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Development and Disparities in Sumatra and the Factors Influencing Them

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Abstract: This study was conducted to analyze the influence of HDI, Road Stability, and Poverty Level on intra-provincial regional disparities in the Sumatra region during 2016-2025, using the Williamson Index as the dependent variable. This study uses secondary data obtained from the Central Bureau of Statistics throughout the Sumatra Island from 2016-2025. This study conducted an analysis with a quantitative approach by utilizing the panel data regression analysis method. The results of the study found the selected estimation model in the form of a Fixed Effect Model. It was found that HDI and Poverty Level had a negative and significant effect on intra-provincial regional disparities in the Sumatra region and Road Stability was found to have a significant positive effect on intra-provincial regional disparities in the Sumatra region in 2016-2025. Then simultaneously the variables of Human Development Index, Road Stability, and Poverty Level had a significant effect on intra-provincial regional disparities in the Sumatra region during the 2016-2025 period.

Keywords: Regional inequality, HDI, Road stability, Poverty level.

INTRODUCTION

The context of equitable national development is one of the four pillars initiated by the government and is considered essential to realizing the vision of a Golden Indonesia by 2045, the four pillars consists of from: 1) Human Development and Mastery Knowledge Knowledge and Technology, 2) Sustainable Economic Development, 3) Equitable Development, and 4) Strengthening National Resilience and Governance (Ministry of National Development Planning/Bappenas, 2019). Economic Development is a process that includes growth economy, poverty alleviation poverty, as well as decline inequality distribution income. Things This Can happen because existence difference from various aspects of each area so that cause regional inequality (Putri and Pitri, 2021).

In a way Geographically, Sumatra Island has very strategic position because its location is bordered direct with Bay Bengal on the side north, Sunda Strait on the side south, ocean Indies to the west, and the Strait of Malacca to the south the east which became track trading the busiest sea in the world. Besides its location its strategic geography, structure the economy

on the island of Sumatra shows level heterogeneity high spatial inter-provincial, where the basis of excellence non-oil and gas economy distributed in a way no evenly from sector agrarian, extractive, to industry modern manufacturing. According to the Gross Regional Domestic Product (GRDP) of Indonesian Provinces by Industrial Origin report published by Statistics Indonesia (BPS) (2024), the economies of western and southeastern Sumatra, including Aceh, North Sumatra, West Sumatra, Jambi, Bengkulu, and Lampung, rely heavily on the agriculture, forestry, and fisheries sectors. Meanwhile, regions such as South Sumatra and the Bangka Belitung Islands are dominated by extractive mining activities based on non-oil and gas natural resources. In contrast, a significant transformation in economic structure is evident in maritime border regions and industrial corridors such as Riau and the Riau Islands, where the manufacturing sector has overtaken the primary sector as the main driver of regional GRDP (Statistics Indonesia, 2024). The substantial diversity in non-oil and gas economic structures across these regions reflects differences in their economic specialization capacities, which may widen intra-provincial regional disparities across Sumatra during the 2016–2025 period if not accompanied by equitable development policies.

Diverse wealth this also has potential cause impact negative namely when every region in Sumatra has structure different economies, will trigger ability growth different economies every year the area. The difference ability growth economy This Then will push the imbalance income per capita or regional inequality in the Sumatra region if still its validity centers growth that makes other areas become isolated and difficult for chase lagging behind. This is supported by Kuznets' theory (1950) which states connection close growth economic and regional disparities are depicted in form inverted U curve. Kuznets stated that in the early days, growth economy precisely become reason the more size condition inequality because development at the stage This only concentrated on one point (Todaro and Smith, 2020).

For leveling growth economy in every area in the Sumatra region, can through effort development economy. One of the aspects that reflect success development economy is Human Development Index (HDI), as accumulation from aspect social economy public namely education, health as well as level eligibility life society. When the HDI is good spread to area around center growth, will help area the For optimize his wealth For chase backwardness from area center growth economy.

This diverse resource endowment may also have adverse effects, as differences in economic structures across regions in Sumatra can lead to varying levels of economic growth among these regions. This is due to the importance of convenience accessibility public in carry out activity social the economy that will impact big to total income or GRDP. Good way will open isolation of the area during this hinder public for access results growth economy, and provide choice better economy big to public.

Remember structure the economy of the Sumatra region, most of which big dominated by the primary sector with mark plus small, will impact no only on potential growth economy but on income society and capabilities public in fulfil need his life. Poverty is problem big in development economy, because poverty will cause quite a domino effect long during the development period. Poor communities have limitations in access education and health, while this are two things important in development (Todaro and Smith, 2020). Poverty become difficult circle for eliminated, the more Lots poor people then the more regional disparities are also large.

Important for analyze level inequality as well as factors that influence inequality in the Sumatra region, considering that area this including strategic areas as track trading with potential source Power rich and diverse nature. With know condition inequality as well as the cause expected can give description about policies that should be taken by the government area related so that existing potential can maximized and capable distributed with more fair as well as evenly.

Furthermore, numerous previous studies have examined regional inequality using economic development sectors as independent variables. Research by Harahap et al. (2022) who used combination variables free in the form of HDI, Growth Rate Population and Economic Growth, found that the HDI is not own influence to inequality development in North Sumatra Province. Then research by Hartati (2019) with combination variables free in the form of Human Development Index, Road Stability, Domestic Investment and Foreign Investment, found that HDI variable has an influence negative significant temporary variables the stability of the road is precisely correlated positive and impactful significant to Inter-Provincial Inequality in Indonesia. Research by Fatryna (2021) with combination variables free in the form of Poverty, HDI and Economic Growth, found that Poverty seen influential negative No significant to regional disparities between provinces on Sulawesi Island while the Human Development Index (HDI) is actually enlarge inequality or influential positive significant to inequality between provinces on Sulawesi Island.

See findings before and still limited research that examines regional disparities with combination variables free from all three namely Human Development Index, Road Stability and Poverty so researchers interested For do study This with lift title "Regional Development and Disparities in Sumatra and the Factors that Influence Them" with use combination variables free in the form of Human Development Index, Road Stability and Poverty Level.

Literature Review

Regional Inequality Theory

This study positions Kuznets' 1955 theory as the main theoretical basis (*grand theory*) for analyzing the dynamics of the relationship between economic expansion and the phenomenon of spatial inequality. This theoretical formulation, initiated by Kuznets, proposes the *inverted U-curve hypothesis*, which projects that the initial phase of economic growth and economic development tends to trigger a surge in inequality. However, once the wheels of development reach a more mature stage, these disparities will gradually be reduced as the distribution of development outcomes becomes more proportional (Todaro and Smith, 2020) .

Concept Theory Regional Disparities

Regional inequality is conceptualized as a spatial finding when economic acceleration is not distributed evenly and comprehensively, thus triggering multidimensional disparities that encompass people's standard of living, the quality of public facilities, income accumulation, and accessibility to basic services (Sjafrizal, 2021). From a regional economic perspective, this asymmetry is generally triggered by heterogeneity in natural resource potential, inequality in workforce quality, disparities in investment levels, and spatial bias in development allocation policies. Causality theory cumulative formulated by Gunnar Myrdal postulates that dynamics regional economy tends to will move to direction absence balance. This is happen Because core (advanced) area has Power pull away more superior in absorb current investment, technology transfer, and migration power Work productive rather than peripheral areas (Sjafrizal, 2021) .

Regional Development Theory

1. *Growth* pole theory
   The growth pole theory, developed by French economist François Perroux in 1955, explains the uneven distribution of economic growth across regions. Furthermore, its focus is on specific regions, specifically those with comparative and competitive potential. According to Perroux, the leading economic sectors in a region will drive growth, which will then spread to other regions (Jumino, 2021) .
2. Human Capital Theory

The increase in the Human Development Index (HDI), which includes education and health, is a manifestation of investment in human capital. This concept is based on the human capital theory proposed by Theodore W. Slutch in 1961, which was later developed by Gary S. Backer in 1964. This theory essentially asserts that investment in the mental and physical qualities of humans is far more important for driving the economy when compared to physical investment in land or machinery.

3. Infrastructure Theory
   Hirschman's 1958 theory of infrastructure development, commonly known as the *Social Overhead Capital* (SOC) concept, asserts that the provision of basic public goods, such as safe roads, is essential for stimulating regional economies. In the context of this research, the variable of road stability is used to reflect the quality of SOC in the Sumatra region.
4. Regional Accessibility Theory
   This theory basically measures the level of convenience, comfort and efficiency of space in connecting people with locations of economic activity, this theory was pioneered by Black in 2003. In contemporary regional economics, the low level of physical accessibility due to poor road infrastructure is the main cause of an area being in a poverty trap (Bird and Higgins, 2016) .

METHODS

Study this us approach descriptive quantitative with analysis panel data regression. Research The study was conducted in 10 provinces on the island of Sumatra, namely Aceh, North Sumatra, West Sumatra, Riau, Riau Islands, Jambi, Bengkulu, South Sumatra, Bangka Belitung, and Lampung. Start conducted in August 2025 with using data for 10 years, calculated from 2016–2025. Population study covers all over province on the island of Sumatra, with sample as many as 10 designated provinces based on research area coverage. Data used is secondary data obtained from publications of the Central Statistics Agency (BPS) and agencies related, in the form of data on GRDP per capita, Human Development Index (HDI), stability road, and level poverty. Data collection techniques were carried out through studies library and documentation with collect statistical data from the official BPS website and source related other. Variables dependent in the form of measured regional inequality use The Williamson index is based on GRDP per capita and the number of resident district/city in each province, while variables independent consists of on HDI, stability road, and level poverty. Data analysis was carried out through analysis descriptive quantitative For count Williamson Index using Microsoft Excel 2010 and analysis panel data regression using EViews 12. Selection of regression model done through Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM) approaches, with Chow, Hausman, and Lagrange Multiplier tests. Next , assumption tests were carried out classical tests which include multicollinearity, heteroscedasticity, and autocorrelation tests, as well as statistical tests in the form of F test, t test, and coefficient determination (R^2) for know influence of HDI, stability road, and level poverty to regional inequality on the island of Sumatra.

RESULTS AND DISCUSSION

Research result

Intra-Regional Inequality in Sumatra Provinces 2016-2025

Table 1. Results of the Williamson Index Calculation for Provinces in the Sumatra Region for 2016-2025.

Classification	Province	Regional Disparities Year									
		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Low	Bangka Belitung	0.19	0, 20	0, 19	0, 21	0.18	0.19	0.18	0, 18	0, 19	0, 18

Classification	Province	Regional Disparities Year									
		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
	Riau	0.22	0.22	0.22	0.21	0.21	0.21	0, 2 1	0, 2 1	0, 2 4	0, 2 2
	Lampung	0.30	0, 2 8	0.31	0.30	0.26	0, 2 5	0.23	0, 2 6	0, 2 7	0, 2 6
	Jambi	0.34	0.34	0.33	0.33	0.30	0.27	0.26	0.26	0.26	0.27
Currently	West Sumatra	0, 30	0, 27	0, 32	0, 27	0, 28	0, 31	0, 31	0, 30	0.32	0.31
	Riau Islands	0.39	0.36	0.39	0.33	0.35	0.36	0, 3 6	0.37	0, 3 7	0.36
	Aceh	0.40	0, 39	0.40	0, 4 0	0, 41	0, 4 3	0, 43	0, 44	0.45	0, 4 2
	Bengkulu	0, 40	0, 44	0, 40	0, 40	0, 42	0, 42	0, 44	0.45	0, 44	0, 42
	North Sumatra	0.45	0.45	0.46	0.46	0.43	0.44	0.45	0.44	0.44	0.45
Tall	South Sumatra	0.56	0.57	0.57	0.58	0.56	0.58	0.59	0.59	0.60	0.60

Source: Processed data, 2026.

Analysis results show that inequality intra- provincial development on Sumatra Island during 2016–2025 experienced fluctuations with level different disparities. Based on Williamson Index, Bangka Belitung has inequality lowest with index ranged from 0.18 to 0.21, followed by Riau (0.21 to 0.24), Lampung (0.23 to 0.31), and Jambi (0.26 to 0.34). Meanwhile, that, West Sumatra, Riau Islands, Aceh, Bengkulu, and North Sumatra show disparity moderate, while South Sumatra has inequality highest with index increase from 0.56 in 2016 to 0.60 in 2025. The difference the reflect regional characteristics and structure an economy that is not same. Structure The economy of Bangka Belitung, Riau, Lampung and Jambi is supported by several sector main, especially agriculture, industry processing, trade and mining, while South Sumatra has domination sector potential mining and quarrying cause concentration mark add to area certain. Difference in GRDP per capita between districts/cities also shows existence gap capacity economy, such as in South Sumatra between Muara Enim and Empat Mace and in North Sumatra between Medan City and South Nias. Overall, results the show that diversity structure economy, differences productivity and concentration activity economy become description important in understand disparity intra- provincial development on Sumatra Island during period study.

Model Specification Test Results

Chow Test Results

Table 2. Chow Test Results

Effects Test	Statistic	d.f.	Prob.
Cross-section F	213.268441	(9,87)	0.0000
Cross-section Chi-square	313.819719	9	0.0000

Source: Panel Data Processing Results with Eviews12, 2026

In table 2 above, the results of the Chow Test show a *cross-section probability figure* F of 0.0000 < 0.05, so it can be concluded that H0 is rejected, meaning the selected estimation model is *the fixed effect model.*

Hausman Test Results

Table 2. Hausman Test Results

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	18.032650	3	0.0004

Source: Panel Data Processing Results with Eviews12, 2026

Based on table 3 above, the results of the Hausman Test obtained a *Chi-square probability value* of 0.0004 < 0.05 or α = 5%, so it is concluded that H1 is accepted and H0 is rejected and the selected estimation model is *the Fixed effect model*. Because in the Chow Test and the Hausman Test it was decided that the best selected estimation model was *the fixed effect model*, so that the Lagrange Multiplier test (LM Test) is no longer necessary.

Table 3. Summary of Panel Data Regression Results *of Fixed Effect Model*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.620159	0.141848	4.372000	0.0000
IPM	-0.003532	0.001518	-2.326769	0.0223
Kemantapan Jalan	0.000683	0.000311	2.196319	0.0307
Tingkat Kemiskinan	-0.006651	0.003517	-1.891189	0.0619
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.976793	Mean dependent var		0.350400
Adjusted R-squared	0.973592	S.D. dependent var		0.115031
S.E. of regression	0.018693	Akaike info criterion		-5.000587
Sum squared resid	0.030401	Schwarz criterion		-4.661915
Log likelihood	263.0294	Hannan-Quinn criter.		-4.863521
F-statistic	305.1582	Durbin-Watson stat		1.126903
Prob(F-statistic)	0.000000			

Source: Panel Data Processing Results with Eviews12, 2026

Classical Assumption Test Results
Multicollinearity Test Results

Table 5. Multicollinearity Test Results

Independent Variables	Centered VIF	Information
X_{1IPM}	2.657215	There is no multicollinearity
$X_{2Road\ Stability}$	1.194436	There is no multicollinearity
$X_{3\ Poverty\ Level}$	2.810769	Not occur multicollinearity

Source: Panel Data Processing Results with Eviews12, 2026

In table 5 above, it can be seen from the test results that the Centered VIF value for the independent variable $X_{1\ HDI}$ is 2.657215 < 10, $X_{2\ Road\ Stability}$ is 1.194436 < 10, and $X_{3\ Poverty\ Level}$ is 2.810769 < 10. From the results of this multicollinearity test, it can be said that there is no multicollinearity problem in the research model.

Heteroscedasticity Test Results

Table 4. Modified Wald Heteroscedasticity Test Results

Heteroscedasticity Test	Wald Statistics	df	Chi-Square Prob.	decision
Modified Walt Test	225.0850	10	9.21E-43	H0 is rejected

Source: Panel Data Processing Results with Eviews12, 2026

From table 6 the results of the heteroscedasticity test show that the Chi-square probability value is 9.21E-43 or 9.2 x $^{10-43}$ when compared with an error degree of 5% or 0.05, the Chi-Square Probability is 9.21E-43 <0.05. Referring to these results, H0 is rejected and H1 is accepted with the conclusion that there are symptoms of heteroscedasticity in the research model.

Autocorrelation Test Results

Table 5. Wooldrige Autocorrelation Test Results Using *the First Difference Approach*

Test Statistic	Value	df	Probability
t-statistic	1.526446	78	0.1309
F-statistic	2.330039	(1, 78)	0.1309
Chi-square	2.330039	1	0.1269

Source: Panel Data Processing Results with Eviews12, 2026

In table 7 above, the results of the autocorrelation test in the form of the Wooldrige Test found an F-statistic value of 2.330039 with an F-statistic probability value of 0.1309, when compared with a significance level of 5% or 0.05, then 0.1309 > 0.05, so that H0 is accepted and H1 is rejected. Thus, it can be concluded that there is no autocorrelation or *serial correlation* in the *Fixed Effect model* in this study.

From a series of classical assumption tests, it was concluded that the model exhibited heteroscedasticity, necessitating special treatment in the form of *the Robust Standard Error White Cross-Section(period cluster).* The use of *Robust Standard Error* is recommended in applied econometrics to ensure robust t-statistics and probability values are used to draw conclusions (Basuki and Prawoto, 2023) .

Table 6. Summary of Panel Data Regression Estimation *Fixed Effect Model* with *Robust Enabling.*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.620159	0.138641	4.473135	0.0000
IPM	-0.003532	0.001512	-2.335884	0.0218
Kemantapan Jalan	0.000683	0.000270	2.533068	0.0131
Tingkat Kemiskinan	-0.006651	0.003103	-2.143353	0.0349
Effects Specification				
Cross-section fixed (dummy variables)				
R-squared	0.976793	Mean dependent var		0.350400
Adjusted R-squared	0.973592	S.D. dependent var		0.115031
S.E. of regression	0.018693	Akaike info criterion		-5.000587
Sum squared resid	0.030401	Schwarz criterion		-4.661915
Log likelihood	263.0294	Hannan-Quinn criter.		-4.863521
F-statistic	305.1582	Durbin-Watson stat		1.126903
Prob(F-statistic)	0.000000			

Source: Panel Data Processing Results with Eviews12, 2026.

From table 8, the panel data regression equation is obtained as follows:

$$Y = 0.620159 - 0.00352 X_{1PM} + 0.000683 X_{2Road\ Stability} - 0.006651 X_{3\ Poverty}$$

From the panel data regression equation above, the values can be explained in relation to the dependent variable as follows:

1. With a coefficient value of "C" of 0.620159, it can be interpreted that when all independent variables, namely the Human Development Index (HDI), Road Stability, and Poverty Level, are zero or constant, then the regional disparity in the Sumatra region is 0.620159 or 0.62. This figure provides information that regional disparities in the Sumatra region during 2016-2025 are basically influenced by other things outside the variables included in the equation model in this study.
2. The coefficient on the variable X_1 HDI is found to be -0.003532, so it can be interpreted that every 1 point increase in HDI will reduce Regional Disparity in the Sumatra Region in 2016-2025 by 0.003532 units, assuming the condition of other variables is constant (*cateris paribus*).
3. Coefficient on variable X_2 Road Stability was found to be 0.000683, so it can be interpreted that every increase in Road Stability of 1 percentage point increases Regional Disparity in the Sumatra Region in 2016-2025 by 0.000683 units, assuming the condition of other variables is constant (*cateris paribus*).
4. Coefficient on variable X_3 Poverty Level was found to be 0.006651, so it can be interpreted that every decrease in the Poverty Level by 1 percentage point increases Regional Disparity in the Sumatra Region in 2016-2025 by 0.006651 units, assuming the condition of other variables is constant (*cateris paribus*).

Statistical Test Results

Simultaneous Test Results (F Test)

The F test is run to see the overall effect of independent variables on the dependent variable together, this test can be done by comparing the calculated F value and the F table with the following provisions (Irfan Syahroni, 2023) :

1. If the calculated f value < f table, then the independent variable does not have a significant effect on the independent variables simultaneously;
2. If the calculated f value > f table, then the independent variable has a significant effect on the dependent variable simultaneously.

In table 8, it is found that the results of the F test show that the F-statistic value > F-table (305.1582 > 2.71) and the prob (F-statistic) is 0.000000 < 0.05, so it can be said that simultaneously all X variables, in this case the Human Development Index, Road Stability, and Poverty Level, have a significant effect on the Y variable or Intra-Regional Development Inequality in Sumatra Provinces during 2016-2025:

Partial Test Results (T-Test)

Partial tests are used to determine the effect of each independent variable on the dependent variable. The decision to accept the hypothesis is based on the probability p-value of each variable, which indicates the error rate at the constant t-value obtained. If the probability p-value is significant <α, then the independent variable is declared to have a significant effect on the dependent variable (Irfan Syahroni, 2023).

Based on the results of panel data regression analysis with *the Fixed Effect Model estimation model,* the influence of the independent variables Human Development Index, Road

Stability, and Poverty Level on the dependent variable, namely Intra-provincial Development Inequality in Sumatra, is as follows:

1. The Human Development Index on Development Inequality has a t-value of -2.335884 with a significant value of 0.0218, when compared with a degree of error of 5% or 0.05, the significance value is greater than the degree of error value (0.0218 <0.05), so that the research results show that the Human Development Index has a significant negative effect on Intra-provincial Development Inequality in the Sumatra Region in 2016-2025.
2. Road stability on development inequality gets a t-value of 2.5330368 with a significant value of 0.0131, which when compared with the error degree value of 5% or 0.05 is said that the significance value is smaller than the error degree value (0.0131 <0.05), then from the results of data processing it is known that Road stability has a positive and significant effect on Intra-provincial Development Inequality in the Sumatra Region in 2016-2025.
3. The Poverty Level on Development Inequality has a t-value of -2.143353 with a significance value of 0.0349, when compared with a degree of error of 5% or 0.05 the significance value is smaller than the degree of error value (0.0349 < 0.05), so information is obtained that the Poverty Level has a significant negative effect on Intra-provincial Development Inequality in the Sumatra Region in 2016-2025.

Determinant Coefficient (R^2)

The determinant coefficient (R^2) is used to determine the accuracy or suitability of the independent variables and dependent variables in a regression equation, the R^2 value is between 0 and 1. If it is found that the R^2 value = 1, this indicates that 100% of the total variation is explained by the independent variable, or in other words X_1, X_2, and X_3 are able to explain the Y variable by 100%. The opposite condition if the R^2 value=0, this indicates that there is no total variance that can be explained by the independent variables in the regression equation (Irfan Syahroni, 2023).

From the data processing results table in table 5.8, it is known that the *Adjusted R-square value* is 0.973592 or it can be said that the combination model of independent variables in the form of HDI, Road Stability and Poverty Level is able to explain around 97.36% of the variation in intra-provincial development inequality in the Sumatra Region during 2016-2025, meanwhile, the remaining 2.64% can be explained by other variables outside this study.

Discussion

Influence Human Development Index, Road Condition and Poverty Rate To Regional Disparities in the Sumatra Region 2016–2025

Testing in a way simultaneous in study This aim For identify influence of HDI, stability road, and level poverty in a way together to regional disparities on the island of Sumatra. From the summary results regression in table 5.8 found The Prob value (F-statistic) is 0.000000 < 0.05, meaning overall variables free own influence significant to regional disparities in the Sumatra Island region in 2016–2025. If reviewed from mark *Adj. R-square* of 0.973592 indicates that combination variables free in the form of Human Development Index, Road Stability and Poverty Level capable explain change level less regional disparity more amounted to 97.36%, while 2.64% was explained by other variables outside study This.

Findings this can caused by several things that happened later produce influence significant in a way simultaneous third variables free which is together in influence movement inequality *intra- provincial* in the Sumatra region during ten year last. Relationship structural This is also reinforced by the theory Endogenous growth by Paul Romer 1986 in Wijayanto (2019), who positions human capital and infrastructure public as factor *multiplier effect* For speed up distribution results development economy so that can felt evenly distributed throughout the region. Hartati's research (2019) found that that combination variables free

Human Development Index and Road Infrastructure have an influence significant in a way simultaneous to *Intra- provincial* Regional Disparities in Indonesia period 2014–2018.

Influence Human Development Index To Development Inequality

Test results variables The Human Development Index (X1) found mark coefficient regression of -0.003532 with level significant of 0.0218 < 0.05. This means variables Human Development Index in a way partial influential negative to *Intra-provincial* Regional Inequality in the Sumatra Region during 2016–2025.

Research result This in line with human capital theory which was coined by Theodore W. Slutch in 1961 and studies continued by Gary S. Backer in 1964 which stated importance investment in improvements quality human physical and mental in effort push economy. Improvement Human Development Index every Provinces in Sumatra that continue experience increase during ten year final Already happen evenly and capable increase regional economy so that succeed tor lower inequality *intra- provincial* in the Sumatra Region during 2016–2025. Conditions the influence of HDI on inequality *intra-provincial* This different in accordance with characteristics and conditions of each province.

The development of the Human Development Index (HDI) of Aceh Province during 2016–2025 shows quite an improvement consistent, namely from 70.00 to 76.23. However, progress the Not yet followed by shrinkage regional disparities in general sustainable. The Williamson Index recorded by 0.40 in 2016, down to 0.39 in 2017, then experience increase up to 0.45 in 2024 before return to figure of 0.42 in 2025. In other words, the increase in the HDI at the level of province Not yet ensure that benefit development can felt in a way balanced by all regions in Aceh.

The development of the Human Development Index (HDI) of Jambi Province during 2016–2025 shows increase from 69.62 to 75.13. At the same time, the Williamson Index experienced decline from 0.34 to 0.27. This pattern show that improvement quality development humans in Jambi are taking place simultaneously with decrease regional disparities in some parts big period observation. On the other hand, the Human Development Index of South Sumatra Province increased from 68.24 in 2016 to 74.76 in 2025, while Williamson index rises from 0.56 to 0.60. This value is the highest among ten province in research at the end period observation. Condition the show that improvement quality development man in a way aggregate not yet followed by a decline regional disparities.

Study previously conducted by Arthalla and Bintoro (2023) and Handayani (2025) found that productivity sector production as reflected by the rate growth economics and values Real GRDP will be greatly influenced by regional human capital. The quality of source Power capable human being become factor determinant tall low regional economy .

Influence Road Stability Against Development Inequality

Test results variables Road Stability (X2) has mark coefficient regression positive of 0.000683 with level significant of 0.0131 < 0.05. Can it is said that variables road stability has an impact positive and significant to *Intra- provincial* Development Inequality in the Sumatra Region during 2016–2025.

The regression results, which indicate that road stability has a significant positive effect on the Williamson Index, can be understood through Perroux’s growth pole theory and Myrdal’s "backwash effect." In this context, infrastructure development within an already unequal space does not automatically foster equity; rather, it reinforces the dominance of the center. Stable, well-maintained roads function in two directions: while they may facilitate the spread of development from the center to the periphery (the "spread effect"), they simultaneously ease the reverse flow of productive resources—such as young labor, capital, and output—from the periphery back to the center. Because road development tends to be

prioritized in areas that have already emerged as growth poles—driven by high economic demand and the region's fiscal capacity—the resulting benefits are absorbed asymmetrically.

These findings align with studies by Siahaan et al. (2021) and subsequently Prasetyo and Firdaus (2022), which discovered that road infrastructure in Indonesia actually widens interregional inequality; this is because the gains in accessibility are primarily enjoyed by regions with a modern economic base and industrial agglomerations, whereas peripheral areas merely serve as suppliers of inputs without undergoing any structural transformation.

In the Sumatra region, areas with relatively robust economic activity are better positioned to leverage improved road conditions compared to areas where economic activity remains limited. If this disparity in benefits drives an economic development gap between regencies or cities, regional inequality—as reflected by the Williamson Index—may widen, even as road infrastructure conditions improve. Consequently, the positive correlation between road infrastructure stability and economic outcomes in this study suggests that enhancements in infrastructure quality do not necessarily lead to a more equitable distribution of development benefits across regions.

In the Sumatra region, the area with activity relative economy strong potential utilise condition the road is getting narrower Good in a way more optimal than area of activity the economy still limited. With thus, the influence positive stability road in study This show that improvement quality infrastructure Not yet Of course followed by equalization results development interregional.

In South Sumatra, the level disparity still tall when stability road return reach more from 90%. Condition This show that condition good road at the level province not yet enough for ensure equality results development. Muara Enim including area with GRDP per capita relatively high, whereas Four Mace be in position lowest. Therefore that, one of indication the problem in South Sumatra is that improvement quality infrastructure not yet followed by equalization ability economy and productivity interregional.

Stability roads in Bengkulu are experiencing quite an improvement consistent, from 42.08% in 2016 to 77.23% in 2025. However, improvements the Not yet followed decline disparity in a way consistent. The Williamson Index recorded by 0.40 in 2016, then reach 0.45 in 2023 before down to 0.42 in 2025. The difference direction development second indicator this show that improvement quality road not yet of course direct produce equality economy interregional.

Findings study This in line with Hartati's study (2019) and research Anin Nabail Azim et al. (2022). Second studies the show that infrastructure road own influence positive and significant to inequality development interregional based on measurement Williamson Index. This result indicates that improvement infrastructure road no necessarily reduce inequality. This can happen because benefit development accepted path every area varies, depending on conditions as well as ability the economy of each region.

The Influence of Poverty Levels to Development Inequality

Test results variables level poverty (X3) has mark coefficient regression negative of -0.006651 with mark significance of 0.0001. The estimated results *Fixed Effect Model* (FEM) shows that level poverty influential negative and significant to Williamson Index on Sumatra Island during period 2016–2025. The results show that decline level poverty related with improvement regional disparities in research models.

The estimation results from the Fixed Effect Model (FEM) indicate that the poverty rate has a negative and significant impact on the Williamson Index on the island of Sumatra during the 2016–2025 period. This suggests that a decline in the poverty rate is associated with an increase in regional disparity within the research model. This negative and significant effect can be understood through Friedmann’s (1966) core-periphery theory and the theory of

unbalanced growth pioneered by Hirschman (1958). The reduction in poverty does not occur uniformly; rather, it is concentrated in growth centers characterized by service- and industry-based economic structures, better access to poverty-alleviation programs, and significantly higher growth rates in Gross Regional Domestic Product (GRDP) per capita. In these areas, poverty reduction translates into increased income and capital accumulation. Conversely, in peripheral regions—which are often reliant on subsistence agriculture—a decline in poverty merely signifies that individuals have moved above the poverty line, without a corresponding increase in productivity.

This situation is reinforced by a study by Lessmann and Seidel (2017), as well as research in Indonesia by Akita and Miyata (2020), which indicate that poverty alleviation—if not accompanied by an equitable distribution of economic opportunities across regions—will exacerbate disparities. This occurs because the rate of economic growth in core hubs outpaces the ability of peripheral areas to catch up. A clear illustration of the regression results can be seen in the data for South Sumatra, where the poverty rate declined from 13.39 percent in 2016 to 9.85 percent in 2025, while the Williamson Index rose from 0.56 to 0.60. This suggests that improvements in public welfare can occur alongside widening regional disparities, although this relationship should not be interpreted as direct evidence of a causal link.

Phenomenon the seen in South Sumatra, when level poverty decrease from 13.39 percent in 2016 to 9.85 percent in 2025, while Williamson index rises from 0.56 to 0.60. Condition This show that repair welfare public can happen simultaneously with increasing regional disparities, although connection the no can interpreted as proof cause and effect in a way direct.

Relative conditions different seen in the Province Riau Islands, which shows decline level poverty from 5.84 percent in 2016 to 4.26 percent in 2025, accompanied by with decline Williamson Index from 0.39 to 0.36. Development This indicates existence repair ongoing prosperity simultaneously with decrease inequality regional development. In Jambi Province, the level of poverty decrease from 8.37 percent in 2016 to 6.89 percent in 2025, while The Williamson index experienced decline from 0.34 to 0.27. Both development the show repair condition ongoing poverty simultaneously with decline inequality regional development.

Meanwhile, Lampung Province recorded decline level poverty from 13.86 percent in 2016 to 9.66 percent in 2025, which is accompanied by with decline Williamson Index from 0.30 to 0.26. Development This show that decline poverty ongoing simultaneously with decrease inequality regional development. Research results Pangareban et al. (2025) showed that level poverty own influence negative and significant to inequality income in Indonesia. Similar findings were also obtained Harahap et al. (2020) in research in North Sumatra Province, which found that poverty influential negative and significant to disparity income based on Williamson Index. Second study the support results study this is what shows existence influence negative and significant level poverty to inequality regional development on the island of Sumatra during 2016–2025 period.

CONCLUSION AND RECOMMENDATIONS

Conclusion

Based on results research, *intra- provincial* regional disparities on the island of Sumatra during the period 2016–2025 measured use The Williamson index shows trend fluctuating with level diverse disparities. The provinces of Bangka Belitung, Riau, Lampung, and Jambi have disparity low, West Sumatra, Riau Islands, Aceh, Bengkulu, and North Sumatra have disparity moderate, while South Sumatra has level inequality highest. The results of panel data analysis using the *Fixed Effect Model* (FEM) show that the HDI and the level of poverty in a way partial influential negative and significant to regional disparities, whereas stability road influential positive and significant. In terms of simultaneous, third variables the influential significant to regional disparities with ability explains the model by 97.36%.

Suggestion

1. Suggestions for Government

   Government provinces on the island of Sumatra need integrate improvement quality source power human, development infrastructure roads, and mitigation poverty with notice characteristics as well as potential every area. Improvement access education, health, and skills need followed with development road connecting remote areas with center production, area processing, and markets. In addition, the development of industry processing, MSMEs, and diversification activity economy based potential local need strengthened for increase mark add, expand field work, and reduce dependence to sector economy certain. The government also needs to do monitoring Williamson Index together indicator welfare public for identify areas that are still left behind and decisive priority development in a way appropriate.

2. Suggestions for Researchers Furthermore

   Researchers furthermore expected can consider variables potential additions influence inequality regional development, such as investment, level unemployment, agglomeration economy and shopping government area. Development research can also done with extend period observation or use approach different analysis for get a clearer picture deep about dynamics inequality on the island of Sumatra. This based on values *Adjusted R-squared* amounting to 97.36%, while the remaining 2.64% explained by factors outside the research model.

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