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Analysis of Riau Intraregional Inequality Over the Past Decade (Period 2010-2023)

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ABSTRACT

This study aims to analyze economic inequality between districts/cities in Riau Province over the past decade. The focus of the study includes identifying intraregional disparity trends, determinants, impacts, and development equity policies evaluation. The methods used include Williamson Index Analysis, Theil Index, Regression Analysis, and Impulse Response Function (IRF). Williamson Index shows that inequality between Riau regions follows a convergence pattern with an inverted U-shaped curve tending, means inequality initially increases but then decreases over time. Bengkalis, Siak, Rohul, Inhil, and Meranti districts are the main contributors to inequality, Bengkalis and Siak contribute due to above-average, while Rohul, Inhil, and Meranti contribute due to low-average. Theil Index shows that from 2011-2014 inequality occurred between regions, but since 2015-2023 inequality dominant within a group of regions. Factors such as infrastructure access, topography, natural resource distribution, and government policies are found to be the main determinants of inequality. Regions with good infrastructure and low topography tend to be more developed, while high natural resource distribution exacerbates inequality in developed and average regions, reduces inequality in disadvantaged regions. Inequality has an impact on increasing poverty in developed and average regions, as well as decreasing health quality in disadvantaged regions. IRF analysis shows that the government's expansionary policy is quite effective in reducing inequality in Riau. The implications of the study provide recommendations to the government to prioritize equitable infrastructure development and effective expansionary policies to reduce inequality by considering topographic conditions and natural resource distribution in promoting equity throughout Riau.

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1. INTRODUCTION

Intraregional inequality is a phenomenon that is a problem in the process of economic development. Where in the process of implementing development there are differences in the level of economic development and social welfare between various regions in a region. This inequality problem is in line with the mandate of the Sustainable Development Goals (SDGs), especially goal 10, namely **Reducing**

Inequality to ensure equality of opportunity and reduce disparities in various aspects, including income and access to basic services across all levels of society [1]. According to [2], equitable development is an important part of development goals, namely not only increasing economic growth in absolute terms, but also distributing it fairly. Riau Province is known as one of the areas rich in natural resources. With abundant natural resource potential, Riau Province has a great opportunity to achieve significant economic growth to improve the welfare of its people. However, even though this potential is great, in the last decade, there have been indications of disparities or inequality in development between regions (intraregional) in Riau Province.

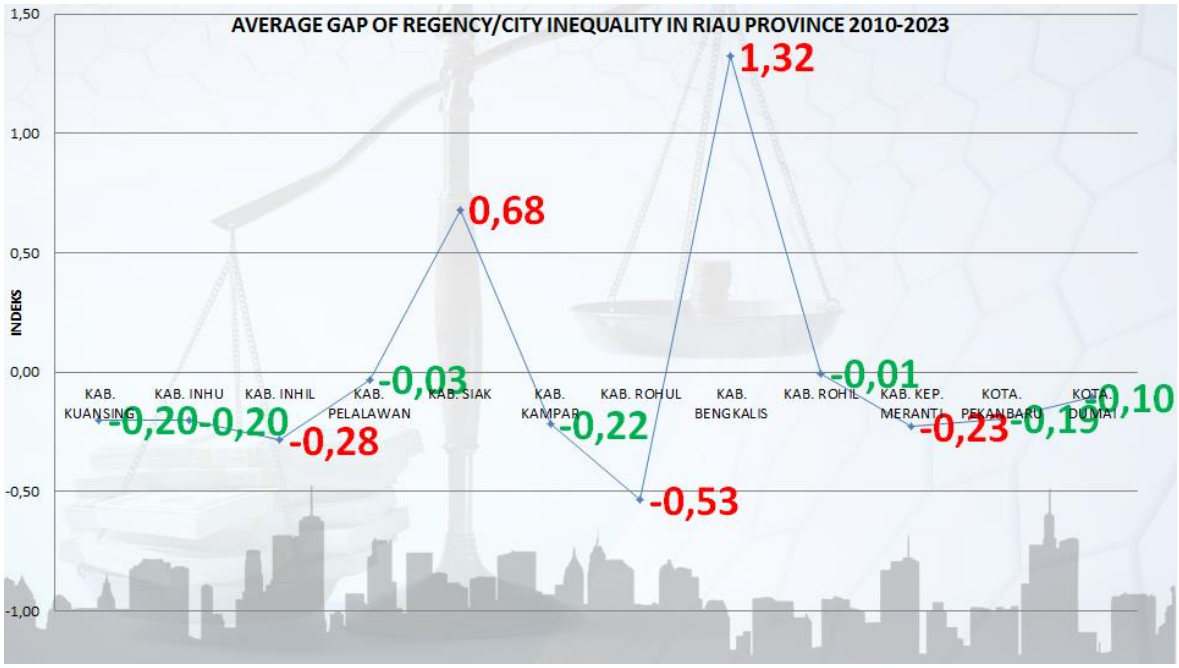

Figure. 1. Average Gap of Regency/City Inequality in Riau Province 2010-2023

Based on visualization **Figure 1.** Average Gap of Regency/City Inequality in Riau Province 2010-2023 indicates that there is a significant intraregional disparity in Riau Province. Bengkalis Regency and Siak Regency are seen as contributors to above-average inequality. Rokan Hulu Regency, Inhil Regency, and Kepulauan Meranti Regency are contributors to below-average inequality. Therefore, the author feels that the study entitled "**Analysis of Riau Intraregional Inequality Over the Past Decade (Period 2010-2023)**" is very important to do. It aims to analyze in more depth the patterns and trends of intraregional disparity in Riau Province, identify the main factors that cause inequality between regions, see the impact of intraregional disparity and evaluate the effectiveness of development equity policies that have been implemented in Riau Province.

2. LITERATURE REVIEW

According to Kuznets, in the early stages of economic development, income inequality tends to increase because most of the benefits of growth are enjoyed by the more advanced sectors, especially industry. However, over time, as development continues and becomes more inclusive, income inequality will decline. This results in an inverted U-shaped curve, where inequality initially rises, peaks, and then falls as the economy reaches a higher level of development [3].

Research by [4] shows that road infrastructure plays an important role in increasing regional output and GRDP per capita. Better roads allow faster and more efficient access to markets, increasing the attractiveness of the region for industrial and commercial investment.

According to the economic location theory by [5], the availability of access to markets and economic centers is the main factor influencing land value and use. [6] concept of "accessibility" states that areas that are more accessible tend to be more attractive to commercial and investment activities, and support the development of transportation and communication infrastructure. Research by [7] in China found that lowland areas are more developed than mountainous areas because of lower infrastructure development costs and higher accessibility.

Economic theory shows that the distribution of natural resources often triggers inequality between regions, especially in the context of regional economies that are highly dependent on these resources. According to the resource curse theory, regions rich in natural resources often experience higher inequality and dependence on one sector. This causes the regional economy to be less differentiated and highly influenced by fluctuations in natural resource prices [8]. Research by [9] revealed that the inequality generated by the distribution of natural resources in Indonesia is mainly caused by the concentration of economic benefits in certain areas, while other areas are often left behind. Research by [10] on palm oil in Indonesia also found that the expansion of natural resources such as plantations can create inequality due to its impact on land distribution and limited economic access for local communities.

[11] highlight that public spending, especially in the infrastructure and basic services sectors, increases economic access and social mobility in disadvantaged areas, thereby reducing regional inequality. [12] found that government spending in the form of fiscal transfers to regions succeeded in reducing inter-regional inequality by increasing economic capacity in less developed regions. A study by [13] shows that government intervention in the form of public spending contributes to reducing inequality in areas prone to underdevelopment, especially in developing countries such as Indonesia.

An empirical study by [14] revealed that investment in education and health increases productivity and income in developed regions, while lagging regions are unable to catch up due to limited human resource infrastructure. Research by [15] shows that disparities between regions are often associated with differences in education and health levels. Regions with good education and health infrastructure will be able to utilize improvements in the quality of human resources to drive economic growth, but on the other hand widen the gap with less developed regions.

From a theoretical perspective, inequalities resulting from structural factors and economic policies indicate the need for a more equitable approach to regional development. Based on development economic theory, such as the center-periphery theory [16] and dependency theory [17], inequality occurs when central areas have greater access to resources and investment than peripheral areas. Therefore, there is a need for effective policy interventions, such as increasing access to infrastructure and redistribution of natural resources to underdeveloped areas, to narrow the gap between regions and achieve more equitable development in Riau Province.

3. METHODS

The research approach used in this study uses a comparative study decomposition approach, and quantitative descriptive statistical analysis.

3.1 Data

The data used in this study is secondary data based on the time series for the period 2010-2023 sourced from the Central Statistics Agency (*eg* : Annual Reports), in addition the author also obtained data from scientific journals, library literature, and the internet related to this study. As for the research variables determined as follows :

Research Variables	Indicator
Regional Disparities	Williamson Index
Access to Infrastructure	Steady Road Percentage

Topography	Area Height
Distribution of natural resources	Primary Sector Distribution
Government policy	Government Expenditure
Quality of Human Resources	IPM
Education	Average Length of Schooling
Health	Life Expectancy
Poverty	Poverty Percentage

3.2 Analysis

Williamson Index Analysis

[18] The Williamson Index is an effective tool for measuring economic inequality between regions, especially in long-term analysis context. In intraregional disparity research, the use of the Williamson Index allows researchers to quantitatively map the level of inequality and track its changes over a period of time.

The Williamson Index (WI) is calculated using the following formula:

$$IW = \frac{\sqrt{\sum_{i=1}^{n}(yi-y)2\ (\frac{f_i}{n})}}{y} \qquad 1$$

Where:

IW = Williamson Index

y_i = GRDP per capita in region i

y = Average GRDP per capita of all regions

f_i = Number of residents in region i

n = Total population in all regions

Theil Index Analysis

[19] Theil Index is a statistical measure used to measure distribution inequality, whether in the context of income, wealth, or other aspects.

The Theil-T index is defined as:

$$T_T = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{yi}{y}\ ln\frac{yi}{y}\right) \qquad 2$$

Where :

- yi is the income (or other indicator) of the ith individual or unit.
- $\bar{y}$ is the average income.
- n is the number of individuals or units.

Decomposition:

$$T_T = T_{between} + T_{within} \qquad 3$$

Where :

- $T_{between}$ is the inequality between groups.
- T_{within} is the inequality within the group.

"Theil's index allows the decomposition of inequality into between- and within-group components, and can thus be used to understand the main sources of inequality in a population" [20].

Regression Analysis

Regression Analysis is used to understand **the determinants** and **the impact** of disparities . **Determinants** and **impacts** of disparities are identified comparatively to compare the results in Riau Province as a Whole, Average Areas in Riau Province, Developed Areas in Riau Province, and Underdeveloped Areas in Riau Province.

Determinants of Disparity

To understand **the determinants of** intraregional disparities, this study uses cross-section data on infrastructure and topography variables, using panel data on natural resource distribution variables, government policies, and human resource quality.

Cross Section Data

Multiple Regression Model:

The basic formula for a multiple regression model is:

$$Y = \beta0 + \beta1\ X1 + \beta2\ X2 + \cdots + \beta n\ Xn + \epsilon \qquad 4$$

- Y is the dependent variable (the predicted variable).
- X 1 , X2 , … , Xn are independent variables (predictor variables).
- β0 is the intercept or constant.
- β1 , β2 , … , βn are regression coefficients that represent the influence of each independent variable on the dependent variable.
- ϵ is the error term or residual error.

In this research analysis, it was determined:

Y = GRDP Per Capita

X1 = Percentage of Steady Road

X2 = Area Height

Panel Data

Multiple Regression Model:

The basic formula for a multiple regression model is:

$$Yit = \alpha + \beta 1\ X1it + \beta 2\ X2it + \cdots + \beta k\ Xkit + \varepsilon it \quad 5$$

Where:

- Yit : Dependent variable for entity **i** at time **t** .
- X1it , X2it , … Xkit : Independent variables.
- β1 , β2 , … , βk : Regression coefficients for the independent variables.
- εit : Error term that captures the variation not explained by the model.

In this research analysis, it was determined:

Y = Development Inequality
X1 = Primary Sector Distribution
X2 = Government Expenditure
X3 = HDI

Table 1. Conditions for Selecting Panel Data Regression Models

Testing	Results	Decision
Chow Test	Prob. > 0.05	CEM
	Prob. < 0.05	FEM
Hausman test	Prob. > 0.05	REM
	Prob. < 0.05	FEM
Lagrange Multiplier Test	Prob. > 0.05	CEM
	Prob. < 0.05	REM

Sumber : [28]

Impact of Disparity

Time Series Regression Model :

Simple Regression Model :

$$Yt = \beta 0 + \beta 1 Xt + \epsilon t \quad 6$$

Where Yt is the dependent variable at time t, Xt is the independent variable at time t , and ϵt is the error term.

- Dependent Variables : Poverty, Education, and Health
- Independent Variable : Development Inequality (Williamson Index)

Impulse Response Function Analysis

For effectiveness analysis, practitioners usually focus on *the Impulse Response Function* (IRF). *The Impulse Response Function* (IRF) traces the impact of one variable shock to another variable over a certain period of time [21].

4. RESULTS AND DISCUSSION

4.1 Results of Williamson Index Analysis

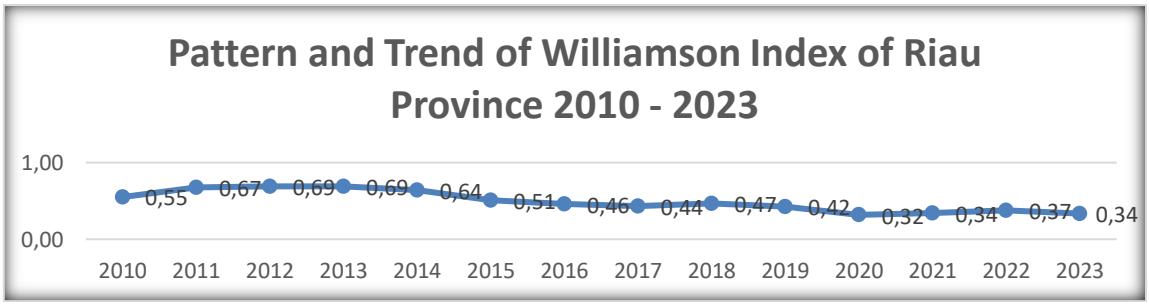

Figure 2. Williamson Index Pattern and Trend of Riau Province 2010 – 2023

Figure 2. shows the findings of the Williamson Index Pattern and Trend of Riau Province 2010-2023. From the graph, it can be seen that the Williamson index pattern tends to be convergence, namely that inequality decreases over time and has a curve pattern that tends to be in the shape of an inverted **U** with an increase in inequality reaching a peak in 2012-2013, followed by a significant decline since 2014. These **findings support** the

Kuznets hypothesis with an inverted **U curve**. According to Kuznets, in the early stages of economic development, income inequality tends to increase because most of the benefits of growth are enjoyed by the more advanced sectors, especially industry. However, over time, as development continues and becomes more inclusive, income inequality will decline. This results in an inverted U-shaped curve, where inequality initially rises, peaks, and then falls as the economy reaches a higher level of development [3].

4.2 Results of Theil Index Analysis

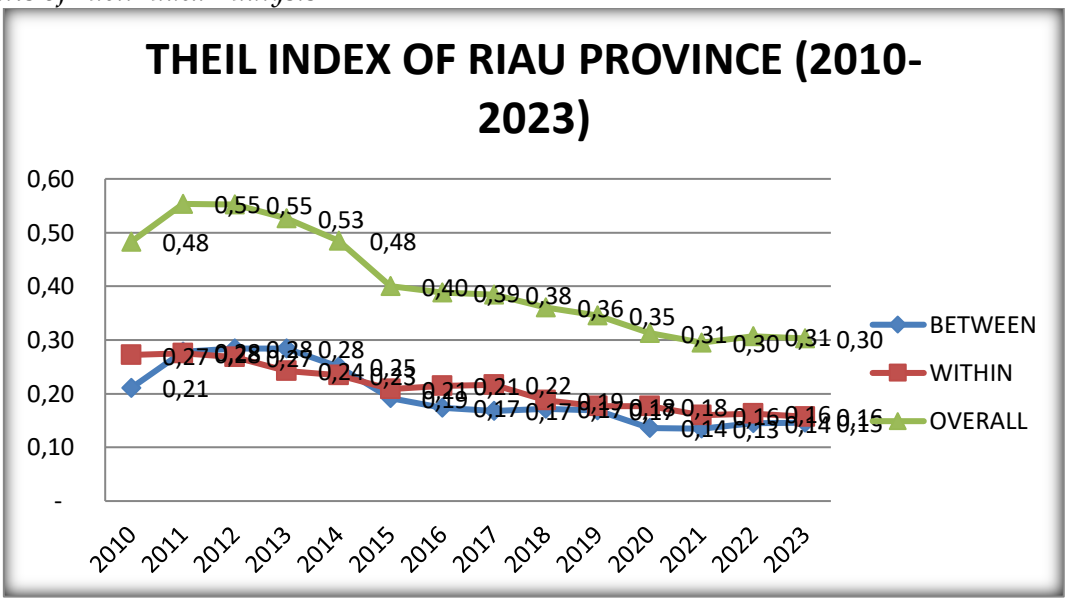

Figure. 3 . Theil Index of Riau Province (2010 – 2023)

Figure. 3 . shows the findings of the Riau Province Theil Index (2010–2023). The graph shows the development of economic inequality in Riau Province based on three main components: "**Between**" (blue line), "**Within**" (red line), and "**Overall**" (green line). The "**Overall**" **index** (green line) shows a significant downward trend from 0.48 in 2010 to 0.30 in 2023. The peak of inequality occurred in 2011 (0.55), and after that, the index decreased consistently until 2020 (0.295) before increasing slightly in 2021-2023. **The inequality index between regions (between)** experienced a significant decline from 0.27 in 2010 to 0.1459 in 2023. In 2011 there was a spike to 0.27, but the overall trend is downward, with a sharp decline from 2013 onwards to stabilize at around 0.1459 in 2023. **Within-area inequality** showed relative stability between 2010 and 2015, where its value ranged from 0.268 to 0.25. After 2015, the downward trend is more pronounced, from 0.2167 in 2016 to 0.157 in 2023, although there was a slight fluctuation in 2020-2022.

2011-2014: Between-region inequality becomes the main contributor to inequality in Riau, while within-region inequality is relatively stable. **2015-2023**: Within-region inequality begins to become more dominant, but overall inequality in Riau has decreased significantly.

In general, this indicates that policies and factors influencing inter-regional development have been increasingly successful in reducing inequality in the last decade.

4.3 Results of Multiple Regression Determinant Analysis of Cross Section Data in Riau Province

Table 2. Results Cross Section Estimate Equation

Dependent Variable: PDRB_KAPITA

Sample: 1 12

Included observations: 12

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	73573.59	38592.42	1.906426	0.0890
% ROAD _MANTAP	1504.836	555.2979	2.709962	0.0240
HEIGHT _ AREA	-1394.729	468.3787	-2.977780	0.0155

R-squared	0.562251	Mean dependent var	155103.5
Adjusted R-squared	0.464973	S.D. dependent var	54460.06
S.E. of regression	39835.10	Akaike info criterion	24.23520
Sum squared resid	1.43E+10	Schwarz criterion	24.35643
Log likelihood	-142.4112	Hannan-Quinn criter.	24.19032
F-statistic	5.779858	Durbin-Watson stat	1.497009
Prob(F-statistic)	0.024295		

Source : *Eviews 10 data processing* , 2024.

Substituted Coefficients:

==========

GRDP_CAPITA = 73573.59 + 1504.836*%STEADY ROAD - 1394.729*ALTITUDE_ALTITUDE

Analysis of Infrastructure Access Factors through the Percentage of Good Roads to GRDP per Capita in Riau Province

Based on the research results, it is known that good road infrastructure factors have a positive and significant influence on regional economic development, as measured by GRDP per capita. The better the road infrastructure, the greater the potential for economic development in areas **in Riau Province**. Based on the statistical **results** in **Table 2. Results Cross Section The Estimate Equation** is significant at the **97.60 % confidence level** (Significance Level 5%) .

Research result This realistic regarding what is actually happening in Riau Province. **Rokan Hulu Regency** and **Meranti Islands Regency**, which are the main contributors to inequality in Riau Province with below average development capacity, do not have access to national road infrastructure which is essential in improving road quality in a region.

The results of this study also have a strong theoretical basis and empirical evidence. Regional development theory states that physical infrastructure, such as roads, is an important catalyst for attracting private investment and increasing labor productivity [22]. Research by [4] shows that road infrastructure plays an important role in increasing regional output and GRDP per capita.

The implications of this study provide recommendations to the Government to prioritize the development of road infrastructure which is a national authority for underdeveloped regions in Riau Province, such as **Rokan Hulu Regency** and **Meranti Islands Regency,** to increase accessibility to economic mobility in these regions so that inclusive and equitable development can be realized in Riau Province.

Analysis of Topographic Factors through Regional Heights Against GRDP per Capita in Riau Province

Based on the research results, it is known that higher areas tend to be less developed than lower areas. The lower the **topography** of the region, the greater the potential for economic development in the region **in Riau Province**. Based on the statistical results in **Table 2. Results Cross Section the Estimate Equation** is significant at the **98.45 % confidence level** (Significance Level 5%).

The results of this study are realistic to the actual conditions in Riau Province. Where **Rokan Hulu Regency**, which is the main contributor to inequality in Riau

Province with a development capacity below average, has the highest topography in Riau Province, and **Bengkalis Regency,** which is the main contributor to inequality in Riau Province with a development capacity above average, has the lowest topography in Riau Province.

According to the economic location theory by [5], the availability of access to markets and economic centers is the main factor influencing land value and use. Areas with low topography usually have better transportation access, making it easier to transport goods and services, and triggering regional economic growth. This is supported by the concept of "accessibility" from [6], where areas that are more accessible tend to be more attractive to commercial activities and investment, and support the development of transportation and communication infrastructure. Research by [7] in China found that lowland areas are more developed than mountainous areas because of lower infrastructure development costs and higher accessibility. This study shows that lower transportation costs in low-lying areas allow for smoother movement of goods and services, reduce logistics costs, and increase the competitiveness of local products.

The implications of this research provide recommendations to the government to consider topographic conditions in promoting equality throughout the Riau region. This study shows that high topographic areas tend to be more disadvantaged than low topographic areas. The results of this study confirm the factual conditions that occur in Riau Province.

Where it was found that **Rokan Hulu Regency,** which is the highest topographic area in Riau Province, is the main contributor to inequality in Riau Province with a development capacity below average. Therefore, attention to equitable development for **Rokan Hulu Regency** needs to be a priority for the government to realize inclusive and equitable development in Riau Province.

4.4 Results of Multiple Regression Determinant Analysis of Panel Data in Riau Province as a Whole

Table 3. Results of *Panel Data Equation Estimates*

Dependent Variable: INEQUALITY
Method: Panel Least Squares
Date: 10/11/24 Time: 20:33
Sample: 2010 2023
Periods included: 14
Cross-sections included: 12
Total panel (balanced) observations: 168

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.372796	0.467123	-2.938832	0.0038
%SDA	0.025051	0.002616	9.577104	0.0000
PENGELUARAN_PEMERINTAH	-9.85E-05	1.70E-05	-5.808747	0.0000
IPM	0.009910	0.005823	1.701909	0.0908

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.942876	Mean dependent var	0.344069
Adjusted R-squared	0.937649	S.D. dependent var	0.370926

S.E. of regression	0.092621	Akaike info criterion	-1.835564
Sum squared resid	1.312523	Schwarz criterion	-1.556639
Log likelihood	169.1874	Hannan-Quinn criter.	-1.722363
F-statistic	180.3855	Durbin-Watson stat	0.590432
Prob(F-statistic)	0.000000		

Source : *Eviews 10 data processing* , 2024.

Substituted Coefficients:

==========

INEQUALITY = -1.37279645418 + 0.0250513145832*_SDA - 9.84933804413e-05*GE + 0.00990960862417*HDI + [CX=F]

Analysis of Natural Resource Distribution Factors through Primary Sector Distribution on Inequality in Riau Province as a Whole

Based on the research results, it is known that **the Natural Resources Distribution Factor** tends to contribute to increasing inequality in districts/ cities in Riau Province. The greater **the Natural Resources Distribution Factor,** the greater the potential for increasing inequality in districts/ cities in Riau Province. Based on the statistical results in **Table 3. Results *of Estimate Equation Panel Data*** significant at the **99.99 % confidence level** (Significance Level 1%).

Economic theory shows that the distribution of natural resources often triggers inequality between regions, especially in the context of regional economies that are highly dependent on these resources. According to the resource *curse* theory, Regions rich in natural resources often experience higher inequality and dependence on one sector. This causes the regional economy to be less differentiated and highly influenced by fluctuations in natural resource prices [8]. Research by [10] on palm oil in Indonesia also found that the expansion of natural resources such as plantations can create disparities due to their impact on land distribution and limited economic access for local communities.

The implications of this research provide recommendations to the government to consider the effectiveness of natural resource distribution in promoting equity throughout the Riau region. Based on the research results, for Riau Province as a whole, economic diversification is needed for equality among sectors that can have a multiplier effect on the equality of public welfare in Riau Province.

Analysis of Government Expenditure Factors on Inequality in Riau Province as a Whole

Based on the research results, it is known that **the Government Expenditure Factor** plays a role in reducing inequality. Government intervention through public spending can help reduce economic disparities in districts/ cities in Riau Province. ***Based*** on the statistical results in **Table 3 .: Results *of Estimate Equation Panel Data*** significant at the **99.99 % confidence level** (Significance Level 1%).

Classical economic theory and Keynesianism support government intervention as a tool to balance the inequalities generated by the market. According to Keynes, public spending or government spending can stimulate economic activity by creating demand, which has a positive impact on the level of public welfare, especially in economically disadvantaged areas [23]. In this context, public spending policies can direct the development of infrastructure, education, and health in less developed areas, thereby increasing economic opportunities more evenly. A study by [13] shows that government intervention in the form of public spending contributes to reducing inequality in areas prone to underdevelopment, especially in developing countries such as Indonesia.

The implications of this research provide recommendations to the government to prioritize effective expansionary policies to reduce regional disparities in Riau Province.

Analysis of Human Resource Quality Factors through Human Development Index (HDI) on Inequality in Riau Province as a Whole

Based on the research results, it is known that improving **the quality factor of human resources through IPM** will increase inequality in the district/city areas in Riau Province. Economic inequality in the district/ city areas in Riau Province is positively influenced by the HDI. Based on the statistical results in **Table 3. Results** ***of Estimate Equation Panel Data*** significant at **a confidence level of 90.92 %** (Significance Level 10%).

According to the theory of human capital developed by [24], improving the quality of human resources will increase productivity and, ultimately, income. However, if the improvement in the quality of human resources is not evenly distributed across regions, regions that have previously had access to higher education and quality health facilities will be more advanced, increasing the disparity between regions. Research by [15] supports this finding, showing that disparities between regions are often associated with differences in education and health levels. Regions with good education and health infrastructure will be able to take advantage of improving the quality of human resources to drive economic growth, but on the other hand widen the gap with less developed regions.

4.5 Results of Determinant Analysis Multiple Regression of Panel Data in Average Areas (Average Regions) in Riau Province

Table 4. Results of ***Panel Data Equation Estimates***

Dependent Variable: INEQUALITY
Method: Panel Least Squares
Date: 10/12/24 Time: 21:48
Sample: 2010 2023
Periods included: 14
Cross-sections included: 7
Total panel (balanced) observations: 98

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.474821	0.350873	1.353255	0.1794
_SDA	-0.002739	0.002633	-1.040383	**0.3010**
GE	-8.21E-05	1.02E-05	-8.032119	**0.0000**
IPM	-7.10E-05	0.004194	-0.016932	**0.9865**
	Effects Specification			
Cross-section fixed (dummy variables)				
R-squared	0.754848	Mean dependent var		0.154223
Adjusted R-squared	0.729776	S.D. dependent var		0.097172
S.E. of regression	0.050513	Akaike info criterion		-3.036721
Sum squared resid	0.224538	Schwarz criterion		-2.772948
Log likelihood	158.7993	Hannan-Quinn criter.		-2.930030
F-statistic	30.10678	Durbin-Watson stat		0.722151
Prob(F-statistic)	0.000000			

Source : *Eviews 10 data processing* , 2024.

Substituted Coefficients:
==========
INEQUALITY = 0.474820640257 - 0.00273888613097*_SDA - 8.20839982608e-05*GE - 7.1007903051e-05*HDI + [CX=F]

Analysis of Natural Resource Distribution Factors through Primary Sector Distribution on Inequality in Average Regions in Riau Province

Based on the research results in **Table 4. Results of the** ***Panel Data Estimate Equation,*** it is known that **the Natural Resource Distribution Factor** does not have a

statistically significant relationship. on inequality in average regions *in* Riau Province. These results indicate that **the Natural Resources Distribution Factor** is not a determinant of intraregional disparity **in average regions *in* Riau Province**.

Analysis of Government Expenditure Factors on Inequality in Average Regions in Riau Province

Based on the research results, it is known that **the Government Expenditure Factor** plays a role in reducing inequality. Government intervention through public spending can help reduce economic disparities **in average regions *in* Riau Province.** Based on the statistical results in **Table 4. Results *of Estimate Equation Panel Data*** significant at the **99.99 % confidence level** (Significance Level 1%).

The results of this study are the same as the results of the study **in point Analysis of Government Expenditure Factors on Inequality in Riau Province as a Whole.**

Analysis of Human Resource Quality Factors through Human Development Index (HDI) on Inequality in Average Regions in Riau Province

Based on the research results in **Table 4. Results *of the Estimate Equation Panel Data,*** it is known that **the Human Resource Quality Factor** represented through **the HDI** does not have a statistically significant relationship. on inequality in average regions *in* Riau Province. These results indicate that **the Human Resource Quality Factor** represented through **the HDI** is not a determinant of intraregional disparity **in average regions *in* Riau Province**.

4.6 Results of Determinant Analysis Multiple Regression of Panel Data in Developed Regions in Riau Province

Table 5. Results of *Panel Data Equation Estimates*

Dependent Variable: INEQUALITY
Method: Panel Least Squares
Date: 10/04/24 Time: 07:59
Sample: 2010 2023
Periods included: 14
Cross-sections included: 2
Total panel (balanced) observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.690534	3.287408	-1.122627	0.2727
_SDA	0.038124	0.005041	7.562350	**0.0000**
GE	-0.000185	8.77E-05	-2.113700	**0.0451**
IPM	0.035126	0.043580	0.806007	0.4282

R-squared	0.941613	Mean dependent var	1.001857
Adjusted R-squared	0.934314	S.D. dependent var	0.446989
S.E. of regression	0.114560	Akaike info criterion	-1.363874
Sum squared resid	0.314975	Schwarz criterion	-1.173559
Log likelihood	23.09424	Hannan-Quinn criter.	-1.305693
F-statistic	129.0161	Durbin-Watson stat	1.046993
Prob(F-statistic)	0.000000		

Source : *Eviews 10 data processing* , 2024.

Substituted Coefficients:

==========

INEQUALITY = -3.69053380124 + 0.0381239141927*_SDA - 0.00018532292111*GE + 0.0351258625399*HDI

Analysis of Natural Resource Distribution Factors through Primary Sector Distribution on Inequality in Developed Regions in Riau Province

Based on the research results, it is known that **the Natural Resources Distribution Factor** tends to contribute to increasing inequality **in developed regions in Riau Province.** The greater **the natural resource distribution factor,** the greater the potential for increasing inequality **in developed regions *in* Riau Province.** Based on the statistical results in **Table 5. Results *of Estimate Equation Panel Data*** significant at the **99.99 % confidence level** (Significance Level 1%) .

The results of this study are the same as the results of the study **in point Analysis of Natural Resource Distribution Factors through Primary Sector Distribution on Inequality in Riau Province as a Whole.**

Analysis of Government Expenditure Factors on Inequality in Developed Regions in Riau Province

Based on the research results, it is known that **the Government Expenditure Factor** plays a role in reducing inequality. Government intervention through public spending can help reduce economic disparities **in developed regions *in* Riau Province.** Based on the statistical results in **Table 5. Results *of Estimate Equation Panel Data*** significant at **a confidence level of 95.49 %** (Significance Level 5%) .

The results of this study are the same as the results of the study **in point Analysis of Government Expenditure Factors on Inequality in Riau Province as a Whole.**

Analysis of Human Resource Quality Factors through Human Development Index (HDI) on Inequality in Developed Regions in Riau Province

Based on the research results in **Table 5. Results *of Estimate Equation Panel Data,*** it is known that **the Human Resource Quality Factor** represented through **the HDI** does not have a statistically significant relationship. on inequality **in developed regions *in* Riau Province**. These results indicate that **the Human Resource Quality Factor** represented through **the HDI** is not a determinant of intraregional disparity **in developed regions *in* Riau Province**.

4.7 Results of Multiple Regression Determinant Analysis of Panel Data in Disadvantaged Regions in Riau Province*Table 6. Results of *Panel Data Equation Estimates

Dependent Variable: INEQUALITY
Method: Panel Least Squares
Date: 10/23/24 Time: 00:37
Sample: 2010 2023
Periods included: 14
Cross-sections included: 2
Total panel (balanced) observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.467467	1.003007	3.457071	0.0021
_SDA	-0.026148	0.010594	-2.468179	0.0214
GE	-0.000236	0.000127	-1.861221	0.0755
IPM	-0.019661	0.014372	-1.367953	0.1845
	Effects Specification			
Cross-section fixed (dummy variables)				

R-squared	0.896142	Mean dependent var	0.409033
Adjusted R-squared	0.878080	S.D. dependent var	0.156068
S.E. of regression	0.054494	Akaike info criterion	-2.821003
Sum squared resid	0.068302	Schwarz criterion	-2.583109
Log likelihood	44.49404	Hannan-Quinn criter.	-2.748276
F-statistic	49.61401	Durbin-Watson stat	0.999287
Prob(F-statistic)	0.000000		

Source : *Eviews 10 data processing* , 2024.

Substituted Coefficients:

==========

INEQUALITY = 3.46746723759 - 0.0261481254506*_SDA - 0.000235928881539*GE - 0.019660816166*HDI + [CX=F]

Analysis of Natural Resource Distribution Factors through Primary Sector Distribution on Inequality in Disadvantaged Regions in Riau Province

Based on the research results, it is known that Increasing **the distribution factor of natural resources** is associated with decreasing inequality. The increasing **distribution factor of natural resources** has the potential to reduce economic inequality **in disadvantaged regions *in* Riau Province.** Based on the statistical results in **Table 6. Results *of Estimate Equation Panel Data*** significant at **a confidence level of 97.86 %** (Significance Level 5%).

In the context of regional economics, a more even distribution of natural resources can function as a driving factor that enables underdeveloped regions to increase their economic development [2]. Better distribution of natural resources allows regions to tap into previously unreachable resources, which then supports increased employment, income and investment in critical sectors such as infrastructure and public services. This is also in line with the *resource-based growth theory* which states that increasing the use of natural resources can improve the gap between regions by distributing economic benefits more evenly [25].

The implications of this research provide recommendations to the government to consider the effectiveness of natural resource distribution in promoting equity in **disadvantaged regions *in* Riau Province.** Based on the research results, for **disadvantaged regions *in* Riau Province,** it is necessary to carry out economic transformation towards a more sustainable sector to increase productivity, create greater added value, and thus improve overall economic welfare. With the improvement in overall economic welfare, **disadvantaged regions *in* Riau Province** will be able to catch up, which will have an impact on reducing the level of inequality.

Analysis of Government Expenditure Factors on Inequality in Disadvantaged Regions in Riau Province

Based on the research results, it is known that **the Government Expenditure Factor** plays a role in reducing inequality. Government intervention through public spending can help reduce economic disparities **in disadvantaged regions *in* Riau Province.** Based on the statistical results in **Table 6. Results *of Estimate Equation Panel Data*** significant at **a confidence level of 92.45 %** (Significance Level 10%) .

The results of this study are the same as the results of the study **on Analysis of Government Expenditure Factors on Inequality in Riau Province as a Whole.**

Analysis of Human Resource Quality Factors through Human Development Index (HDI) on Inequality in Disadvantaged Regions in Riau Province

Based on the research results in **Table 6. Results *of Estimate Equation Panel Data,*** it is known that **the Human Resource Quality Factor** represented through **the HDI** does not have a statistically significant relationship. on inequality **in disadvantaged regions *in* Riau Province**. These results indicate that **the Human Resource Quality Factor** represented through **the HDI** is not a determinant of

intraregional disparity **in disadvantaged regions *in* Riau Province.**

4.8 Results Research on the Impact of Intraregional Disparities in Riau Province as a Whole

Table 7. Results of Pairwise Dumitrescu Hurlin Panel Causality Tests

Pairwise Dumitrescu Hurlin Panel Causality Tests
Date: 10/12/24 Time: 21:18
Sample: 2010 2023
Lags: 1

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
RLS does not homogeneously cause INEQUALITY	4.20285	4.72456	2.E-06
INEQUALITY does not homogeneously cause RLS	**2.05570**	**1.28911**	**0.1974**
UHH does not homogeneously cause INEQUALITY	2.78146	2.45034	0.0143
INEQUALITY does not homogeneously cause UHH	**0.70792**	**-0.86733**	**0.3858**
_POVERTY does not homogeneously cause INEQUALITY	2.70958	2.33532	0.0195
INEQUALITY does not homogeneously cause _POVERTY	**5.27204**	**6.43527**	**1.E-10**

Source : *Eviews 10 data processing* , 2024.

Tabel 8. *Results Estimate Equation Panel Data*

Dependent Variable: _POVERTY
Method: Panel EGLS (Cross-section random effects)
Date: 10/24/24 Time: 21:59
Sample: 2010 2023
Periods included: 14
Cross-sections included: 12
Total panel (balanced) observations: 168
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.512128	2.168602	3.925168	0.0001
INEQUALITY	2.297131	0.996945	2.304170	0.0225

Source : *Eviews 10 data processing* , 2024.

Substituted Coefficients:
==========
_POVERTY = 8.51212789067 + 2.29713069367*INEQUALITY + [CX=R]

Based on the research results in **Table 7. Results of Pairwise Dumitrescu Hurlin Panel Causality Tests,** it is known **that inequality homogeneously causes poverty in Riau Province as a whole.** And the research results in **Table 8. Results of *the Estimate Equation Panel Data* show that** the higher the level of inequality, the higher the level of poverty in the **Riau Province as a whole**.

Riau Province is known to have a dominant economic structure supported by the distribution of natural resources, namely oil and natural gas and plantations, especially palm oil commodities. [26] in Capital in the Twenty-First Century emphasized that natural resources assets and income derived from these resources tend to worsen inequality, because these resources generate large incomes for capital owners while workers or the general public do not receive a comparable proportion of this wealth. Theoretically, this result can be explained by the hypothesis that unequal income distribution causes most of the income or wealth to be concentrated in a handful of the population, thereby reducing economic

opportunities for low-income groups to escape the poverty line.

4.9 Results Research on the Impact of Intraregional Disparity in Average Regions in Riau Province

Table 9. Results of Pairwise Dumitrescu Hurlin Panel Causality Tests

Pairwise Dumitrescu Hurlin Panel Causality Tests
Date: 10/13/24 Time: 00:13
Sample: 2010 2023
Lags: 1

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
RLS does not homogeneously cause INEQUALITY	4.27561	3.69736	0.0002
INEQUALITY does not homogeneously cause RLS	**2.15139**	**1.10151**	**0.2707**
UHH does not homogeneously cause INEQUALITY	1.29507	0.05508	0.9561
INEQUALITY does not homogeneously cause UHH	**0.97358**	**-0.33779**	**0.7355**
_POVERTY does not homogeneously cause INEQUALITY	3.27802	2.47828	0.0132
INEQUALITY does not homogeneously cause _POVERTY	**6.38770**	**6.27838**	**3.E-10**

Source : *Eviews 10 data processing* , 2024.

Tabel 10. Results of *Estimate Equation Panel Data*

Dependent Variable: _POVERTY
Method: Panel EGLS (Cross-section random effects)
Date: 10/13/24 Time: 00:17
Sample: 2010 2023
Periods included: 14
Cross-sections included: 7
Total panel (balanced) observations: 98
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.702542	1.153369	5.811272	0.0000
INEQUALITY	3.600721	1.367178	2.633689	0.0098

Source : *Eviews 10 data processing* , 2024.

Substituted Coefficients:
==========
_POVERTY = 6.70254176315 + 3.6007208097*INEQUALITY + [CX=R]

Based on the research results in **Table 9. Pairwise Dumitrescu Hurlin Panel Causality Tests Results** show **that inequality homogeneously causes poverty in average regions *in Riau* Province .** And the research results in **Table 10. Results *of the Estimate Equation Panel Data* show that** the higher the level of inequality, the higher the level of poverty **in the average regions *in* Riau Province** .

The results of this study are the same as the results of the study **in the Discussion point on the results of the study on the impact of intraregional disparities in Riau Province as a whole.**

4.10 Results Research on the Impact of Intraregional Disparities in Developed Regions in Riau Province

Table 11. Results of Pairwise Dumitrescu Hurlin Panel Causality Tests

Pairwise Dumitrescu Hurlin Panel Causality Tests
Date: 10/13/24 Time: 00:25
Sample: 2010 2023
Lags: 1

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
RLS does not homogeneously cause INEQUALITY	5.07158	2.49624	0.0126
INEQUALITY does not homogeneously cause RLS	**1.76592**	**0.33700**	**0.7361**
UHH does not homogeneously cause INEQUALITY	3.13112	1.22874	0.2192
INEQUALITY does not homogeneously cause UHH	**0.12363**	**-0.73574**	**0.4619**
_POVERTY does not homogeneously cause INEQUALITY	2.89500	1.07451	0.2826
INEQUALITY does not homogeneously cause _POVERTY	**5.39709**	**2.70887**	**0.0068**

Source : *Eviews 10 data processing* , 2024.

Table 12. Results of *Panel Data Equation Estimates*

Dependent Variable: _POVERTY
Method: Panel Least Squares
Date: 10/13/24 Time: 00:30
Sample: 2010 2023
Periods included: 14
Cross-sections included: 2
Total panel (balanced) observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	5.409151	0.299747	18.04572	0.0000
INEQUALITY	0.712740	0.286669	2.486286	0.0199

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.750644	Mean dependent var	6.123214
Adjusted R-squared	0.730696	S.D. dependent var	0.875007
S.E. of regression	0.454081	Akaike info criterion	1.359874
Sum squared resid	5.154737	Schwarz criterion	1.502611
Log likelihood	-16.03824	Hannan-Quinn criter.	1.403510
F-statistic	37.62916	Durbin-Watson stat	1.609138
Prob(F-statistic)	0.000000		

Source : *Eviews 10 data processing* , 2024.

Substituted Coefficients:
==========
_POVERTY = 5.40915084762 + 0.712739949379*INEQUALITY + [CX=F]

Based on the research results in **Table 11. Pairwise Dumitrescu Hurlin Panel Causality Tests results** show **that inequality homogeneously causes poverty in developed regions *in* Riau Province.** And the

research results in **Table 12. Results *of the Estimate Equation Panel Data* show** that the higher the level of inequality, the higher the level of poverty **in developed regions *in* Riau Province** .

The results of this study are the same as the results of the study **in point Discussion of the research results on the impact of intraregional disparities in Riau Province as a whole.**

4.11 Results on the impact of intraregional disparities in disadvantaged regions in Riau Province

Table 13. Results of Pairwise Dumitrescu Hurlin Panel Causality Tests

Pairwise Dumitrescu Hurlin Panel Causality Tests
Date: 10/14/24 Time: 00:08
Sample: 2010 2023
Lags: 2

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.
RLS does not homogeneously cause INEQUALITY	3.80563	0.40724	0.6838
INEQUALITY does not homogeneously cause RLS	**2.09997**	**-0.28348**	**0.7768**
UHH does not homogeneously cause INEQUALITY	7.07401	1.73081	0.0835
INEQUALITY does not homogeneously cause UHH	**7.75740**	**2.00756**	**0.0447**
_POVERTY does not homogeneously cause INEQUALITY	0.40787	-0.96872	0.3327
INEQUALITY does not homogeneously cause _POVERTY	**5.21390**	**0.97754**	**0.3283**

Source : *Eviews 10 data processing*, 2024.

Tabel 14. Results *Estimate Equation Panel Data*

Dependent Variable: UHH
Method: Panel Least Squares
Date: 10/12/24 Time: 01:31
Sample: 2010 2023
Periods included: 14
Cross-sections included: 2
Total panel (balanced) observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	71.29732	0.361310	197.3302	0.0000
INEQUALITY	-7.312116	0.863706	-8.465979	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.920594	Mean dependent var	68.30643
Adjusted R-squared	0.914241	S.D. dependent var	1.368398
S.E. of regression	0.400730	Akaike info criterion	1.109901
Sum squared resid	4.014621	Schwarz criterion	1.252637
Log likelihood	-12.53862	Hannan-Quinn criter.	1.153537
F-statistic	144.9179	Durbin-Watson stat	0.733232

Prob(F-statistic)	0.000000

Source : *Eviews 10 data processing* , 2024.

Substituted Coefficients:
==========

UHH = 71.2973236881 - 7.31211622235*INEQUALITY + [CX=F]

Based on the research results in **Table 13. Pairwise Dumitrescu Hurlin Panel Causality Tests results** show that **inequality homogeneously causes UHH in disadvantaged regions *in* Riau Province.** And the results of the study in **Table 14. Results *of Estimate Equation Panel Data* show that** increasing inequality is correlated with decreasing life expectancy. Inequality has a negative impact on the health and quality of life of the population **in disadvantaged regions *in* Riau Province.**

In Riau Province, underdeveloped areas are known to be in **Rokan Hulu Regency, Indragiri Hilir Regency, and Meranti Islands Regency.** The results of this study are realistic with the conditions that occur in Riau Province were underdeveloped areas in Riau Province experience low health quality in Riau Province. **Indragiri Hilir Regency and Meranti Islands Regency** have the lowest quality of life expectancy in Riau Province. In 2023, each has a Life Expectancy figure of 68.62 and 68.41 [27].

Impulse Response Function Analysis Results

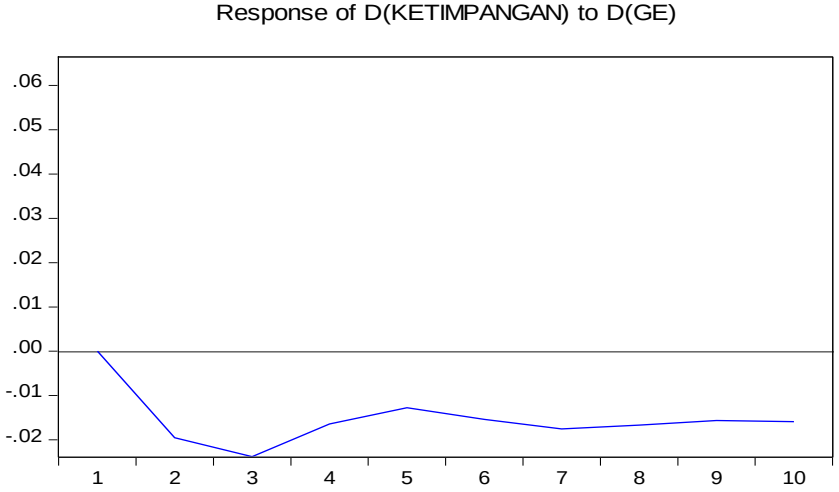

Figure. 4. Response of D(INEQUALITY) to D(GE)

Figure 4. shows the results of **the Response of D(INEQUALITY) to D(GE).** The graph shows that the response to shocks to Government Expenditure (GE) is directly negative and decreases at the beginning, which means that increasing government spending will reduce inequality directly in the first few periods. The effect is stable below zero, indicating that government spending has a stable long-term impact in reducing inequality.

5. CONCLUSION

Inequality in Riau Province is included in the moderate category of inequality with an inverted U-shaped pattern, increasing at the beginning of the period then decreasing over time. Where infrastructure access, regional topography, distribution of natural resources and government policies are the causes of the rise and fall of inequality levels in Riau Province. In developed areas, inequality has an impact on poverty, in underdeveloped areas it has an impact on health quality. Government policies in Riau Province are effective in reducing inequality, but there is a lack of attention from the central government to underdeveloped areas in Riau Province.

Research Limitation

The limitation of this study is that it does not provide spatial correlation analysis to determine the distribution of inequality patterns, whether the distribution of inequality patterns is clustering or random

distribution. Therefore, advanced researchers are advised to use more advanced econometric methods, adopting spatial economic analysis models, so as to provide deeper insight into inter-regional interactions and the influence of spatial dependence on inequality in Riau.

Research Implication

- Theoretically the implications of this study show that inequality in Riau follows an inverted U-shaped curve pattern, in accordance with Kuznets' theory which states that inequality tends to increase in the early stages of development but will decrease over time.
- Practically the implications of this study provide recommendations to the government to prioritize equitable infrastructure development and effective expansionary policies to reduce inequality by considering topographic conditions and natural resource distribution in promoting equity throughout Riau.

REFERENCES

[1] United Nations. (2015). *Transforming our world: The 2030 agenda for sustainable development*. United Nations. https://sdgs.un.org/2030agenda

[2] Todaro, M. P., & Smith, S. C. (2011). *Economic development* (11th ed .). Pearson. https://www.scirp.org/reference/referencespapers?referenceid=2512794

[3] Kuznets, S. (1955). Economic growth and income inequality. *The American Economic Review, 45*(1), 1-28. https://assets.aeaweb.org/asset-server/files/9438.pdf

[4] Eberts, R. W., & Fogarty, M. S. (1987). Estimating the relationship between local public spending and economic growth. *Journal of Urban Economics, 21*(3), 391–408. https://www.researchgate.net/publication/5029413_Estimating_the_Relationship_between_Local_Public_and_Private_Investment

[5] Von Thünen, J. H. (1826). *The isolated state* . https://www.britannica.com/topic/The-Isolated-State

[6] Alonso, W. (1964). *Location and land use: Toward a general theory of land rent.* Cambridge, MA: Harvard University Press. https://doi.org/10.2307/2172828

[7] Fan, S., Zhang, L., & Zhang, X. (2002). *Growth, inequality, and poverty in rural China: The role of public investments* (Research Report). International Food Policy Research Institute. https://econpapers.repec.org/paper/fprresrep/125.htm

[8] Auty, R. M. (1993). *Sustaining development in mineral economies: The resource curse thesis* . Routledge. https://archive.org/details/sustainingdevelo0000auty/page/n9/mode/2up

[9] Resosudarmo, B. P., & Yusuf, A. A. (2006). Is the log export ban an effective instrument in reducing poverty and deforestation in Indonesia? *Economy and Environment Program for Southeast Asia*.https://www.researchgate.net/publication/4720195_Is_the_Log_Export_Ban_Effective_Revisiting_the_Issue_through_the_Case_of_Indonesia

[10] Gatto, M., Wollni, M., & Qaim, M. (2015). *Oil Palm Boom and Land-Use Dynamics in Indonesia: The Role of Policies and Socioeconomic Factors*. *Land Use Policy*, 46, 292-303. https://www.econstor.eu/bitstream/10419/117318/1/EFForTS_dp-06.pdf

[11] Martinez-Vazquez, J., & McNab, R. M. (2012). Fiscal decentralization and economic growth. *World Development, 40*(4), 696-711. 10.1016/j.worlddev.2011.09.007.

[12] Alisjahbana, A., & Yusuf, A. A. (2003). Fiscal decentralization and poverty reduction in Indonesia. *Asian Economic Journal, 17*(1), 85-104. https://www.jstor.org/stable/25773827

[13] McCulloch, N., Sjahrir, B. S., & Setiawan, A. (2013). Public spending and poverty in Indonesia. *Asian Economic Journal, 27*(1), 1-23. https://doi.org/10.14710/ijpd.4.2.49-56.

[14] Gennaioli, N., La Porta, R., Lopez-de-Silanes, F., & Shleifer, A. (2014). Growth in regions. *Journal of Economic Growth, 19*(3), 259-309.

[15] Akita, T., Kurniawan, P., & Miyata, S. (2011). Structural changes and regional income inequality in Indonesia: A bidimensional decomposition analysis. *Asian Economic Journal, 25*(1), 55–77. **https://doi.org/10.1111/j.1467-8381.2011.02053.x**

[16] Perroux, F. (1950). Economic space: Theory and applications. *Quarterly Journal of Economics, 64*(1), 89-104. https://doi.org/10.2307/1881960

[17] Frank, A. G. (1967). *Capitalism and underdevelopment in Latin America: Historical studies of Chile and Brazil*. Monthly Review Press.

[18] Syafrizal. (2012). *Regional and urban economics* . King Grafindo Persada. https://openlibrary.org/books/OL31049151M/Ekonomi_region_dan_perkotaan

[19] Cowell, F. A. (2011). *Measuring inequality* (3rd ed.). Oxford University Press. https://doi.org/10.1093/acprof:osobl/9780199594030.001.0001

[20] Theil, H. (1967). *Economics and information theory* . North-Holland Publishing Company. https://doi.org/10.2307/2230396

[21] Widarjono, A. (2007). *Econometric theory and applications for economics and business* (Second Edition). Faculty of Economics UII.
[22] Aschauer, D. A. (1989). Is public expenditure productive? *Journal of Monetary Economics, 23*(2), 177–200. https://doi.org/10.1016/0304-3932(89)90047-0
[23] Keynes, J. M. (1936). *The general theory of employment, interest and money*. Macmillan. https://www.files.ethz.ch/isn/125515/1366_KeynesTheoryofEmployment.pdf
[24] Becker, G. S. (1964). *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education.* University of Chicago Press. https://doi.org/10.2307/2229541
[25] Auty, R. M. (2001). *Resource abundance and economic development* . Oxford University Press . https://openlibrary.org/books/OL17024248M/Resource_abundance_and_economic_development
[26] Piketty, T. (2014). *Capital in the twenty-first century* (A. Goldhammer, Trans.). Harvard University Press. DOI: 10.1017/S0047279415000616
[27] **Central Statistics Agency of Riau Province.** (2024). *Riau in figures 2024.* Pekanbaru: BPS Riau. https://riau.bps.go.id/id/publication/2024/02/28/b75ed69ddf689a2e23f46207/provinsi-riau-dalam- number-2024.html
[28] Savitri et al. (2021). *Statistik Multivariat Dalam Riset*. Bandung: Widina Bhakti Persada Bandung. https://repository.penerbitwidina.com/media/publications/351950-statistik-multivariat-dalam-riset-92b4ea8a.pdf