicators will enrich scientific treasures and reduce regional inequality. In this research, we attempt to build a new indicator to measure regional disparities by creating a classification of regional inequality, which compares the Williamson Index with the Theil Index. By adopting the Klassen typology model, inequality is classified into four categories. In several previous studies on regional inequality, the Williamson index was used as a variable bound to regional inequality. In addition, Durongkaveroj (2017) researched a measurement that can be used to analyze income inequality by applying the Input-Output table, with the Gini coefficient as the leading indicator of income inequality. In this study, regional inequality is a categorical variable consisting of four categories: Severe Inequality, High Inequality, moderate inequality, and low inequality. Based on the background that has been presented, the

research aims to analyze the typology of inequality in Indonesia using a logistic multinomial regression approach.

2. Literature Review

Theoretically, the problem of development inequality between regions was originally proposed by North (1955), who analyzed the Neoclassical Growth Theory. In Neoclassical growth theory, estimates or predictions are made that there is a relationship between the level of economic development and regional inequality, better known as the Neoclassical Hypothesis (Sjafrizal, 2008). Regional inequality theory is heavily influenced by neoclassical economics and the idea of long-run convergence, although economics has become more diverse over time. The relationship between inequality and development was developed by Kuznets (1955), who famously hypothesized the Kuznets curve. This hypothesis states that inequality will have an "inverted U" pattern, whereby throughout the development process, inequality will increase as a result of industrialization. Income inequality will first increase until it reaches a peak point and then decrease. This inequality can increase due to two factors. The first is that savings are concentrated among high-income residents, where this income is partly saved. In contrast, people who have low incomes have savings close to zero. Second, there is industrialization, where economic development progressively shifts the main activity (agriculture) to industrial activities; population inequality in rural areas is lower than in urban populations, and migration from villages to cities will further trigger an increase in inequality in the region accompanied by differences in per capita productivity where per capita productivity in industry is higher than in agriculture. These two things underlie the existence of the Kuznets hypothesis, which, if described, will be in the form of an inverted "U" (Martínez-Navarro et al. ,2020; Anand & Kanbur ,1993; Piketty ,2003).

Williamson (1965) adopted the idea of the Kuznets hypothesis for cases of spatial inequality or regional inequality. He argued that industrialization occurred due to the discovery and utilization of natural resources such as coal and iron. These natural resources are often unevenly distributed within the state, which in turn leads to inequality of territory. The economic prosperity that occurs due to industrialization is also uneven; at this stage of development, job opportunities will be more attractive in booming areas, attracting labor from abroad, suppressing wages in destination areas, and increasing wages in home areas. This results in a natural convergence process because, driven by government policy, regional inequality will decrease and create an inverted U-shaped relationship (Lessmann, 2014).

Iammarino et al. (2019) found that regional inequality occurs due to two groups of forces. The first is the long cycle of development in the economic structure that occurred due to a large wave of technological advances in the 1970s. Second, there is a long cycle of regional evolution consisting of human resources and specific skills, formal and informal institutions, capacity for innovation, and reaction to change. Changes in economic structure are related to regional characteristics that produce development patterns. At any given time, this interaction provided a powerful opportunity to push less developed regions towards a convergence process between regions. Since the 1970s, and especially in the new millennium, there has been divergence.

Myrdal (in Jhingan, 2004) argued that economic development produces a circular causal process in which the rich benefit more and those who fall behind are more and more inhibited. This is due to the strong backward and weak spread effects in underdeveloped countries. Reverse effects are defined as all adverse changes due to causes outside the place, such as the effects of migration, capital movement, and trade,

as well as all impacts arising from circular causes between non-economic and economic factors. At the same time, the spread effect refers to the impact of development momentum that spreads centrifugally from the centre of economic development to other regions. The backwards effect tends to enlarge, and the spread effect gets smaller. This trend will exacerbate international inequality and trigger regional inequality among underdeveloped countries (Jhingan, 2004). This view of Myrdal makes him the most prominent economist contributing to inequality(Hall & Ludwig, 2009).

One of the important things in analyzing regional inequality is related to the measurement of inequality itself. Several approaches can be used to see regional inequality, such as the Williamson Index (Williamson, 1965; Hidayat et al., 2019; Yasari, 2021). The Williamson Index is one of the measuring tools used to measure the level of regional inequality originally used by Jeffrey G. Williamson. The Williamson index calculation is based on each region's GDP data. The measurement results of the Williamson Index value are indicated by numbers 0 to 1 or $0 < VW < 1$. If the Williamson index is closer to 0, the smaller the inequality of economic development, and if the Williamson index is closer to 1, the widening inequality of economic development (Sjafrizal, 2012; Barika, 2012). Another regional inequality model often used is the Theil Index or Entropy Index. The value of the Theil index ranges from 0 to 1, where if the value of the Theil index is 0, the distribution of GDP on the basis of cash prices between regional groups is perfectly evenly distributed. If the value is close to 1, it will be more uneven (Mahardiki & Santoso, 2013; Sirtama, 2021). The analysis of the Theil Entropy Index can be divided into two sub indications: regional inequality within regions and regional inequality between regions. The Theil index can distinguish gaps between regions and gaps within a region. So that the size of the gap in groups (intra-region) and inter-groups (inter-region) can be known (Muta'Ali, 2015). The index's ability to see inequality makes it widely used in calculating and analyzing regional income distribution.

3. Data, Methodology, and Variables

3.1 Data and variables

The type of research is quantitative 7descriptive. The data used in this study is secondary data. Data sources were obtained from the Central Bureau of Statistics (BPS), Bank Indonesia, and other related agencies. In addition, data sources are also obtained from access through the internet with websites, including www.djpk.depkeu.go.id, www.bi.go.id, www.bps.go.id, and www.bpk.go.id. The data type is panel data, a combination of *cross-section data* (between regions) and *time series data* (time series). This research uses secondary data from the Central Statistics Agency from 2002 to 2021. The data used includes data on economic growth, infrastructure, human resources, economic openness, investment, fiscal decentralization, regional expansion, population, and spending on pro-poor growth functions in 32 provinces in Indonesia.

3.2 Methodology

This study aims to analyze the typology of regional inequality in Indonesia using a multinomial logistic regression approach. Before logistic multinomial regression, the Williamson and Theil indexes are first calculated to determine the category of independent variables. Furthermore, to analyze the factors that affect regional inequality in Indonesia, logistic multinomial regression analysis is used.

The Williamson and Theil indexes were used to analyze the typology of inequality in Indonesia after regional autonomy and decentralization. The Williamson and Theil index formula is as follows:

a) Williamson index or Williamson inequality index   (Williamson, 1965); (Sjafrizal, 2018); (Hidayat et al., 2019); (Mukhlis, 2020).

$$IW = \frac{\sqrt{\sum(Yi-Y)^2\ (fi/n)}}{Y} \qquad (1)$$

Where:
IW is the Williamson Index,
Yi is GDP per capita in Province i,
Y is the National GDP per capita,
fi is the total population in Province i and
n is the total national population.

b) Theil's Entropy Index is as follows (Theil, 1967); (Sjafrizal, 2018); (Akita, 2003); (Soseco, 2010); (Nur Aidar, 2015); (Bickenbach & Liu, 2013);

$$Td = \sum_{i=j}^{n}\sum_{j=i}^{n}\left(\frac{y_{ij}}{Y_i}\right) log\left(\frac{y_{ij}/Y_i}{n_{ij}/N_i}\right) \qquad (2)$$

Where
Td is the Theil index
yi is the district/city GRDP
Y is the province's GRDP
xi is the total population of the district/city
X is the population of the province

Regional inequality is measured using the Williamson index, and income distribution inequality uses the Theil index. These measurements have the same measurement variables, namely regional income and population. Therefore, we classify inequality based on these two calculation methods. On the vertical axis is the average regional inequality, and on the horizontal axis is the average income distribution. Four quadrants or inequality classifications are obtained by comparing the two measurements. The four classifications of inequality consist of Classification 1 Severe Inequality, namely regions with a higher level of regional inequality and a higher level of income distribution inequality than the average of other regions. Classification 2 is High Inequality, an area with high-income distribution inequality, but regional inequality is lower than the average of other regions. This means that although it generally has low differences from other regions, the income distribution in the province is high, where the gap between rich and poor people is high. Classification 3 is moderate inequality in areas with low-income distribution inequality, but regional inequality is higher than the average of other regions. Classification 4 is low inequality, namely regions with regional inequality and income distribution inequality lower than the average of other regions.

Table 1: Classification of Regional Inequality

Criteria		Average Theil Index	
		$it_{it} > IT_t$	$it_{it} < IT_t$
Average Williamson Index	$iw_{it} > IW_t$	Area of Severe inequality (1)	Areas of moderate inequality (3)
	$iw_{it} < IW_t$	Areas of high inequality (2)	Areas of low inequality (4)

Description
  iw_{it} = average Williamson index of provinces in year t
  IW_t = National Williamson Index average in year t
  it_{it} = average Theil index of provinces in year t
  IT_t = average National Theil index in year t
Source: Researcher with reference to the Klassen Typology

Then, the multinomial logistic regression method was used to determine what factors affect regional inequality in Indonesia. The model used is a multinomial logistic regression model, with the model specification modified from the model used (Kuncoro, 2018).

$$D4 = \beta_0 + \beta_1 Growt_{it} + \beta_2 Infrastructure_{it} + \beta_3 Human\ Resources_{it} + \beta_4 Openess_{it} + \beta_5 Investment_{it} + \beta_6 Fiscal\ Decentralization_{it} + \beta_7 Regional\ Expansion_{it} + \beta_8 Population_{it} + \beta_9 GSF_{it} + e_{it} \quad (3)$$

where:
  D4 is Regions with economic positions. Classification 1 is Severe Inequality, Classification 2 is High Inequality, Classification 3 is moderate inequality, and Classification 4 is low inequality.
  Growth is Economic Growth
  Infrastructure is the total length of the road
  Human resources are the pure participation rate of high school/vocational schools
  Openness is the ratio of exports and imports to GDP
  Investment is the ratio of Gross Fixed Capital Formation to GDP
  Fiscal decentralization is the ratio of the total realization of regional expenditure to the total central government expenditure
  Regional expansion is the number of district and city governments
  Population is the total population
  GSF is a government spending function that is Pro-Poor Growth

The test statistics used to test the suitability of the model in logistic regression are *Goodness of Fit*. The interpretation of the model in logistic regression uses the *odds ratio* value, which shows the comparison of how many times the increase or decrease in the incidence number of Y = j to Y = 1 as a comparison category if the value of the predictor variable (x) changes by a particular value (Tulong et al., 2018).

$$\psi_{ab} = OR_j(a,b) = \frac{p(Y=j|x=a)/p(Y=1|x=a)}{p(Y=j|x=b)/p(Y=1|x=b)} \quad (4)$$

The relationship between odds ratio to model parameters (β) is:

$$\psi_{ab} = \exp(\hat{\beta}) \quad (5)$$

4. Results

4.1. Research Results

Based on the average value of the Williamson index in 2002-2021 and the average value of the Theil index in 2002-2021, the typology of inequality in Indonesia is grouped into four categories. Quadrant I shows provinces classified as provinces with severe disparities with an above-average Williamson and Theil Index. These areas include the provinces of South Sumatra, Riau Islands, West Java, Central Java, DI Yogyakarta, East Java, Banten, West Nusa Tenggara, East Nusa Tenggara, East Kalimantan, South Sulawesi, and Papua. A total of 12 provinces are areas with severe inequality.

Furthermore, quadrant II is an area with high inequality. In quadrant II, or regions with high inequality, the Williamson Index value is lower than the average and has a Theil Index value higher than the average value. This indicates that although inequality in the region is low, income inequality is high or above average. Aceh and West Papua provinces are included in the category of high inequality.

Quadrant III are provinces with a moderate inequality classification, namely regions that have a Williamson index or, in other words, have regional inequality higher than the average. In comparison, inequality in income distribution is lower than the average. This indicates the problem of income inequality between low-income communities. Provinces with moderate inequality classification include Riau Province, Bangka Belitung Islands, and North Sulawesi.

The provinces of North Sumatra, West Sumatra, Jambi, Bengkulu, Lampung, Bali, West Kalimantan, Central Kalimantan, South Kalimantan, Central Sulawesi, Southeast Sulawesi, Gorontalo, West Sulawesi, Maluku, and North Maluku are regions with an inequality classification in quadrant IV or low inequality classification. The Williamson and Theil index values are lower than the average in these provinces. This indicates that regional and income distribution inequality in these provinces is low.

Figure 1: Map of Regional Inequality Classification in Indonesia
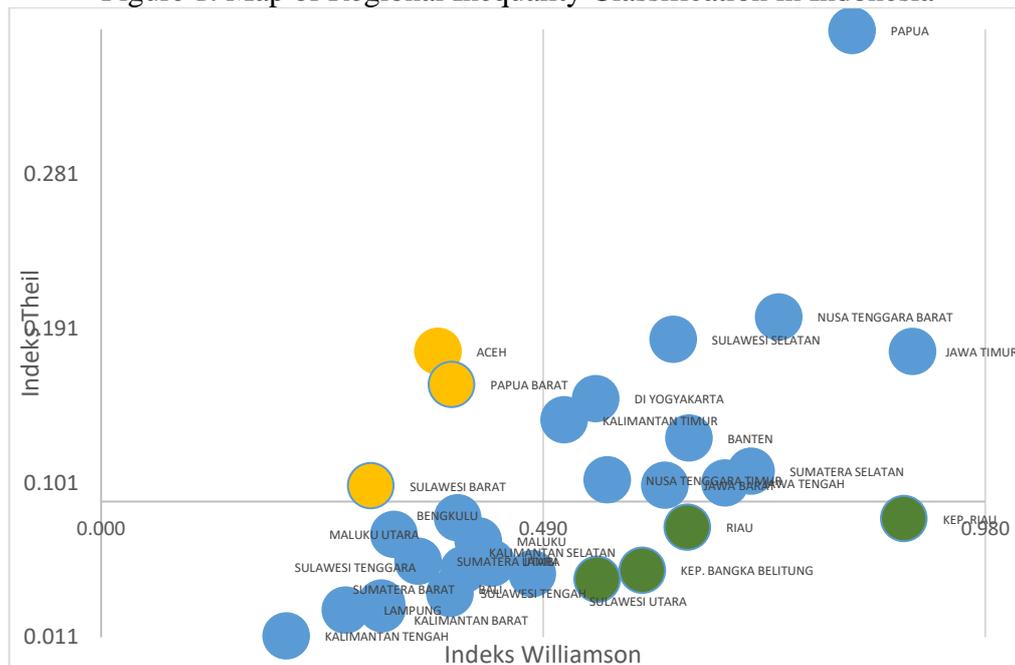
Source: Central Statistics Agency, data processed.

A multinomial logistic regression model is used to analyze the shift in the position of regional inequality in Indonesia. The dependent variable consists of four regional classifications: areas with severe inequality, regions with high inequality, regions with moderate inequality, and areas with low inequality, with base variables being regions with severe inequality. The independent variables include economic growth, infrastructure, human resources, openness, investment, fiscal decentralization, regional expansion, population, and spending on pro-poor growth functions.

Table 2: Results of Multinomial Regression Analysis Logit

Classification	β	S.E.	Sig.	Exp(β)
High Inequality				
constant	2.0974	1.0905	0.054	8.145
Growth	-0.0012	0.0018	0.504	0.998
Infrastructure	-0.0034	0.0031	0.263	0.996
Human Resources	0.0029	0.0013	0.029*	1.002
Openness	-0.0024	0.0010	0.022*	0.997
Investment	-0.0034	0.0016	0.032*	0.996
Fiscal Decentralization	-.00004	0.0035	0.989	0.999
Regional expansion	-0.0068	0.0186	0.716	0.993
Population	-0.0073	0.0018	0.000*	0.992
Pro-poor growth spending	0.0009	0.0015	0.519	1.000
Moderate Inequality				
constant	4.6393	0.7309	0.000	103.479
Growth	-0.0006	0.0015	0.710	0.999
Infrastructure	-0.0131	0.0024	0.000*	0.987
Human Resources	0.0010	0.0009	0.236	1.001
Openness	-0.0006	0.0008	0.469	0.999
Investment	-0.0041	0.0009	0.000*	0.996
Fiscal Decentralization	-0.0057	0.0025	0.021*	0.994
Regional expansion	-0.0262	0.0145	0.070**	0.974
Population	-0.0058	0.0012	0.000*	0.994
Pro-poor growth spending	0.0015	0.0009	0.120	1.001
Low Inequality				
constant	4.099	0.6336	0.000*	60.302
Growth	0.0022	0.0013	0.079**	1.002
Infrastructure	-0.0048	0.0017	0.004*	0.995
Human Resources	0.0020	0.0008	0.009*	1.002
Openness	-0.0008	0.0007	0.233	0.999
Investment	-0.0023	0.0008	0.002*	0.998
Fiscal Decentralization	-0.0130	0.0022	0.000*	0.987
Regional expansion	-0.0604	0.0126	0.000*	0.941
Population	-0.0032	0.0010	0.001*	0.997
Pro-poor growth spending	0.0018	0.0008	0.019*	1.001

Source: Central Statistics Agency.

To analyze the typology of regional inequality. a multinomial logistic regression model is used with the following model:

Multinomial logit model of regions with high inequality

$$g_1(x) = 2.0974 - 0.0012 \text{ Growth} - 0.0034 \text{ Infrastructure} + 0.0029 \text{ Human Resources* } - 0.0024 \text{ Openness* } - 0.0034 \text{ Investment* } - 0.00004 \text{ Fiscal Decentralization } - 0.0068 \text{ Regional Expansion} - 0.0073 \text{ Population*} + 0.0009 \text{ Pro-poor growth spending} \qquad (6)$$

Equation (6) shows the chances or tendency of provinces with high inequality classification compared to provinces with severe inequality classification. The magnitude of the odds is 8,145 times. The parameter estimation based on the explanatory variables can be seen from the value of the β coefficient. Of the nine variables, four variables have a significant influence, namely human resources (X_3), openness (X_4), investment (X_5), and population (X_8). The human resources variable has a coefficient of 0.0029 with an *odd ratio* value of 1.002, which means that if the pure participation ratio of high school/vocational schools increases, then the chances of the province being in the high inequality classification increase compared to the severe inequality classification, assuming other variables are constant with an opportunity value of 1.002 times. The openness variable has a coefficient value of -0.0024 with an *odd ratio* value of 0.997. This means that if the openness increases, the chance of high inequality classification is lower than the severe inequality category, assuming that other variables are constant.

In addition, investment variables also have a negative coefficient value. The value of the investment coefficient is -0.0034, with an *odd ratio* of 0.996. This means that if investment increases, the chances of a province being in a high inequality classification are 0.996 times lower than a severe inequality classification, assuming other variables are constant. The same thing also happens in the population variable, where the number of people has a negative coefficient of -0.0073 with an *odd ratio* value of 0.992, which means that with the increase in the population, the chances of regions with high inequality classification are lower than in the province with a severe inequality classification of 0.992 times.

The variables of economic growth (X_1), infrastructure (X_2), fiscal decentralization (X_6), regional expansion (X_7), pro-poor growth spending (X_9) statistically did not have a significant effect on the opportunities or tendencies of regions that are in the high inequality classification compared to provinces with severe inequality classifications. However, the chance for trends that these variables may create is economic growth (0.998 times), infrastructure (0.996 times), fiscal decentralization (0.999 times), regional expansion (0.993 times), and the pro-poor growth function spending variable (1 time).

Multinomial logit model of regions with moderate inequality

$$g_2(x) = 4,6393 - 0,0006 \text{ Growth} - 0,0131 \text{Infratructure*** } + 0,0010 \text{ Human Resources } - 0.0006 \text{ Openness } - 0.004 \text{ Investment*** } - 0.0057 \text{ Fiscal Decentralization** } - 0.0262 \text{ Regional Expansion* } - 0.0058 \text{ Population*** } + 0.0015 \text{ Pro-poor growth spending} \qquad (7)$$

The multinomial model (7) shows the opportunities of regions that are in the moderate inequality classification compared to provinces with severe inequality classification. Based on the coefficient value and odd *ratio value,* it is known that there are five variables that have a negative effect on the opportunities of regions that are in the high inequality classification compared to provinces with severe inequality classification. Assuming that other variables are constant, if The Infrastructure or road length increases by 1 km, then the chances of the province being in the moderate

inequality classification are 0.987 times lower than the province of severe inequality classification, assuming other variables are constant. Similarly, the investment variable has an opportunity value of 0.996 times, the fiscal decentralization variable of 0.994 times, the regional expansion variable is 0.974 times, and the population variable is 0.994 times. This indicates that there is an increase in infrastructure, investment, fiscal decentralization, regional expansion, and the number of populations, so the province's chances of being in the moderate inequality classification are lower than severe inequality.

In Equation (7), there are four variables that are statistically insignificant to the opportunities of regions that are in the severe inequality classification towards the province with the moderate inequality classification. The three variables are economic growth (0.999 times), human resources (1.001 times), openness (0.999 times), and pro-poor growth spending (1.001 times).

Multinomial logit model of low-inequality regions

$g_3(x)$= 4.009 - 0.0022 Growth* – 0.0048 Infrastructure*** + 0.0020 Human Resources**
-0.0008 Openness - 0.0023 Investment*** - 0.0130 Fiscal Decentralization*** - 0.0604 Regional Expansion***– 0.0032Population*** + 0.0018 0015 Pro-poor growth spending*** $\hspace{4cm}$ (8)

The multinomial model logit (8) shows the chances of provinces classifying areas with low inequality compared to provinces with severe inequality classification. In the third logit multinomial equation, there is only one variable that does not significantly affect the chances of a province in the classification of regions with severe inequality compared to provinces with a low inequality classification, namely the openness variable.

The economic growth variable significantly negatively affects the chances of provinces with low inequality classification compared to provinces with severe inequality classification. For every one percent increase in economic growth, the opportunity for the province to be in the low inequality classification is smaller than the province in the severe inequality classification, assuming other variables are fixed. This shows that the increase in economic growth has not been able to reduce regional inequality. Economic growth has not been able to overcome the problem of inequality in Indonesia. The improvement of road infrastructure also has a negative coefficient, which means that there is an increase in infrastructure, so the chances of the province being in the low inequality classification are smaller than the province with severe inequality classification. The improvement of infrastructure concentrated in large urban areas further widens regional inequality. The same thing also happens with investment variables that have a negative coefficient. The investment variable has a coefficient value of -0.0023 with *an odd ratio* value of 0.998 and has a significant effect on alpha 1%. This means that for every 1 percent increase in Investment, the opportunity for the province to be in the classification of low regional inequality is smaller than severe inequality. The variables of fiscal decentralization, regional expansion, and population also negatively and significantly influence provinces classified as regions with low inequality compared to provinces with severe inequality classification. The fiscal decentralization coefficient is -0.0130, with an *odd ratio* of 0.987. The regional expansion coefficient is -0.0604 with an *odd ratio* value of 0.941, the population variable has a coefficient of -0.0032 with a bizarre ratio value of 0.997, and the functional expenditure variable has a coefficient of -0.0018 with an *odd ratio* of 1.001.

Human resources and the pro-poor growth spending have a positive and significant influence. Every time the pure participation ratio of high school/vocational

schools increases, the province's opportunity to be in the low inequality category is greater than low compared to the province with a severe inequality classification of 1,002 times.

In addition, as a new variable in this study, the pro-poor growth function spending variable shows a positive and significant influence on alpha 5%. Any increase in the pro-poor growth spending ratio will increase the chances of the province being classified as low regional inequality compared to the province in the severe inequality category by 1,001 times. The results of this study show that the functional expenditure variable, as a new variable in this study, can increase the chances of the province being in the low inequality category.

The marginal effect value is used to see how the probability of the dependent variable changes due to the change in the independent variable, assuming the other variables are considered constant. Table 3 shows the marginal effect of each variable on regional inequality classification.

Table 3: Marginal Effects Classification of Regional Inequality

Variable	Marginal effects on probability			
	Severe inequality	**High inequality**	**Moderate inequality**	**Low inequality**
Growth	-0.0002	-0.0001	-0.0002	0.0005***
	(0.297)	(0.144)	(0.131)	(0.006)
Infrastructure	0.0010***	0.00009	-0.0011***	0.00002
	(0.000)	(0.545)	(0.000)	(0.935)
Human Resources	-0.0003***	0.00009	-0.00005	0.00025**
	(0.007)	(0.191)	(0.545)	(0.042)
Openness	0.0001	-0.0001**	0.00001	-0.00005
	(0.137)	(0.05)	(0.845)	(0.627)
Investment	0.0004***	-0.00008	-0.0003***	-0.00008
	(0.000)	(0.330)	(0.001)	(0.498)
Fiscal Decentralization	0.0015***	0.00043**	0.00023	-0.0021***
	(0.000)	(0.014)	(0.257)	(0.000)
Regional expansion	0.0071***	0.0016*	0.00113	-0.0098***
	(0.000)	(0.087)	(0.370)	(0.000)
Population	0.0006***	-0.0002***	-0.0004***	-0.00004
	(0.000)	(0.008)	(0.000)	(0.755)
Pro-poor growth spending	-0.0002**	-0.00001	0.00004	0.00021*
	(0.026)	(0.861)	(0.654)	(0.059)

*Note: * Significant 10%, ** Significant 5%, *** Significant 1%*
Source: Central Statistics Agency, processing with Stata 14, 2023

In addition to looking at the *odd ratio* value, the chances of each independent variable on the position of regional inequality classification can also be seen through the marginal value of the effect. Table 3 shows the marginal effect value of variables in multinomial logistics data processing. In the category of severe inequality areas, it is known that when other variables are constant, economic growth has the opportunity to reduce severe regional inequality, if there is an increase in economic growth by 1 percent, it will have the opportunity to reduce severe regional inequality by 0.02 per cent. Human Resources also have the opportunity to reduce severe regional inequality, where an increase in the enrollment ratio of high school/vocational schools by 1 per cent will reduce severe regional inequality by 0.03 per cent. In addition, the variable that has the

opportunity to reduce severe regional inequality is function spending. Every 1 per cent increase in the spending ratio of the pro-poor growth spending will reduce severe regional inequality by 0.02 per cent.

Conversely, the variables of infrastructure, economic openness, Investment, fiscal decentralization, regional expansion, and Population can increase severe regional inequality. Every 1 km increase in road length will likely increase severe inequality by 0.10 per cent. A 1 per cent increase in investment can increase severe regional inequality by 0.04 per cent. As the variable of fiscal decentralization has the opportunity to increase severe regional inequality, every addition of 1 new administrative region will have the opportunity to increase severe regional inequality by 0.15 per cent. In addition, an increase in Population can increase severe regional inequality by 0.06 per cent.

In regions with high inequality categories, five variables have the opportunity to reduce regional inequality. Every 1 per cent increase in economic growth has the opportunity to reduce high regional inequality by 0.01 per cent. In this category, every 1 per cent increase in the degree of openness of exports and imports to GDP will have the opportunity to reduce high regional inequality by 0.01 per cent. Likewise, increasing Investment variables by 1 per cent can reduce high regional inequality by 0.04 per cent. In addition, an increase in Population has the opportunity to reduce high regional inequality by 0.06 per cent. pro-poor growth spending has the opportunity to reduce high regional inequality by 0.02 per cent. The variables of infrastructure, human resources, fiscal decentralization, and regional expansion have the chance to increase high regional inequality in this category. An increase of 100 km of road Infrastructure can increase regional inequality by 0.009 per cent. As for an increase of 1 per cent, the pure enrolment rate of high school/vocational schools can increase high regional inequality by 0.009 per cent. In addition, decentralization and regional expansion variables can increase high regional inequality with values of 0.04 per cent and 0.16 per cent, respectively.

As for areas with moderate regional inequality categories, it is known that variables of economic growth, infrastructure, human resources, investment, and population have the opportunity to reduce inequality in this category. Assuming other variables are constant, an increase in the economic growth of 1 per cent would have the chance to mitigate moderate regional inequality by 0.02 per cent. Similarly, a 1 km road length increase can reduce moderate regional inequality by 0.11 per cent. Human resources have the opportunity to mitigate moderate regional inequality by 0.005 per cent. In addition, every 1 per cent increase in investment has the chance to reduce moderate regional inequality by 0.03 per cent, and an increase of 1000 people can reduce moderate regional inequality by 0.04 per cent.

Conversely, the variable of Openness has the opportunity to increase moderate regional inequality, where every 1 per cent increase in Openness has the opportunity to increase moderate regional inequality by 0.001 per cent. The same thing happened to the Fiscal Decentralization variable, where every 1 per cent increase in the ratio of total regional expenditure to total central expenditure has the opportunity to increase moderate regional inequality by 0.11 per cent. Similarly, with the variable Pro-Poor Growth Function Spending, if the ratio of Pro-Poor Growth Spending to Total Function Expenditure increases by 1 per cent, it can increase moderate regional inequality by 0.004 per cent.

Furthermore, in Table 3, it is also known that the variables of economic growth, infrastructure, human resources, and pro-poor growth spending have the opportunity to increase regional inequality in the low regional inequality category. Economic Growth increased by 1 per cent, with the opportunity to increase inequality in low regions by 0.05 per cent. Increased road length Infrastructure also increases the chances of low regional inequality by 0.002 per cent. Correspondingly, every increase in human resources by 1

per cent has the opportunity to increase low regional inequality by 0.02 per cent. Conversely, the variables of economic openness, investment, fiscal decentralization, regional expansion, and population have the opportunity to reduce low regional inequality. When other variables are assumed to be fixed, when there is an increase in openness, there will be a chance to minimize low inequality by 0.005 per cent; in the case of an increase in investment by 1 per cent, it has the opportunity to mitigate low inequality by 0.008 per cent. The variable of fiscal decentralization, which increased by 1 per cent, can reduce 0.98 per cent of low regional inequality. The chance of reducing low regional inequality by 0.04 per cent can also occur when the Population increases by 1000 people.

4.2. Discussion

The problem of regional inequality is still a global and national issue. (SDGs) even aim to reduce inequality within and between countries, as stated in Goal 10, namely, *reducing inequality*. Regional inequality in Indonesia refers to the criteria of Bappenas (2013), which includes high inequality. The average regional inequality that occurred in Indonesia in the period 1995-2001 was 0.75. Based on the results of research using *marginal effect*, the impact of each dependent variable on the classification of regional inequality in Indonesia is known. Economic growth significantly affects regional inequality with a low inequality classification compared to other regional inequality categories (Severe, High, Moderate). Provinces that are in the low inequality classification are North Sumatra, West Sumatra, Jambi, Bengkulu, Lampung, Bali, West Kalimantan, Central Kalimantan, South Kalimantan, Central Sulawesi, Southeast Sulawesi, Gorontalo, West Sulawesi, Maluku, and North Maluku.

In provinces classified as having severe regional inequality, high inequality, and moderate inequality, it is found that economic growth has a negative but insignificant relationship to the reduction of inequality. Increasing economic development in these classification areas has yet to reduce disparities. This is in line with Kuznets' hypothesis, which states a positive relationship between economic growth levels and regional inequality in the short term, found in the United States; in the short term, it proved valid to the Kuznets hypothesis. According to the latest study, the government prefers economic justice to equity so that an increase in inequality can accompany economic growth (Marrero & Rodríguez, 2023). Abidemi (2023) concluded that no surge in economic development has led to a decrease in income inequality in Sub-Saharan Africa.

Based on multinomial logistic regression analysis, it can be seen that the fiscal decentralization variable has a positive effect on inequality in areas with severe and high levels of inequality but, on the contrary, will have a negative impact on regions with low inequality. Thus, at severe and high levels of inequality, the implementation of fiscal decentralization leads to increasing inequality, and at low levels of inequality, fiscal decentralization can reduce inequality. One argument related to this is that a high level of regional inequality is generally accompanied by inequality in their respective economic resources. Thus, implementing fiscal decentralization will provide more significant benefits to regions with enormous economic resources, which tends to widen the gap between areas. In regions with low inequality, the level of financial resources is relatively different, so implementing fiscal decentralization can narrow the gap between areas. In line with the effects of fiscal decentralization, regional expansion will increase regional inequality in areas with severe and high inequality. On the contrary, it will have a negative impact or can reduce regional inequality in areas with low inequality.

The development of road infrastructure is more likely to cause inequality in areas with severe and moderate inequality classifications than in other regional inequality classifications (high and low inequality classifications). In the regions that are classified as having severe inequality, improved road infrastructure has the opportunity to

exacerbate inequality. South Sumatra, Riau Islands, West Java, Central Java, DI Yogyakarta, East Java, Banten, West Nusa Tenggara, East Nusa Tenggara, East Kalimantan, South Sulawesi, and Papua are provinces that are classified as having severe inequality. These are the provinces with the Williamson index and Theil index above average. In addition, the area is included in the category of large urban areas with a large income gap between high-income and low-income groups.

Similarly, eastern Indonesia, such as East Kalimantan and Papua, has a high-income gap between mining and non-mining owners. Infrastructure development is more oriented towards big cities in the province, so the inequality between the central region and the supporting areas or hinterland is increasing; conversely, in areas that are in the moderate inequality classification, such as Riau Province, Bangka Belitung Islands, and North Sulawesi. Improving road infrastructure has the opportunity to reduce inequality. Development oriented towards infrastructure development in the form of highways aims to facilitate the distribution of goods and services so that regional disparities can be overcome.

Human resources, as seen from the pure participation of high school / vocational schools, can significantly affect areas with severe and low inequality classification. Every 1 per cent increase in the pure enrolment ratio of high school/vocational schools will have the opportunity to reduce severe inequality by 0.03 per cent. People in urban areas participate more in school than those in the surrounding regions. Efforts to increase school participation are a form of equity in education. Higher school participation in this region can reduce the education gap. It will open up opportunities to reduce inequality in the province in the severe inequality classification. However, this is not the case with regions in the low inequality classification. Increasing the pure participation of high school/vocational schools has the opportunity to increase inequality. An uneven increase in school participation in district/city governments can increase inequality. The availability of high school/vocational school facilities that only exist in the downtown area causes inequality in low-inequality classification areas to increase.

Economic openness is seen from the large percentage of exports and imports of goods and services to GDP. Financial openness is more likely to reduce inequality in areas with a high inequality classification than in other regional inequality classifications (severe inequality classification, moderate inequality classification, and low inequality classification). A one per cent increase in the economic openness ratio will reduce inequality in regions with a high inequality classification of 0.01 per cent. As for other regional inequality classifications, economic openness does not significantly affect regional inequality. Export and import activities of goods and services are usually carried out by the upper middle group so that the increase in the percentage of exports and imports does not directly impact all communities. This is also in line with Wiguna & Panennungi (2019), which found that trade openness did not significantly affect the income inequality of districts/cities within provinces in Indonesia.

Similar to infrastructure development, investment is also more likely to cause inequality in areas with severe and moderate inequality classifications than in other regional inequality classifications (high and low inequality classifications). In regions with severe inequality classification, an increase of 1 per cent in gross fixed investment will have the opportunity to increase regional inequality with severe inequality classification by 0.04 per cent. Investment activities concentrated in growth centres will have a chance to widen income gaps further in and between regions. As for areas with moderate inequality classification, regional inequality is above the national average. However, income inequality is still below the national average, which means that income distribution inequality is even. An increase in gross fixed capital investment or investment by 1 per cent will have the opportunity to reduce moderate classification

inequality by 0.03 per cent. The better the investment climate, the more the inequality between regions will be reduced.

Meanwhile, Fiscal Decentralization will likely significantly affect inequality in regions with severe, high, and low inequality classifications but not in areas with moderate inequality classifications. In general, fiscal decentralization positively influences regional inequality in Indonesia. The greater the ratio of total local government expenditure to total central government expenditure, the more the income gap between regions widens. Fiscal decentralization policy in Indonesia is still oriented towards the decentralization of expenditure rather than the decentralization of revenues. Regional fiscal capacity is still limited and largely relies on central transfers, which can lead to inefficiencies and flypaper effects and reduce the benefits of fiscal decentralization. The chance of decreasing regional inequality in the low inequality classification caused by fiscal decentralization is 0.21 per cent. In the low regional inequality classification, the higher the ratio of regional expenditure to total central government expenditure indicates that the control of state financial resources increases and can reduce inequality between regions.

In line with fiscal decentralization, regional expansion also has the same influence on Indonesia's regional inequality. Regional Expansion marked by the addition of new autonomous regions has the opportunity to significantly affect inequality in areas with severe, high, and low inequality classifications. In areas of severe and high inequality classification, adding the number of new autonomous regions actually increases inequality in these categories. This, among other things, happens because the formation of new areas is generally caused by political reasons rather than economic factors and equity. Many regional expansions are based on motives because they want to serve in the Local Bureaucracy and DPRD. In addition, regional expansion is also based on the motive to rebuild the history and power of the old aristocracy that once existed in the past (Putri & Almahmudi, 2020). Even the evaluation carried out by (Ministry of Home Affairs, 2011) against the autonomous regions resulting from the expansion (DOHP) Discovering the benefits of establishing a new autonomous region is still far from the expected promises and expectations. Regional Expansion has a negative and significant influence in areas in the low inequality classification. Adding new autonomous regions can equalize development in the low inequality classification. Some research results that support this include those found by Rajab & Kamarudin (2021); Suhartono (2015), and Sanjaya et al. (2019).

In addition, population size is more likely to influence areas with severe inequality classification than areas with high, moderate, and low inequality classification. An increase in the number of people in areas with severe inequality classification will increase the chance of increasing inequality by 0.06 per cent. An increasing population, if not accompanied by an increase in income, will have the opportunity to worsen inequality. However, the population generally has a negative chance of other categories of regional disparities. In areas classified as moderate inequality and low inequality, income distribution is more evenly distributed (lower than average), and an increase in population accompanied by high productivity can reduce disparities in this region.

Pro-poor growth spending will likely affect regions with severe and low inequality classifications. In areas classified as severe inequality, pro-poor growth spending has a negative effect. The increase in pro-poor growth spending in regions with severe classifications is focused on equity and development efforts that can provide a multiplier effect that can increase people's incomes and regional incomes, which have the opportunity to reduce the inequality that occurs. Conversely, an increase in the expenditure ratio of the pro-poor growth spending in areas with a low inequality classification can increase low inequality by 0.02 per cent. Lee & Rogers (2019) found

Central government spending tends to be greater in regions with low regional disparities. A more dispersed economic distribution will make aid widely distributable and impact increasing budgets. The variable of pro-poor growth spending will reduce inequality in areas with severe inequality and will have the opposite effect on areas with low levels of inequality. This remains in line with the spending objectives of the pro-poor growth spending, where spending is prioritized to regions and communities with low-income levels, which is expected to improve their welfare and reduce inequalities between regions. Likewise, with the human resources variable, where this variable significantly reduces inequality in areas with high inequality and vice versa, it will increase inequality in areas with low inequality.

Thus, based on this multinomial logistics model, we can recommend that in regions with severe inequality, attention and budget allocation can be prioritized on efforts to increase human resources and pro-poor and growth spending. At the same time, fiscal decentralization policies and regional expansion are more of a priority for regions with low inequality levels to provide maximum benefits for reducing inequality between regions.

5. Conclusion

The problem of regional inequality is still a concern for every country, especially middle-income countries. Using the Williamson and Theil indexes, regional inequality in Indonesia is grouped into four classifications. The four classifications are severe inequality classification, high inequality classification, moderate inequality classification, and low inequality classification. Thirty-seven per cent of provinces fall under the severe inequality classification, and 46 per cent of provinces fall under the low inequality classification.

The results showed significant, influential variables in regions with severe inequality classification, infrastructure, human resources, investment, fiscal decentralization, regional expansion, population, and spending on pro-poor growth functions. Significant variables in areas with high inequality classification are openness, investment, fiscal decentralization, regional expansion, and population. infrastructure, Investment, and population are substantial variables in regions with moderate inequality classification. Significant variables in areas with low inequality classification are economic growth, human resources, investment, fiscal decentralization, regional expansion, and spending on pro-poor growth functions.

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