**CONVERGENCE : THE JOURNAL OF ECONOMIC DEVELOPMENT**
Vol.6, No.1, pp.70-89, June 2024

**e-ISSN 2721-625X**
**ISSN 2721-6330**

# DRIVERS OF DEVELOPMENT INEQUALITY IN NORTH SUMATRA: ECONOMIC GROWTH, AGGLOMERATION, HUMAN DEVELOPMENT INDEX AND GOVERNMENT EXPENDITURE

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***ABSTRACT***

*Regional development disparities among cities in North Sumatra remain a crucial issue in regional economics, impacting uneven growth and societal welfare. This study analyzes urban development inequality in eight cities in North Sumatra from 2011 to 2023 using the Williamson Index (IW) and panel data regression analysis. The findings indicate that the average regional development inequality is moderate, with an IW value of 0.31, though significant disparities exist among cities. Medan exhibits the highest inequality (IW = 0.836) due to economic dominance and urbanization concentrated in trade and industry sectors, while Pematang Siantar records the lowest inequality (IW = 0.054) with more balanced development distribution. Simultaneously, economic growth, the Human Development Index (HDI), agglomeration, and local government capital expenditure significantly influence regional disparities. However, in a partial analysis, only HDI (p = 0.0092) and agglomeration (p = 0.000) are found to have a significant impact, whereas economic growth and government capital expenditure do not show a significant effect. These findings highlight that economic agglomeration is the most dominant factor exacerbating inequality, while an increase in HDI tends to widen disparities if development distribution remains uneven. Therefore, more effective policies are needed, such as redistribution of investment based on HDI, optimization of capital expenditure allocation for infrastructure in underdeveloped areas, and economic incentives to promote more balanced growth beyond Medan.*

*Keywords: Regional Inequality, Economic Growth, Human Development Index, Agglomeration, Government Capital Expenditure*

***ABSTRAK***

*Kesenjangan pembangunan regional di antara kota-kota di Sumatera Utara tetap menjadi masalah penting dalam ekonomi regional, yang berdampak pada pertumbuhan yang tidak merata dan kesejahteraan masyarakat. Penelitian ini menganalisis ketimpangan pembangunan perkotaan di delapan kota di Sumatera Utara dari tahun 2011 hingga 2023 menggunakan Williamson Index (IW) dan analisis regresi data panel. Temuan menunjukkan bahwa rata-rata ketimpangan pembangunan daerah sedang, dengan nilai IW 0,31, meskipun ada kesenjangan yang signifikan antar kota. Medan menunjukkan ketimpangan tertinggi (IW = 0,836) karena dominasi ekonomi dan urbanisasi yang terkonsentrasi pada sektor perdagangan dan industri, sedangkan Pematang Siantar mencatat ketimpangan terendah (IW = 0,054) dengan distribusi pembangunan yang lebih seimbang. Secara bersamaan, pertumbuhan ekonomi, Indeks Pembangunan Manusia (IPM), aglomerasi, dan belanja modal pemerintah daerah secara signifikan mempengaruhi kesenjangan regional. Namun, dalam analisis parsial, hanya IPM (p = 0,0092) dan aglomerasi (p = 0,000) yang ditemukan memiliki dampak yang signifikan, sedangkan pertumbuhan ekonomi dan belanja*

**e-ISSN 2721-625X**
**ISSN 2721-6330**

*modal pemerintah tidak menunjukkan efek yang signifikan. Temuan ini menyoroti bahwa aglomerasi ekonomi adalah faktor paling dominan yang memperburuk ketimpangan, sementara peningkatan IPM cenderung memperlebar kesenjangan jika distribusi pembangunan tetap tidak merata. Oleh karena itu, diperlukan kebijakan yang lebih efektif, seperti redistribusi investasi berbasis IPM, optimalisasi alokasi belanja modal untuk infrastruktur di daerah tertinggal, dan insentif ekonomi untuk mendorong pertumbuhan yang lebih seimbang di luar Medan.*

***Kata Kunci:*** *Ketimpangan Pembangunan, Pertumbuhan Ekonomi, Indeks Pembangunan Manusia, Aglomerasi, Belanja Modal Pemerintah*

## INTRODUCTION

Development inequality between regions is a fundamental issue in regional economics that can exacerbate social and economic inequality (Todaro & Smith, 2020). Development is a process that continues to develop to improve people's welfare, but in its implementation it often causes inequality, both between regions, social, and economic. Development inequality in Indonesia, including in North Sumatra, is an important issue that requires serious attention. North Sumatra, as one of the major provinces in Indonesia, has abundant natural resource potential and high cultural diversity. However, despite this potential, the distribution of development between coastal, urban, and inland areas is often uneven. According to regional development theory, this inequality occurs due to disparities in access to resources, infrastructure, and economic opportunities. David Harvey in the theory of "Spatial Justice" proposes that uneven development can lead to social injustice. In addition, Simon Kuznets' theory of economic growth also shows that in the early stages of development, inequality tends to increase before finally decreasing along with more equitable economic development. This condition becomes relevant in the context of North Sumatra, which faces major challenges in creating inclusive and sustainable development.

The research on development inequality in North Sumatra is important because it can provide a clear picture of the factors that cause such inequality. One of the indicators that shows the existence of development inequality in North Sumatra is the Williamson Index. This index measures income inequality between regions within a province or country. The data shows that the Williamson Index in North Sumatra is higher than that of Sumatra as a whole, indicating a greater inequality of development in the province. This higher figure shows that the difference between the more developed and underdeveloped regions in North Sumatra is quite significant, both in terms of economy, infrastructure, and access to

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public services. The comparison level of the Williamson Index of North Sumatra and the national average can be seen in Figure 1.

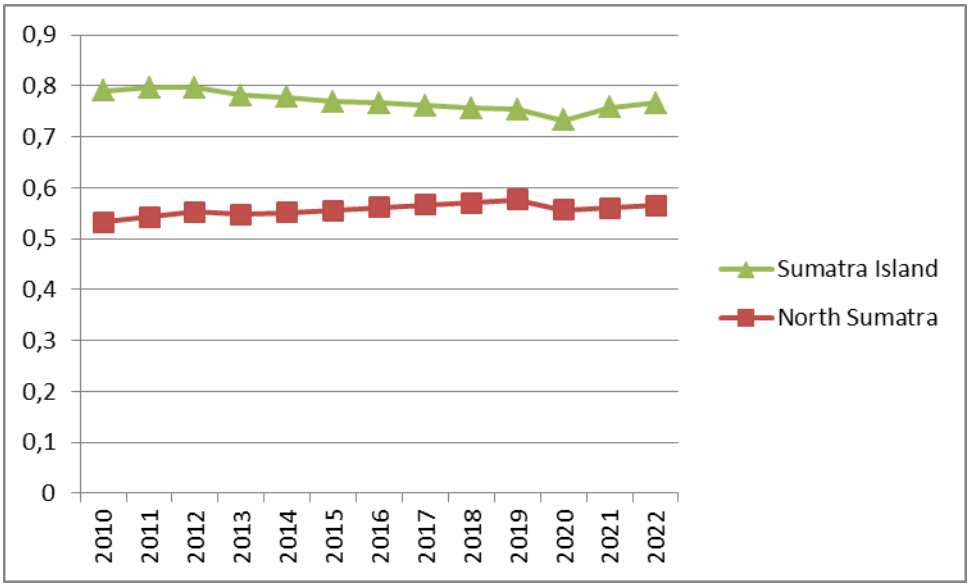


**Figure 2:** Comparison trend chart of the Development Inequality Index between North Sumatra and Sumatra Island 2010-2022 period
*Source : Central Statistics Bureau*

The trend of development inequality in North Sumatra during the 2010-2022 period showed fluctuations indicating that despite efforts to equalize development, disparities between regions are still persistent. Some regions experienced rapid economic growth, while other regions lagged behind in various aspects of development. This phenomenon is in line with the findings of Kiton (2019) which stated that several regions in this province experienced rapid economic growth, while other regions lagged behind in various aspects of development. Williamson Index data shows that development inequality in North Sumatra is consistently higher than the national average during the period 2010-2022. In North Sumatra, the inequality index increased from 0.532 in 2010 to 0.565 in 2022, with a peak in 2019 (0.576). This indicates that the development gap between cities in North Sumatra is widening, indicating an uneven distribution of development. In contrast, nationally, the development inequality index has experienced a downward trend from 0.258 in 2010 to 0.201 in 2022, reflecting improvements in development equity at the national level. This trend shows that although nationally development inequality is decreasing, North Sumatra still faces major challenges in efforts to equalize development between regions. Even some cities in North Sumatra such as Medan recorded very high

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inequality values (IW = 0.836), while cities such as Pematang Siantar had lower inequality (IW = 0.054).

Furthermore, this inequality of development has an impact on the quality of life of the community, where most people in rural and border areas experience difficulties in accessing education, health, and decent work. As a result, many regions lag behind the economic centers in major cities, which in turn exacerbates socio-economic disparities between regions. By looking at these problems, research on development inequality in North Sumatra is very important. This research will help to understand the root of the problem of development inequality, provide policy recommendations to reduce inequality, and accelerate the process of equitable development in this area.

In Indonesia, especially in North Sumatra Province, this inequality is clearly visible through the disparity in welfare levels between districts and cities. Indicators such as the Human Development Index (HDI), the level of economic agglomeration, local government capital expenditure, and economic growth are often used to measure this disparity. Data from the Central Statistics Agency shows that in 2010, the Gross Regional Domestic Product (GRDP) of North Sumatra at constant 2010 prices reaching IDR 331.09 trillion. In 2023, the GRDP will increase to IDR 573.53 trillion, with a growth rate of 5.01% in 2023 compared to the previous year. Despite significant economic growth, development inequality between regions is still a major challenge.

This difference reflects a development pattern that is concentrated in large cities that have better access to infrastructure and economic investment, while other areas experience stagnation due to limited resources and low accessibility. This inequality can be seen from key indicators such as economic growth, the Human Development Index (HDI), the level of economic agglomeration, and local government capital expenditure, which theoretically and empirically it has been proven to have a close relationship with development inequality (Jhingan, 2012; Tarigan, 2009). The phenomenon of industrial agglomeration in several large cities such as Medan and Binjai shows that the concentration of economic activity can drive growth, but also has the potential to worsen inequality if not accompanied by equitable development policies (Chrisetyoningrum, 2022). In the context of North Sumatra, factors such as regional government capital expenditure have an important role in determining the distribution of infrastructure and public services that can

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ISSN 2721-6330

narrow the development gap (Regulation of the Minister of Home Affairs No. 13 of 2006). However, the effectiveness of this capital expenditure is still debated, given the differences in fiscal capacity between more developed and underdeveloped regions (Bonet, 2006). Several previous studies have shown that economic growth is not always directly proportional to the distribution of welfare, so further studies are needed on the variables that contribute to development inequality (Ketut Patra, 2022). Therefore, understanding the factors that contribute to this inequality is very important for the formulation of more inclusive economic policies. By considering these various aspects, this study aims to analyze the development inequality between regions in North Sumatra during the period 2011-2023 using the panel data regression approach and the Williamson index. This study will explore how the variables of HDI, agglomeration, local government capital expenditure, and economic growth affect development inequality in the province of North Sumatra.

## LITERATURE REVIEW

Based on economic base theory, the growth of a region depends on the base sector (the sector that produces output for the external market). Inequality arises when only a few regions have strong base sectors, thus attracting investment, labor, and resources from other regions, creating a pattern of economic agglomeration. Meanwhile, based on growth pole theory, the economic growth does not occur evenly, but is concentrated in growth centers called growth poles. Cities with more advanced infrastructure, better resources, and strong connectivity will develop faster than other areas. Furthermore, in Polarization theory and trickle-down effect, Myrdal developed the concept of cumulative causation, where rapid economic development in one region (polarization) will absorb resources from other regions, creating a divergence effect that worsens inequality. However, in the long run, there is a trickle-down effect where excess economic growth in developed regions can spread to other regions through investment, labor, and technology transfer.

In agglomeration thery, explains how economic activity tends to be concentrated in certain areas due to economies of scale, reduced transportation costs, and access to larger labor and markets. High economic agglomeration accelerates growth in major cities, but also increases inequality between regions. Meanwhile, Williamson developed an index that measures development inequality based on income distribution between regions. This

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ISSN 2721-6330

theory states that in the early stages of economic growth, inequality increases because investment is concentrated in certain regions, but in the later stages, inequality can decrease if there is redistribution of investment and economic decentralization policies.

Several previous studies have examined development inequality with various approaches. Gennaioli et al. (2013) examined the relationship between human capital and economic growth in various regions and found that regions with high investment in education tend to experience faster growth. Sanogo (2019) examined the impact of fiscal decentralization on access to public services and showed that decentralization can exacerbate inequality if budget distribution is disproportionate. Venables (2019) highlighted the role of economic geography in development inequality and stated that regions closer to trade centers have higher economic advantages.

Development inequality is one of the main issues in regional economics that has the potential to worsen social and economic disparities between regions. According to Todaro and Smith (2020), development inequality can be measured through various indicators such as the Human Development Index (HDI), the level of economic agglomeration, local government capital expenditure, and economic growth. Regional economic theory shows that the distribution of resources, investment, and different fiscal and economic policies between regions are the main factors in creating development inequality (Jhingan, 2012; Tarigan, 2009).

Furthermore, economic growth is often considered a factor that can reduce development inequality in the long term. However, several studies have shown that in the early stages, economic growth can actually widen the gap, because the benefits of growth are more concentrated in certain areas (Ezcurra & Del Villar, 2021). The results of a study conducted in East Kalimantan showed that economic growth had a significant influence on development inequality, although other factors such as unemployment also played a role (Arifin, 2018). However, in the context of North Sumatra, the results of this study showed that economic growth did not have a significant influence on development inequality.

The Human Development Index (HDI) is an important indicator in assessing the level of community welfare in a region. According to Rodriguez and Wilkie (2019), an uneven increase in the HDI can widen the development gap, especially if investment in education

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and health is only concentrated in certain areas. A study conducted in Banten showed that the HDI has a significant role in determining the level of development inequality (Arsita, 2019). The results of this study are in line with findings in North Sumatra, where an increase in the HDI actually contributed to increasing development inequality due to uneven distribution of investment.

Moreover, economic agglomeration is often considered as the driving force of economic growth in a region. According to Chrisetyoningrum (2022), the concentration of economic activity in the form of industrial agglomeration can accelerate economic growth, but also has the potential to worsen inequality if not accompanied by equitable development policies. The results of this study indicate that agglomeration has the strongest influence on increasing development inequality in North Sumatra. Previous studies have also revealed that areas with high levels of agglomeration tend to have faster economic growth than other more disadvantaged areas (Arsita, 2019).

Local government capital expenditure is often considered as a key instrument in reducing development inequality through the provision of equitable infrastructure and public services. However, research conducted by Bonet (2006) in Colombia shows that fiscal decentralization without equitable distribution of resources can actually worsen development inequality. This is also found in the Indonesian context, where fiscal policies and regional budgets are often not in line with development needs in each region (Minister of Home Affairs Regulation No. 13 of 2006). The results of this study indicate that local government capital expenditure in North Sumatra does not have a significant effect on development inequality, supporting the findings of Siburian (2021) that capital expenditure that is not well distributed is unable to reduce development inequality.

## RESEARCH METHODS

This study uses a quantitative approach with development inequality analysis using the Williamson index and panel data regression. The Williamson Index is calculated using the following equation:

$$IW = \sqrt{\frac{\sum_{i=1}^{n}\left(\frac{GRDP_i}{N_i} - Y\right)^2 N_i}{Y^2 \sum_{i=1}^{n} N_i}} \quad \text{.....[1]}$$

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Where: IW is Indeks Williamson, GRDPi is Gross Regional Domestic Product Region I, Ni is Total Population of Region I, Y is the average per capita GRDP (Gross Regional Domestic Product) of the province, and n is Number of regions analysed. Furthermore, to analyze the factors that affect income inequality in North Sumatra, it will be analyzed using panel data. The objects of the research are 8 cities in North Sumatra during the period 2011-2023, obtained from Central Bureau of Statistics of North Sumatra, Ministry of Finance, and other publications. The equation model of this research is:

$$IW_{it} = \alpha + \beta_1 EG_{it} - \beta_2 HDI_{it} + \beta_3 AGL_{it} - \beta_4 LogG_{it} + \varepsilon_{it} \ldots\ldots\ldots [2]$$

Where IW is Williamson index of development inequality (index), EG is Economic growth (percent), HDI is human development index (index), AGL is Agglomeration (index), LogG is logarithm of total local government capital expenditure, i is 8 cities in North Sumatra, t is period (2011-2023), α is the constant, β is the coefficient of each EG, HDI, AGL, and LogG, ε is eror term.

## RESULTS AND DISCUSSION

### Descriptive Analysis

### Urban Area Disparities in North Sumatra

Regional development does not always go according to expectations, often facing challenges such as inequality between regions. One of the main factors causing this inequality is the uneven distribution of development. Other contributing factors include differences in natural resources, demographic conditions, limited mobility of goods and services, concentration of economic activities, and unbalanced allocation of development funds. In this study, the inequality of development between cities in North Sumatra using the concept of relative GRDP per capita introduced by Jaime Bonet (2006). The calculation is based on GRDP at constant prices in 2010, divided by the population. The higher the value of relative GRDP per capita (approaching or more than one), the greater the inequality of development. The results of the study show that most cities in North Sumatra generally have moderate development inequality values with an average value of 0.31. This indicates a more even condition. However, in Medan City itself, the inequality of development is very high, reaching 0.836. This is certainly because Medan is the largest city and also the main economic and administrative center in North Sumatra. As a metropolitan city, Medan attracts more investment, labor, and business than other cities in

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North Sumatra. This also creates an agglomeration effect, where capital and economic resources are concentrated in one area, while other areas experience slower growth. In addition, Medan is experiencing rapid urbanization with many people from other areas migrating to find work. This causes high population density and pressure on the city's infrastructure, while the migrants' areas of origin experience economic stagnation due to a lack of productive labor. The lowest development inequality is in Pematang Siantar with an index0.054,shows better development equity. This is influenced by the smaller city size and more proportional distribution of resources.


**Figure 2:** Map of Urban Development Inequality in North Sumatra for the period 2011-2023

*Source: Central Bureau of Statistics*

## Economic Growth of Cities in North Sumatra

Medan recorded the highest average economic growth (6.08%). Medan's significant economic growth is driven by the contribution of the trade, services, and industry sectors. Advanced infrastructure, transportation access, and strategic position as a gateway for international trade (through Belawan Port and Kualanamu Airport) strengthen its economic competitiveness. In addition, urbanization has a positive impact on domestic consumption and investment. Meanwhile, the lowest economic growth in Tebing Tinggi reached 5.30%, reflecting limited economic activity, mainly due to dependence on traditional sectors such as agriculture and small industries. The average economic growth

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of cities in North Sumatra Province reached 5.54%, this illustrates that overall economic growth is quite good. However, the disparity in growth between cities shows that several regions, especially Medan, dominate the province's economic growth.


**Figure 3:** Economic Growth of Cities in North Sumatra
*Source: Central Bureau of Statistics*

**Human Development Index of Cities in North Sumatra**

The high Human Development Index (HDI) in Medan, which reached 78.62, reflects success in the aspects of education, health, and people's purchasing power. The existence of educational facilities such as well-known universities, large hospitals, and access to various job opportunities contribute to the high quality of life in this city. In contrast, the lowest HDI is in Gunung Sitoli, with a value of 66.71, indicating significant limitations in access to education, health services, and economic opportunities. The Human Development Index of Cities in North Sumatra in 2011-2023 can be seen in figure 4.

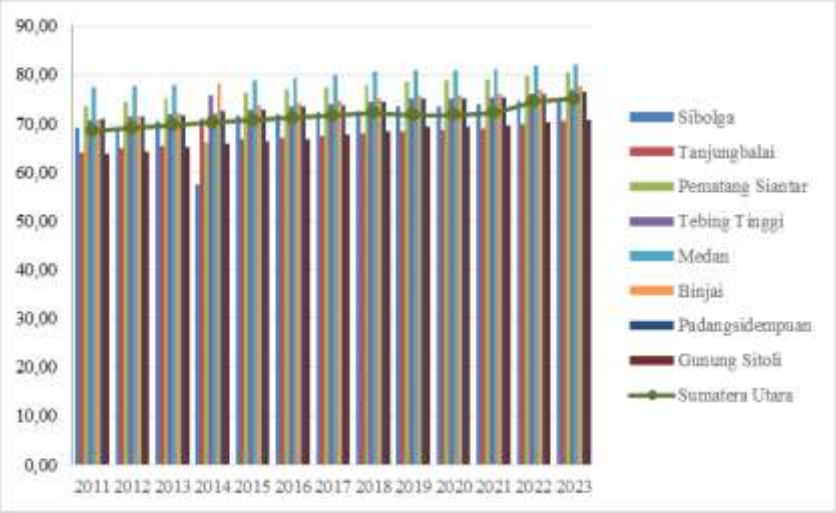


**Figure 4:** Human Development Index of Cities in North Sumatra
*Source: Central Bureau of Statistics*

e-ISSN 2721-625X
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Geographical barriers, such as the location of Gunung Sitoli on Nias Island which is separated from the mainland of Sumatra, are also major factors that hinder infrastructure development and accessibility. Although the average HDI in North Sumatra is quite high, at 72.39, the large disparity between Medan and other cities confirms the imbalance in the distribution of human development in this region.

**City Agglomeration in North Sumatra**

Medan is the center of economic agglomeration in North Sumatra with an agglomeration index value of 0.2923, reflecting the high concentration of industrial, trade, and service activities. This city acts as the epicenter of the provincial economy, attracting workers from various regions and creating significant economic dependence on Medan. In contrast, Gunung Sitoli recorded the lowest agglomeration index value, namely 0.0065, indicating that its economic activity is still local without significant concentration. This low value reflects the lack of industrialization and lack of economic integration of Gunung Sitoli with other cities in North Sumatra. Overall, most cities in North Sumatra have a low level of agglomeration, with an average agglomeration index of only 0.05. This shows that economic activity in this province is highly concentrated in Medan without any significant spread to other regions. Excessive economic dependence on Medan not only increases disparities between regions, but also has the potential to strengthen development inequality in the long term. Efforts to distribute centers of economic growth to other cities are needed to create better equality.

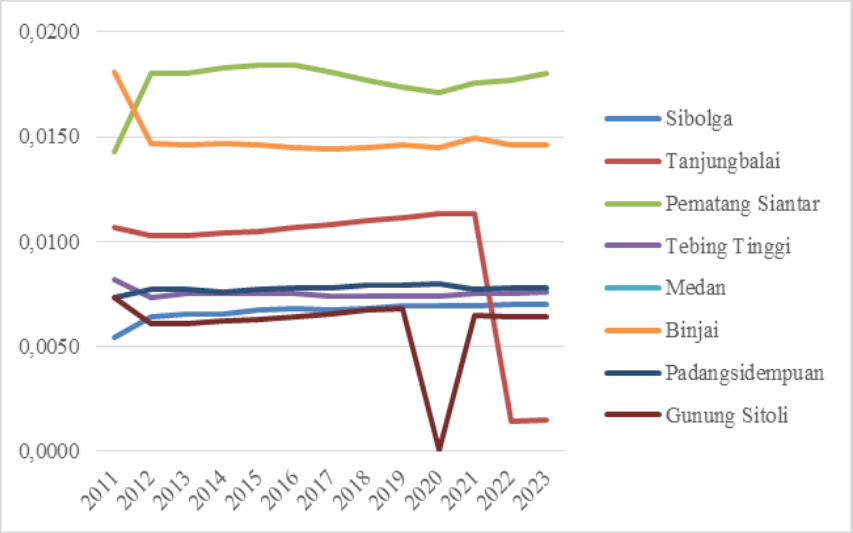


**Figure 5:** City Agglomeration Index in North Sumatra
*Source: Central Bureau of Statistics*

e-ISSN 2721-625X
ISSN 2721-6330

**Capital Expenditure of Regional Governments in North Sumatra**

The highest value of capital expenditure was recorded in Medan, amounting to Rp 749,468,498,000. This high allocation is in line with Medan's status as the provincial capital, as well as the center of government and economy. These funds are used to support the development of major infrastructure such as toll roads, public facilities, and industrial areas that strengthen Medan's position as a major growth center in North Sumatra. In contrast, the lowest value of capital expenditure was found in Sibolga, amounting to IDR 110,335,941,600. The low allocation of these funds reflects the limited regional budget to finance infrastructure development and improve public services. This hampers the development potential of the city, especially in supporting local economic growth. The average capital expenditure in North Sumatra was IDR 263,549,649,580, indicating a significant disparity in budget distribution between regions.

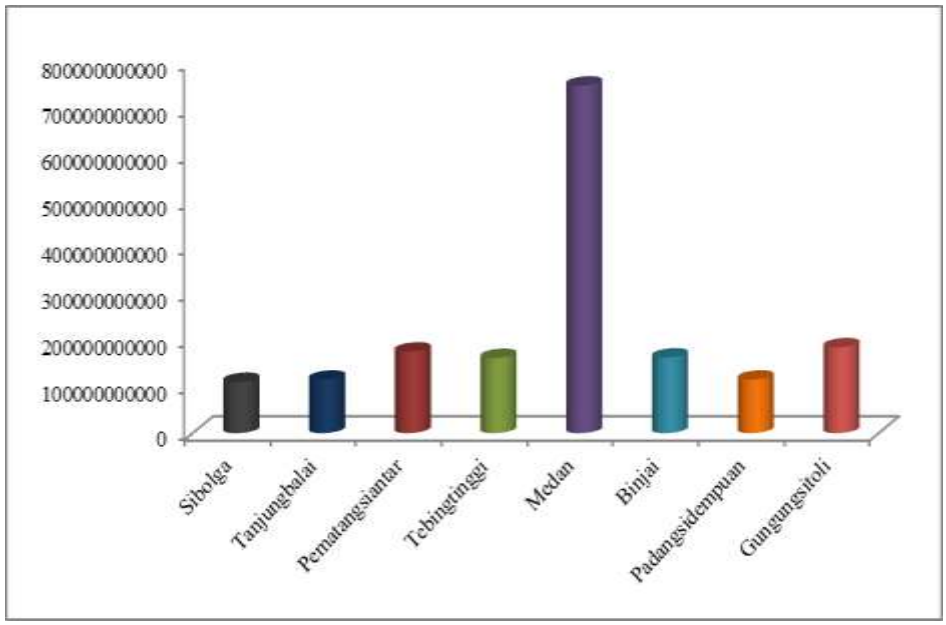


**Figure 6:** Average Capital Expenditure of City Governments in North Sumatra

*Source: Central Bureau of Statistics*

**Statistical Analysis**

**Classical Assumptions**

Based on the results of data processing, a probability value of0.236943,which is greater than the level of significance0.05.This shows that the data is normally distributed, so it can be used in statistical analysis without the need for additional transformation to meet the normality assumption.

e-ISSN 2721-625X
ISSN 2721-6330

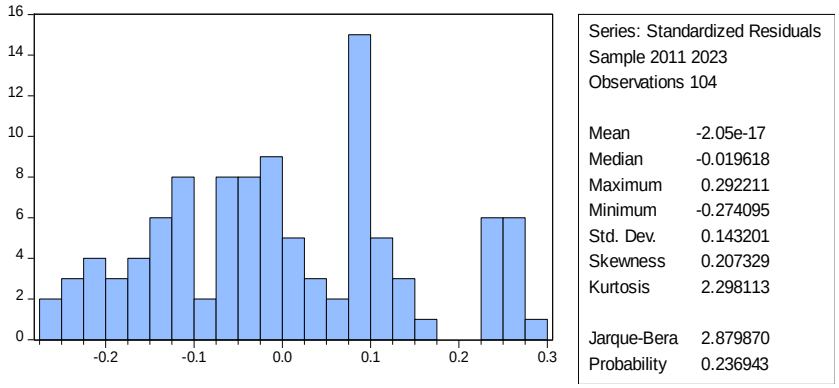


**Figure 7:** Normality test results
*Source: Eviews 10 (data processed)*

Based on the results of the correlation analysis, all variables have correlation values below 0.85, which indicates that no problems have occurredmulticollinearityin the model. Thus, the relationship between independent variables is not too strong, so that the regression model used remains valid and can provide accurate estimates.

**Table 1:** Multicollinearity test results

| | EG | HDI | LOG_G | AGL |
|---|---|---|---|---|
| **EG** | 1.000000 | -0.250155 | 0.165335 | 0.078092 |
| **HDI** | -0.250155 | 1.000000 | 0.479785 | 0.516684 |
| **LOG_G** | 0.165335 | 0.479785 | 1.000000 | 0.800135 |
| **AGL** | 0.078092 | 0.516684 | 0.800135 | 1.000000 |

*Source: Eviews 10 (data processed)*

Furthermore, based on the results of the heteroscedasticity test, the data distribution is in the range of -500 to 500 on the graph, indicating that there is no particular pattern in the residual distribution.

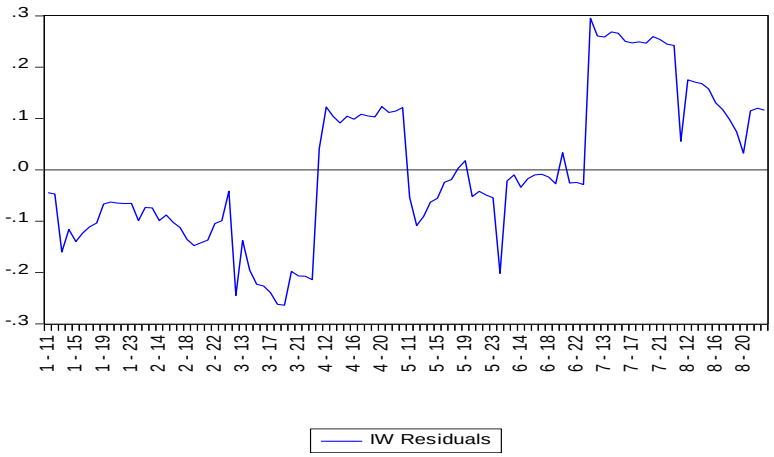


**Figure 8:** Heteroscedasticity test results
*Source: Eviews 10 (data processed)*

e-ISSN 2721-625X
ISSN 2721-6330

**Panel data regression**

**Estimation Model and Statistical Test**

The regression model used in this study is the Random Effect Model (REM), which was selected based on the results of the Chow and Hausman tests

**Table 2:** Chow test

| Effect Test | Statistic | d.f | Prob |
|---|---|---|---|
| Cross-section F | 176.114393 | (7,92) | 0.0000 |
| Cross-section F | 277.391793 | 7 | 0.0000 |

*Source: Eviews 10 (data processed)*

Based on the Chow test, the results show that the Cross-section F value is 0.0000. This means that the Fixed Effect Model (FEM) model is better than the Pooled OLS model. Furthermore, the Hausman test is carried out to ensure the selection of the best model between FEM and REM.

**Table 3:** Hausman test

| Test Summary | chi statistic | d.f | Prob |
|---|---|---|---|
| Cross-section random | 2.735815 | 4 | 0.6030 |

*Source: Eviews 10 (data processed)*

The Hausman test results show that the Cross-section Random value is also 0.6030, with a significance level of α = 5%. Based on these results, the best model used is the Random Effect Model (REM). Then, based on the results of the model selection test, the Random Effect Model (REM) was chosen as the most appropriate model for this study.

The results of the best regression model (Random Effect Model) can be seen in Table 4

**Table 4:** Hasil Regresi Model Terbaik (Random Effect Model)

| Variable | Cofficient | Prob. |
|---|---|---|
| C | -0.3204 | 0.2760 |
| Y | 0.003 | 0,1833 |
| IPM | 0.00371 | 0,0283 |
| AGL | 2.1675 | 0,0006 |
| log G | 0.0096 | 0,4069 |
| R-squared | 0.2873 | |

e-ISSN 2721-625X
ISSN 2721-6330

| Variable | Cofficient | Prob. |
|---|---|---|
| F statistic | 5.7059 | |
| Prob. F statistic | 0,0004 | |

*Source: Eviews 10 (data processed)*

The selection of this model was based on the results of the Chow and Hausman tests. Thus, the regression model in this study is as follows:

$$IW_{it} = -0.3204 + 0.003EG_{it} + 0.00371HDI_{it} + 2.1675AGL_{it} + 0.0096LogG_{it} + \varepsilon_{it} \text{ .....[3]}$$

Based on the calculated F value obtained 5.7059 with a significance of 0.0004 < -= 0.05), it can be concluded that simultaneously, economic growth, Human Development Index, agglomeration and local government capital expenditure have a significant influence on development inequality in the city of North Sumatra. The R-squared value of 0.29 indicates that 29% of the variation in development inequality can be explained by the four independent variables (economic growth, Human Development Index, agglomeration and local government capital expenditure). Meanwhile, the remaining 71% is influenced by other factors outside this study.

**Discussion**

Basen on regression result, every 1% increase in economic growth will increase the Williamson Index by 0.0030 points, assuming other variables remain constant. This suggests that increased economic growth tends to widen development inequality, which may occur because growth is not evenly distributed across regions. Partially, economic growth does not have a significant effect on the inequality of urban development in North Sumatra. This is indicated by a probability value of 0.1833. Williamson stated that economic growth in the early stages often increases the inequality of development, because investment and economic growth are concentrated in certain areas before finally spreading to other areas. However, the results of this study show that economic growth is not significant in reducing inequality, this is in accordance with the theory that without effective redistribution policies, growth does not automatically reduce inequality (Todaro & Smith, 2020). Previous studies also stated economic growth does not always have an impact on equitable development, especially if there is no economic redistribution policy (Ezcurra & Del, 2021). Other studies have found that economic growth tends to widen the

e-ISSN 2721-625X
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gap without an equalization mechanism, which often occurs in developing countries with a centralized economic structure (Milanovic (2019). Other studies have revealed that economic growth has a positive but insignificant relationship to income inequality (Agustina, 2022).

Furthermore, based on the regression result, every 1 point increase in the Human Development Index (HDI) will increase the Williamson Index by 0.0037 points. This means that even though the HDI increases, its impact on equitable development is still limited or even widens the gap, this is because areas with high HDI tend to attract more investment and productive labor than other areas. The results of the analysis show that the Human Development Index (HDI) has a positive and significant effect on the inequality of urban development in North Sumatra, with a probability value of 0.0092. In theory, increasing the HDI through investment in education and health should be able to improve people's welfare evenly, but the imbalance in investment distribution causes HDI growth to not occur uniformly in all regions (Rodríguez-Pose & Tselios, 2019). Cities with better access to education and health infrastructure such as Medan and Binjai experienced a faster increase in HDI than areas with limited resources, so that the development inequality widened. Areas with high HDI are also more attractive to investors and productive workers, which ultimately widens the gap with areas with low HDI (Gennaioli et al., 2020). This shows that although the HDI increases in aggregate, the impact is felt more by areas with a strong economic base, while underdeveloped areas continue to experience stagnation in development (Ketut Patra, 2022). This finding also strengthens previous research stating that high HDI does not always guarantee equitable development, because more developed regions will continue to grow faster than less developed regions, unless there are better redistribution policies (Rodriguez & Wilkie, 2019). Therefore, the strategy of equitable investment in the education and health sectors must be strengthened, so that increasing HDI can contribute to reducing development inequality effectively, rather than worsening the gap between regions.

Then, every 1 point increase in the agglomeration index will increase the Williamson Index by 2.1675 points. This shows that the higher the level of economic agglomeration (for example, the concentration of industry and business in a particular area), the greater the development inequality that occurs. This is in line with the theory of regional

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economics which states that areas with high agglomeration tend to be more advanced than other areas that are left behind. Agglomeration has a positive and significant effect with a probability value of 0.0006. This shows that economic agglomeration has the strongest impact on increasing inequality in urban development in North Sumatra. This is in accordance with the theory that economic agglomeration can drive growth, but without effective redistribution policies, it can worsen regional inequality (Lessmann 2014). These results also support the theory of previous research that economic concentration in cities drives local growth but worsens inequality with surrounding areas (Arsita, 2019). Other studies have shown that agglomeration-based growth without equalization policies can widen the gap between regions (Ezcurra & Del Villar 2021). Other studies have stated that uncontrolled agglomeration tends to increase income and infrastructure access gaps between regions (Rodriguez-Pose & Wilkie 2019).

Furthermore, Every 1% increase in local government capital expenditure will increase the Williamson Index by 0.0096 points. This shows that government capital expenditure has not been effective enough in reducing development inequality, this could be due to uneven budget distribution or low budget effectiveness. Regional government capital expenditure does not have a significant effect on the inequality of urban development in North Sumatra, as shown in the regression results with a probability value of 0.4069 which is greater than $\alpha = 0.05$. This is due to several main factors, one of which is the uneven distribution of the budget, where the allocation of capital expenditure is absorbed more in big cities such as Medan than in underdeveloped areas, so that the impact of equalization is minimal (Siburian, 2021). In addition, the effectiveness of the use of capital expenditure is often hampered by unbalanced fiscal capacity, where regions with larger budgets have more ability to develop infrastructure than regions with fiscal limitations (Lessmann, 2018). Fiscal decentralization without a good redistribution strategy is also the main reason why capital expenditure is ineffective in reducing inequality, because regions with low fiscal capacity continue to experience economic stagnation without sufficient incentives or intervention from the central government (Sanogo, 2019). In addition, the region's dependence on traditional economic sectors with slower growth also limits the impact of capital expenditure on development inequality, especially when budget allocations are more directed to the industrial and service sectors in urban areas (Rodríguez-Pose, 2020). Therefore, without more effective redistribution policies and

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ISSN 2721-6330

better coordination between the central and regional governments, capital expenditure will continue to have a limited impact on reducing development inequality in North Sumatra.

## CONCLUSION

The disparity in urban development in North Sumatra during the period 2011–2023 averaged 0.31 based on the Williamson Index (IW) calculation, indicating a fairly high level of inequality. Medan City has the highest development inequality, driven by strong economic dominance and urbanization, especially in the trade and industry sectors. In contrast, Pematang Siantar has the lowest development inequality, Tebing Tinggi shows the lowest economic growth, Gunung Sitoli records the lowest Human Development Index (HDI) and agglomeration, while Sibolga has the lowest local government (Pemda) capital expenditure. Simultaneously, economic growth, HDI, agglomeration, and Pemda capital expenditure have a significant effect on development inequality in the city areas of North Sumatra, but partially only HDI and agglomeration have a significant impact. Economic agglomeration is the most dominant factor in exacerbating inequality, while HDI, although significant, tends to widen inequality. On the other hand, economic growth and Pemda capital expenditure do not show a significant effect on development inequality. Therefore, a more effective policy strategy is needed, including optimizing the allocation of capital expenditure to improve infrastructure in disadvantaged areas, implementing a more equitable agglomeration policy with investment incentives outside Medan, HDI-based economic redistribution through investment in education and health in areas with low HDI, and more targeted fiscal planning with a budget decentralization strategy based on regional needs.

## LIMITATIONS AND RECOMMENDATIONS

This study has several limitations, including the limited variables analyzed, where factors such as infrastructure, human resource quality, and fiscal policy have not been included. In addition, the study period which only covers 10 years limits understanding of long-term trends. For further research, it is recommended that the scope of variables be expanded by including other factors that influence development inequality and economic growth. The research period also needs to be extended to capture broader policy changes and economic dynamics. In addition, equitable development policies need to be improved through

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optimizing investment outside Medan, developing new industrial areas, and increasing connectivity between regions.

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