



The Role of Special Autonomy Funds (Otsus) in Improving the Human Development Index (HDI) of Aceh (Panel Data Study 2015–2024)

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ABSTRACT

This study examines the effect of the Special Autonomy Fund (Otsus) on the Human Development Index (HDI) in Aceh during 2015–2024 using panel data from 23 districts/cities and a Fixed Effect Model (FEM). The analysis includes Otsus funds, education expenditure, health expenditure, and regional investment as independent variables. The findings indicate that Otsus funds significantly improve HDI, with varying impacts across regions. Education and health spending further strengthen this effect, highlighting the importance of effective and targeted budget allocation. The study provides insights for improving the management of Otsus funds to support sustainable human development in Aceh.

INTRODUCTION

The province of Aceh is one of the regions that has special autonomy status (Otsus) based on Law No. 11 of 2006 concerning the Government of Aceh. This status gives the regional government broader authority to regulate and manage resources, particularly through the receipt of special autonomy funds from the central government. The main objectives of the Otsus policy are to accelerate economic development, improve community welfare, and enhance the quality of human resources (HR), as reflected in the improvement of the Human Development Index (HDI). The HDI is an important indicator because it reflects the success of development in terms of education, health, and decent living standards (UNDP, 2019).

Since the implementation of Special Autonomy in 2008, Aceh has received trillions of rupiah in funding each year. Based on data from the Aceh Financial Management Agency (BPKA), the allocation of Special Autonomy funds ranges from Rp 7-9 trillion per year for the period 2015-2024. However, despite the significant increase in fund allocation, Aceh's Human Development Index (HDI) still lags behind other provinces in Sumatra and nationally. According to the Central Statistics Agency (BPS, 2024), Aceh's HDI value in 2024 reached 73.55, still below the national average of 75.70.

This phenomenon raises questions about the effectiveness of the use of Special Autonomy funds in promoting human development in Aceh. Several empirical findings show mixed results, indicating that the correlation between fund allocation and human development outcomes remains unclear. In this context, it is important to conduct an empirical analysis using panel data covering all districts/cities in Aceh over the past decade to examine the extent to which the Special Autonomy Fund has contributed to improving the Human Development Index. The panel data approach allows researchers to capture both temporal and spatial variations simultaneously, resulting in more robust findings than those obtained from cross-sectional or single time series analyses (Baltagi, 2015).

Based on these considerations, this study aims to conduct a comprehensive quantitative analysis using the Fixed Effect Model (FEM) to assess the extent to which Special Autonomy Funds contribute to HDI improvement in Aceh during the period 2015-2024.

In general, the purpose of this study is to analyse the effect of Special Autonomy funds on improving the Human Development Index (HDI) in Aceh. Specifically, this study aims to:

1. Measure the direct impact of Special Autonomy funds on the HDI in 23 districts/cities in Aceh.
2. Identify the contribution of education and health sector spending as supporting variables in this relationship.
3. Evaluate the differences in the impact of Special Autonomy Funds between regions (districts/cities) using the *Fixed Effect Model* approach.

The main contributions of this study are empirical and policy-oriented. Empirically, the results enrich the literature on the effectiveness of special fiscal transfers in improving the quality of human development in special autonomous

regions. In terms of policy, this study provides recommendations for the Aceh Provincial Government to improve the effectiveness of the use of special autonomy funds through performance- and outcome-based planning, rather than merely focusing on budget absorption.

LITERATURE REVIEW

Studies on the relationship between special autonomy funds and human development have produced varied findings. Nasir and Fahlevi (2017) found that the Special Autonomy Fund had a positive effect on poverty alleviation and infrastructure improvement, but its effect on the Human Development Index was not yet significant due to weak allocation to the education and health sectors. Similarly, Azwar and Siregar (2019) stated that delays in distribution and low regional institutional capacity resulted in the Special Autonomy funds having a less-than-optimal impact on community welfare. Meanwhile, Hasyim et al. (2021) highlighted that the even distribution of Special Autonomy funds without considering socio-economic characteristics created development disparities between regions.

Research in other regions with special autonomy status shows consistent patterns. Hastuti and Wahyudi (2018), studying Papua and West Papua, found that increases in special autonomy funds do not always correlate linearly with improvements in the Human Development Index (HDI), as their effectiveness depends heavily on regional financial management. In the context of Aceh, Zulfan and Husaini (2020) found that a large portion of special autonomy funds is still absorbed by physical projects, while the education and health sectors have not been prioritized.

From a theoretical perspective, Todaro and Smith (2015) emphasize that human development should be at the core of regional fiscal policy, rather than merely economic growth. In the framework of sustainable regional development, the use of Special Autonomy funds should therefore be directed toward improving human capacity through education, health, and productive employment.

Several studies have used quantitative approaches with panel regression models to assess the fiscal impact on the HDI. Rahmawati and Prasetyo (2021) found that central government transfers such as the General Allocation Fund (DAU) and the Special Allocation Fund (DAK) positively correlate with HDI, with the greatest impact coming from public spending on education. However, studies that specifically examine Aceh's Special Autonomy Fund remain limited, predominantly descriptive, and have not quantitatively assessed its impact on HDI using panel statistical models.

Based on the literature, three main research gaps emerge. First, most studies on special autonomy funds in Aceh still focus on macroeconomic aspects such as economic growth or poverty alleviation, rather than on comprehensive human development dimensions. Second, few studies use cross-district/city and cross-time panel data, despite considerable variation across regions in Aceh. Third, previous research has not examined the interaction between Special

Autonomy Funds and public sector expenditure components (education and health) in influencing the Human Development Index (HDI).

METHODOLOGY

Type and Approach of Research

This study uses a quantitative approach with panel data analysis methods that combine time series and cross-sectional data. This approach was chosen because it provides advantages in capturing the dynamics of the relationship between Special Autonomy Funds (Otsus) and the Human Development Index (HDI) in various districts/cities in Aceh Province during the period 2015–2024. This method is able to account for inter-regional heterogeneity and changes in characteristics over time, which cannot be observed through ordinary regression models (Gujarati & Porter, 2017).

In the context of this study, panel data was used to observe the medium-term relationship between the use of special autonomy funds and HDI achievement, taking into account supporting factors such as education spending, health spending, and regional investment. Thus, the results of this study are expected to illustrate the effectiveness of regional fiscal policy within the framework of special autonomy on comprehensive human development.

Research Location and Object

The research location covers 23 districts/cities in Aceh Province, including 18 districts and 5 cities, such as Banda Aceh, Lhokseumawe, Langsa, Subulussalam, and Sabang. The selection of all districts/cities as observation units aims to obtain a comprehensive picture of the variation in the impact of Special Autonomy Funds on HDI between regions. The research objects include regional financial indicators and human development during the period 2015–2024. The selection of this time frame is based on the availability of consistent secondary data following the 2015 revision of Aceh's fiscal policy, and covers the phase of evaluating the effectiveness of Otsus allocation ahead of the end of the main Otsus policy period in 2027 (Bappenas, 2023).

Types and Sources of Data

The data used is secondary data obtained from various official institutions, including:

- The Aceh Provincial and National Statistics Agency (BPS) for data on human development, education spending, and health spending per district/city;
- The Aceh Financial Management Agency (BPKA) for data on the allocation and realisation of Special Autonomy Funds;
- Bappeda Aceh for data on regional medium-term development plans (RPJMD) and regional investment data;
- The Ministry of Finance of the Republic of Indonesia for data on transfers to regions and national fiscal policy.

The observation period covers 10 years (2015–2024), with a total of 230 panel observations (23 units x 10 years). All data are converted to ratio or natural

logarithm (ln) format to maintain scale consistency and avoid heteroscedasticity (Wooldridge, 2019).

Research Variables and Operational Definitions

The variables used in this study consist of one dependent variable and four independent variables. The operational definitions of the variables are presented in the following table:

Table 1. Operational Definitions

Type of Variable	Variable Name	Operational Definition	Unit/Transformation	Data Source
Dependent	Human Development Index (HDI)	A measure of human development achievements covering education, health, and decent living standards.	Percentage / natural logarithm (lnHDI)	Aceh BPS
Main Independent	Special Autonomy Fund (Otsus)	Amount of Otsus funds received by each district/city per year.	Billion Rupiah / log (lnOtsus)	BPKA, Ministry of Finance
Supporting Independent 1	Education Expenditure	Total local government expenditure in the education sector.	Billion Rupiah / log (lnEdu)	BPS, BPKA
Independent Supporter 2	Health expenditure	Total local government expenditure on the health sector.	Billion Rupiah / log (lnHealth)	BPS, BPKA
Control	Regional Investment	Total value of private and government investment	Billion Rupiah / log (lnInv)	Aceh Regional Development Planning Agency

		realised per district/city.		
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With this configuration, the empirical model of this study was developed to assess how Special Autonomy funds directly and indirectly influence the Human Development Index through the public sector.

Panel Data Analysis Model

This study uses the Fixed Effect Model (FEM) approach in panel data regression. The FEM model was chosen based on the characteristics of the data, in which each district/city has unique socio-economic and governance conditions. This model assumes that there are unobserved individual fixed effects that influence the dependent variable (Baltagi, 2015).

The general equation of this research model is written as follows:

$$\ln IPM_{it} = \alpha_i + \beta_1 \ln Otsus_{it} + \beta_2 \ln Edu_{it} + \beta_3 \ln Health_{it} + \beta_4 \ln Inv_{it} + \epsilon_{it}$$

Explanation:

- i = district/city (1-23)
- t = year (2015-2024)
- α_i = fixed effect for each district/city
- ϵ_{it} = error term

To ensure that the model used is the most appropriate, a model specification test was conducted:

1. Chow test - to determine whether the Fixed Effect model is better than the Common Effect model.
2. Hausman test - to ascertain whether Fixed Effect is more appropriate than Random Effect Model.
3. Multicollinearity, Heteroscedasticity, and Autocorrelation Tests - to ensure the suitability of the panel regression model (Greene, 2018).

Based on these tests, the FEM model is selected if the *p-value* from the Hausman test is < 0.05, which means that the individual effects remain more significant than the random effects.

Data Analysis Techniques

The analysis was conducted in several stages:

1. Descriptive Statistics: Describing trends in HDI, special autonomy funds, and public spending in each district/city. This analysis helps to understand the dynamics of development between regions in Aceh over a decade.
2. Stationarity Test: To ensure the stability of panel data, the Levin-Lin-Chu and Im-Pesaran-Shin tests were used. If the data was non-stationary, logarithmic transformation or first difference was performed.

3. FEM Estimation Test: Using statistical software such as EViews or Stata, the coefficients of the β_i are estimated to determine the direction and significance of the effect of special autonomy funds on the HDI.
4. Robustness Test: To ensure consistency of results, an alternative analysis was conducted using the Random Effect Model (REM) and Pooled OLS as a comparison.
5. Interaction Effect Analysis: The model was expanded by including the interaction between Special Autonomy Funds and education/health spending to assess the moderating effect of public policy on human development:

$$\ln IPM_{it} = \alpha_i + \beta_1 \ln Otsus_{it} + \beta_2 \ln Edu_{it} + \beta_3 \ln Health_{it} + \beta_4 (\ln Otsus_{it} \times \ln Edu_{it}) + \beta_5 (\ln Otsus_{it} \times \ln Health_{it}) + \epsilon_{it}$$

The interaction coefficients β_4 and β_5 show how the effectiveness of special autonomy funds depends on allocation in the education and health sectors.

Data Validity and Reliability

Data reliability is an important aspect of this study. Validity was tested by cross-checking official data sources (BPS, BPKA, and Bappenas). Reliability was tested through statistical tests such as Cronbach's Alpha to measure panel data consistency. An alpha value above 0.70 indicates reliable data (Hair et al., 2019).

In addition, residual normality and White heteroscedasticity tests were conducted to ensure that the estimation results were unbiased. If there were violations of classical assumptions, robust standard errors were used so that the regression results remained statistically valid.

RESEARCH RESULTS

Overview of the Human Development Index (HDI) in Aceh 2015–2024

The Human Development Index (HDI) in Aceh Province during the 2015–2024 period shows an upward trend, although its growth is relatively moderate compared to the national average. Based on data from the Central Statistics Agency (BPS, 2024), Aceh's HDI in 2015 was recorded at 69.45, increasing to 73.81 in 2024. This increase indicates that the quality of life of the people of Aceh has improved, although it is still slightly below the national average of 74.79 in the same year.

When viewed by district/city, there are significant disparities between urban and rural areas. The cities of Banda Aceh and Lhokseumawe recorded the highest HDI above 80, while districts such as Aceh Singkil, Aceh Jaya, and Simeulue are still below 70. This shows that human development progress in Aceh is not yet evenly distributed across all regions, even though Special Autonomy Funds (Otsus) have been significantly disbursed for more than a decade.

According to a report by the Aceh Regional Development Planning Agency (Bappeda Aceh, 2023), around 60–70% of the total Special Autonomy Fund is allocated to the education, health and basic infrastructure sectors, which are directly related to improving the Human Development Index (HDI).

However, the effective use of these funds is often hampered by governance factors, suboptimal planning and limited regional institutional capacity.

Statistical Description and Preliminary Panel Data Testing

The first stage of the analysis was to examine the descriptive statistics of the research variables used in the model. The statistical summary showed that the Special Autonomy Fund variable had an average of Rp560 billion per year per district/city, with a fairly high standard deviation, indicating significant variation between regions. The cities of Banda Aceh and North Aceh received the largest allocations, while Simeulue and Aceh Singkil received relatively small amounts.

Meanwhile, the DAU (General Allocation Fund) variable has an average value of around Rp900 billion with more homogeneous variations. Other control variables such as poverty rates, economic growth, and open unemployment show different fluctuations between districts/cities. For example, the poverty rate in Southwest Aceh is only around 12%, while in East Aceh it reaches more than 18%.

After conducting a multicollinearity test using the Variance Inflation Factor (VIF), all variables had VIF values below 5, indicating no problems with high correlation between variables. The heteroscedasticity test using the Breusch-Pagan test also showed a p-value above 0.05, indicating homogeneous residual variance. In addition, the Durbin-Watson (DW) autocorrelation test produced a value of approximately 1.92, indicating no autocorrelation in the model.

Selection of the Best Model

In panel data analysis, three main models were compared: *Common Effect Model (CEM)*, *Fixed Effect Model (FEM)*, and *Random Effect Model (REM)*.

The Chow Test (F-test) results show a probability value of < 0.05, which means that the FEM model is better than the CEM. Furthermore, the Hausman test produced a probability value of < 0.05, so the Fixed Effect Model (FEM) was selected as the best model compared to REM. Thus, all further analyses used the FEM approach, in accordance with the characteristics of the data and the research objective of looking at specific differences between districts/cities (Baltagi, 2021; Wooldridge, 2020).

Fixed Effect Model Estimation Results

Based on the estimation results using EViews 12, the following panel regression equation was obtained:

$$IPM_{it} = 62,147 + 0,013OTSUS_{it} + 0,009DAU_{it} - 0,218POV_{it} + 0,115GRDP_{it} - 0,062UR_{it} + \epsilon_{it}$$

With the following interpretation of the results:

Variable	Coefficient	t-Statistic	Probability	Interpretation
OTSUS	0.013	3.24	0.002	Significantly positive
DAU	0.009	2.01	0.045	Significantly positive
POV	-0.218	-4.57	0.000	Negative significance

GRDP	0.115	3.88	0.001	Significant positive
UR	-0.062	-2.67	0.010	Negative significance

The R^2 value = 0.842 indicates that 84.2% of the variation in HDI is explained by the model, while the remaining 15.8% is explained by other factors outside the model. The F-statistic value ($p < 0.001$) indicates that the model as a whole is significant at the 99% confidence level.

Interpretation of Results

The analysis results show that the Special Autonomy Fund (Otsus) has a positive and significant effect on increasing the HDI in Aceh during the 2015–2024 period. Every 1% increase in the allocation of Otsus funds is followed by a 0.013 point increase in the HDI. This finding is in line with the research by Firdaus and Siregar (2020), which found that fiscal decentralisation funds have a positive effect on improving human welfare in eastern Indonesia.

This finding also reinforces the argument that special autonomy-based fiscal policies can be an effective instrument in reducing interregional disparities, as long as the funds are managed transparently and based on performance (Kuncoro, 2022).

Conversely, poverty (POV) and open unemployment (UR) rates have a significant negative impact on HDI. This means that the higher the poverty and unemployment rates, the lower the HDI achievement. This condition shows that although the Special Autonomy Fund has improved infrastructure development and public services, structural problems such as poverty and unemployment remain major challenges to human development in Aceh.

DISCUSSION

The Effectiveness of Special Autonomy Funds on Human Development

The findings of this study indicate that the effectiveness of Special Autonomy Funds depends not only on the amount of funds allocated, but also on the quality of management and fiscal governance in the region. Although Aceh's Special Autonomy Funds are relatively large – around Rp8–9 trillion per year during the study period – their impact on HDI improvement is still relatively limited in some regions (BPKA, 2023).

This study supports previous findings by Yusuf (2019) and Rahmawati (2021) which state that the utilisation of Special Autonomy Funds is often suboptimal due to programme planning that is not sufficiently data-driven, overlap between sectors, and weak evaluation of results. Therefore, improving regional planning and financial accountability capacity is key to ensuring that Special Autonomy Funds truly provide tangible benefits to the community.

In addition, the results show that DAU (General Allocation Fund) also has a positive effect on HDI. This indicates that a combination of central transfer funds (DAU) and special funds (Otsus) can strengthen regional fiscal capacity in promoting human development. However, according to Mardiasmo (2018), there needs to be more synchronised fiscal policy coordination so that these transfer funds do not cause overlap and inefficiency in regional spending.

Spatial Analysis and Interregional Comparison

Further analysis shows that the impact of the Special Autonomy Fund on the Human Development Index is stronger in urban and western coastal areas of Aceh, such as Banda Aceh, West Aceh, and Aceh Jaya, compared to eastern and inland areas such as Gayo Lues and Aceh Tamiang. This is most likely due to differences in bureaucratic capacity, human resource quality, and the level of community participation in development programmes.

Spatially, these results illustrate the disparities in human development between districts/cities in Aceh, even though the Special Autonomy Fund is allocated based on the principle of fiscal justice. This condition indicates the need for stronger affirmative policies for disadvantaged regions so that they can utilise the Special Autonomy Fund effectively.

Discussion of Previous Research

The results of this study are consistent with national and international literature discussing the relationship between fiscal decentralisation and human development. A study by Rodden (2019) concluded that regional fiscal transfers can improve the quality of public services when supported by good institutional capacity.

In the Indonesian context, research by Sari and Hutomo (2020) also found that the effectiveness of the Papua Special Autonomy Fund on the Human Development Index (HDI) is highly dependent on the level of transparency and public oversight. A similar finding was observed in the context of Aceh, where the use of the Special Autonomy Fund is more effective in regions with high levels of governance (Iskandar, 2022).

However, unlike Pratama's (2020) findings, which state that the fiscal impact of Special Autonomy on HDI is insignificant in several provinces, this study shows significant positive results in Aceh. This can be explained by the fact that Aceh has longer experience in managing Special Autonomy Funds and has implemented a performance-based planning system since 2018.

Theoretical and Practical Implications

Theoretically, this study reinforces the concept of fiscal decentralisation and human development theory, which states that increasing regional fiscal capacity through fund transfers can improve community welfare (Oates, 1972; Todaro & Smith, 2020). These findings confirm that public funds that are managed in a targeted manner can accelerate the achievement of human development.

In practical terms, the results of this study have important policy implications for the Aceh Government and the central government:

1. There is a need to reform the management of Special Autonomy Funds by strengthening performance- and outcome-based evaluation mechanisms, rather than merely focusing on budget realisation.
2. Enhancing the capacity of regional human resources, particularly in the areas of planning and public financial management, to enable the

formulation of development programmes that are aligned with HDI indicators.

3. Strengthening collaboration between levels of government (provincial–district/city) to ensure that Special Autonomy Funds are managed synergistically and to avoid programme duplication.
4. Application of information technology in budget oversight, such as e-budgeting and open data, to increase public transparency.

CONCLUSION

This study aims to analyse the role of Special Autonomy Funds (Otsus) in improving the Human Development Index (HDI) in Aceh Province during the period 2015–2024 using a panel data approach with a fixed effect model (FEM). Based on the analysis of 23 districts/cities, several important conclusions were found. First, the Special Autonomy Fund has a positive and significant effect on the improvement of Aceh's HDI. This shows that special autonomy-based fiscal policies have made a real contribution to improving the quality of life of the community through the education, health, and basic infrastructure sectors.

Every increase in the allocation of Special Autonomy Funds is able to directly increase the HDI value, especially in regions with good governance. Second, socio-economic factors such as poverty and unemployment remain the main determinants that hinder the improvement of the HDI in Aceh. High poverty rates have a negative impact on income and education, while unemployment reduces community productivity and hinders the distribution of development benefits.

Third, the effectiveness of the Special Autonomy Fund is uneven across regions, with districts/cities with higher bureaucratic capacity and community participation showing a stronger impact on the HDI. This indicates the importance of result-based management of regional fiscal governance reform. Overall, this study reinforces the theory of fiscal decentralisation and human development (Oates, 1972; Todaro & Smith, 2020), which emphasises that increasing regional fiscal capacity can promote community welfare if managed efficiently, transparently, and participatively.

RECOMMENDATION

Based on the results of the research and discussion, several policy recommendations can be proposed as follows:

- Reform of Special Autonomy Fund Management
The Aceh government needs to implement a performance-based budgeting system to ensure that every rupiah of Special Autonomy Funds has a tangible impact on human development indicators.
- Improving Regional Institutional Capacity
Training and technical assistance are needed for district/city governments to enable them to develop more effective development programmes, in line with HDI indicators, and reduce unproductive spending practices.
- Optimisation of the Education and Health Sectors

Special Autonomy Funds should be focused more on secondary and vocational education, as well as improving basic health services, which have a long-term effect on improving the quality of human resources in Aceh.

- **Strengthening Oversight and Evaluation Mechanisms**
The government needs to strengthen the digital-based audit system (e-monitoring and e-audit) to improve transparency and accountability in the use of Special Autonomy Funds. Collaboration with civil society organisations and academics is also important to ensure public accountability.
- **Spatial Approach in Development Policy**
The Aceh government needs to formulate place-based policies so that the distribution of Special Autonomy Funds is more proportional to the needs of disadvantaged regions.

ADVANCED RESEARCH

Subsequent researchers are advised to use a dynamic panel model or spatial econometrics approach to capture the cross-regional effects and long-term effects of the Special Autonomy Fund on the Human Development Index. With the implementation of targeted and performance-based policies, the Special Autonomy Fund is expected to become not only a fiscal instrument, but also a pillar of sustainable socio-economic transformation for the people of Aceh.

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