

**FISCAL TRANSFERS, INCOME INEQUALITY, AND HUMAN
DEVELOPMENT: EVIDENCE FROM
CENTRAL KALIMANTAN PROVINCE**

Oleh

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Bidang Konsentrasi Perencanaan Pembangunan dan Keuangan Daerah



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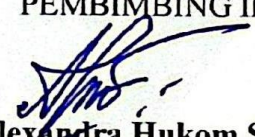
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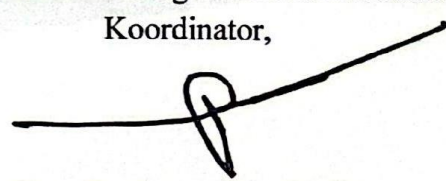
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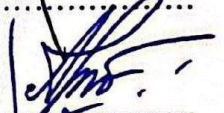
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FISCAL TRANSFERS, INCOME INEQUALITY, AND HUMAN DEVELOPMENT: EVIDENCE FROM CENTRAL KALIMANTAN PROVINCE

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Abstract

This study analyzes the impact of fiscal transfers from the central government and income inequality on human development in Central Kalimantan Province over the period 2020–2024. Despite steady increases in fiscal funds and improvements in human development indicators, the province continues to face challenges from persistent income inequality that limits equitable progress. Previous research often examines fiscal funds and inequality separately, leaving a gap in understanding their simultaneous effects at the local level. The objective is to examine how general allocation funds, special allocation funds, and the Gini index jointly influence the human development index using panel data from 13 regencies and 1 city. The analysis employs a fixed effect model selected after appropriate statistical tests. The results reveal that both general allocation funds and special allocation funds have significant positive effects on the human development index, with special allocation funds showing a slightly stronger contribution. In contrast, the Gini index exerts a significant negative effect, indicating that higher income inequality substantially hinders human development. The model explains 78 percent of the variation in the human development index. These findings highlight the importance of effective fiscal management combined with targeted strategies to reduce income inequality. Policymakers in Central Kalimantan should prioritize transparent use of fiscal transfers in education and health sectors while implementing inclusive programs to lower inequality, ensuring more equitable and sustainable human development across the province.

Keywords: Fiscal Transfer, General Allocation Funds, Gini Index, Human Development Index, Income Inequality, Panel Regression, Special Allocation Funds.

I. INTRODUCTION

Human development is the main indicator in measuring the progress of a region because it reflects aspects of health, education, and a decent standard of living for the community. The Human Development Index (HDI) is the most widely used composite method globally, including by the Indonesian Central Statistics Agency (Badan Pusat Statistik/BPS) to assess people's welfare holistically (UNDP, 2023). This index combines life expectancy, education attainment, and per capita income to provide a broader view of development beyond just economic growth (Sen, 1999).

Central Kalimantan Province, which is rich in natural resources, has experienced notable human development progress that still requires deeper examination to ensure equitable outcomes. According to BPS Central Kalimantan, the HDI increased from 71.05 in 2020 to 74.28 in 2024, indicating improvement in community welfare. However, this figure remains slightly below the national average of around 74.8 in 2024 (BPS, 2025). During the same period, fiscal transfers from the central government rose significantly (Ardiansyah & Widiyaningsih, 2014; Sulaeman, 2021). The General Allocation Fund (Dana Alokasi Umum/DAU) increased by an average of 7% annually, from IDR 2.1 trillion in 2020 to IDR 2.7 trillion in 2024, while the Special Allocation Fund (Dana Alokasi Khusus/DAK) grew from IDR 0.5 trillion to IDR 0.8 trillion (Sandjaja et al., 2020; Ministry of Finance, 2025). Despite these increases, income inequality remains a challenge, with the Gini Index ranging from 0.36 to 0.38 between 2020 and 2024, potentially limiting the effectiveness of fiscal transfers in

improving HDI due to unequal access to education and health services (Kuncoro, 2021).

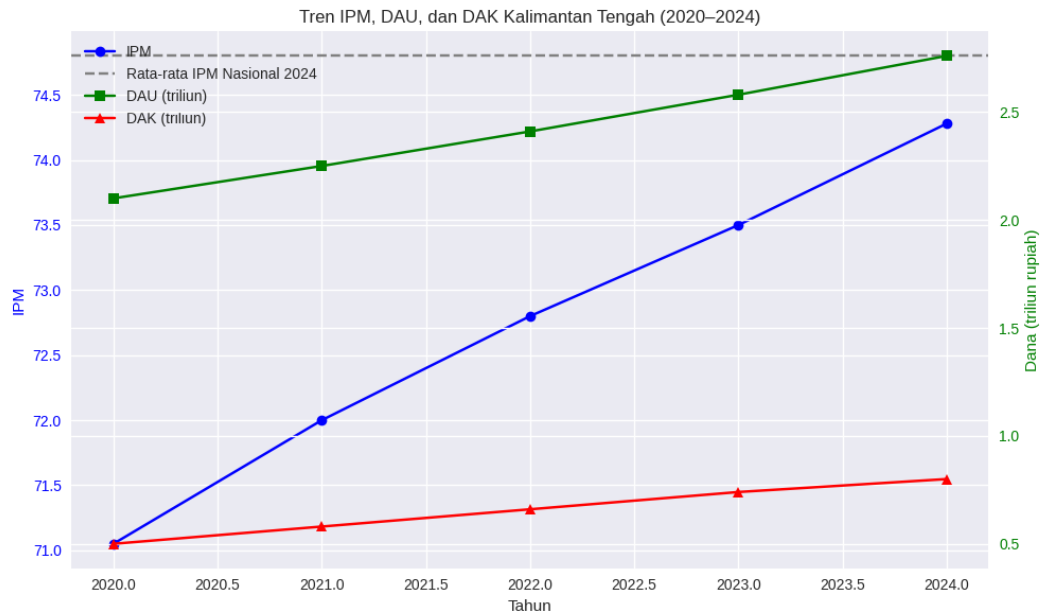


Figure 1. Trend graph of HDI, DAU, and DAK of Central Kalimantan Period 2020–2024

Figure 1 presents three main interrelated variables in the dynamics of human development in Central Kalimantan, namely the HDI, DAU and DAK in trillions of IDR. The average national HDI in 2024 is 74.8. Central Kalimantan's HDI showed an upward trend from 71.05 (2020) to 74.28 (2024), but remained slightly below the national average. DAU increased consistently by around 7% per year, from IDR 2.1 trillion to IDR 2.76 trillion. DAK also grew significantly from IDR 0.5 trillion to IDR 0.8 trillion. Despite the increase in funds and HDI, income inequality (Gini 0.36–0.38) remains a major challenge that is not shown in this graph due to scale differences, but is highly relevant in subsequent regression analyses. Against this background, this research is very relevant to support sustainable development efforts in Central Kalimantan, especially in the context

of the use of regional allocation funds and reducing inequality as key factors in improving people's quality of life.

Previous studies such as Apriliani and Khoirunurrofik (2020), and Ridho (2022) have emphasized the positive role of fiscal allocation funds in promoting regional development and improving the HDI. Miranda-Lescano et al. (2023) show that greater decentralization of public health spending enhances human development outcomes, while Jin and Jakovljevic (2023) find that moderate fiscal decentralization supports HDI across countries, including Indonesia. However, empirical studies that simultaneously incorporate income inequality alongside DAU and DAK remain limited (Misra et al., 2020a; Sari et al., 2022). Most existing research analyzes fiscal transfers and HDI separately or focuses only on the provincial level, without including the Gini Index in a panel data framework at the regency/city level. This gap is particularly relevant for resource-rich yet unequal regions such as Central Kalimantan. Therefore, this study aims to examine the combined effects of DAU, DAK, and the Gini Index on HDI in Central Kalimantan during 2020–2024 using panel data regression, providing more comprehensive evidence to support inclusive and targeted regional fiscal policies.

II. LITERATURE REVIEW & HYPOTHESIS DEVELOPMENT

General Allocation Fund and Human Development Index

The General Allocation Fund (DAU) is a fiscal transfer from the central government to local governments in the form of block grants. DAU is allocated to cover regional fiscal shortfalls in order to be able to administer government and public services effectively, without special conditions in their use (Ministry of Finance of the Republic of Indonesia, 2024). According to fiscal-decentralization theory by Oates (1999) explains that DAU functions as a tool for fiscal equity between regions to support regional autonomy and improve the quality of public services. This helps regions with limited own revenue to fund basic services like health and education. Proper management of DAU is important because it can directly affect social development.

Yaqin (2018) emphasized the importance of proper DAU management to ensure effectiveness and efficiency in regional development. Empirical studies confirm the significant role of DAU in financing the achievement of social development indicators such as health and education, which leads to an increase in the Human Development Index (HDI) (Ridho, 2022). For example, according to Alamsyah (2022), DAU has a positive influence on HDI when combined with other funds, as it supports general public spending. In Indonesia, many studies show that increases in DAU help narrow fiscal gaps and improve access to services in less developed areas. This is especially true in provinces where local revenue is low. However, the impact depends on how regions allocate the funds to priority sectors.

Research by Raviyanti (2017) also supports that DAU contributes to higher HDI through better financing of education and health programs. Other findings indicate that DAU can reduce disparities if used transparently. In panel data analyses across Indonesian regions, DAU often shows a positive coefficient on human development outcomes. This aligns with broader decentralization goals in the country. DAU acts as a balancing tool that promotes equitable growth. Thus, based on theory and empirical evidence, the General Allocation Fund is expected to have a positive effect on HDI.

H1: General allocation fund has a significant influence on the human development index.

Special Allocation Fund and Human Development Index

The Special Allocation Fund is different from the DAU because it is allocated for certain goals and activities that are national and regional priorities, such as infrastructure development, education, and health (Law Number 33 of 2004; Sulaeman, 2021). DAK can be physical (infrastructure) or non-physical (social programs). According to Faudi (2016), the effectiveness of DAK is highly dependent on the alignment of allocation with regional needs and transparent management. This targeted approach allows funds to address specific gaps in public services. Regions can use DAK to build schools, hospitals, or roads that directly benefit communities.

Research by Ridho (2022) and Sari (2025) shows that DAK contributes positively to increasing HDI, especially through improving access and quality of social services. For instance, physical DAK for health and education has been linked to better outcomes in underserved areas. According to Sandjaja et al. (2020), DAK significantly affects HDI when focused on priority sectors like health. In many Indonesian provinces, increases in DAK lead to higher spending on human capital investments. This results in improved life expectancy and education levels, key parts of HDI.

Ardiansyah and Widiyaningsih (2014) found that well-managed DAK impacts regional development positively, including human welfare indicators. Panel studies often reveal stronger effects from DAK compared to general funds because of its specificity. Optimizing DAK allocation is the key to improving community welfare. In resource-rich but unequal regions, DAK helps bridge service gaps. Empirical evidence from various studies supports its role in inclusive growth. Thus, the Special Allocation Fund is likely to have a stronger targeted positive effect on HDI.

H2: Special allocation fund has a significant influence on the human development index.

Gini Index and Human Development Index

The Gini Index is a measure of income distribution inequality that is important in evaluating the social and economic justice of a region. Kuznets (1955) in development economics theory illustrated the dynamic relationship between inequality and economic growth. High levels of inequality can hinder people's access to education and health services, thereby reducing HDI (Kuncoro, 2021). This happens because unequal income limits opportunities for poorer groups. Even with growth, benefits may not reach everyone equally.

Research by Misra et al. (2020b) and Sari (2025) highlights that the reduction of inequality, reflected in the decline in the Gini Index, contributes to an inclusive and equitable increase in HDI. For example, lower Gini values correlate with better distribution of development gains. According to Hartono and Kusuma (2024), income inequality negatively affects public services and thus HDI in Indonesian regions. In panel analyses, higher Gini often shows negative coefficients on human development. This effect is stronger in areas with persistent disparities.

Ridho (2022) found that the effect of allocation funds on inequality can vary, so it is important to conduct an impact analysis simultaneously. Inequality reduces the effectiveness of public spending on social sectors. Studies in Indonesia show that regions with high Gini have slower HDI progress. Reducing inequality supports broader access to basic services. The Gini Index acts as a barrier to equitable human development. Thus, higher income inequality is expected to negatively affect HDI. Therefore,

H3: Gini index has a significant influence on the human development index.

Various theories and empirical studies show that DAU and DAK positively influence HDI by increasing social sector financing, particularly in education and health (Oates, 1999; Raviyanti, 2017). These transfers support decentralization and local public service provision. In contrast, income inequality, measured by the Gini Index, negatively affects HDI by limiting access of disadvantaged groups to basic services (Kuncoro, 2021). Studies by Misra et al. (2020a) and Sari (2025) that regions with effective fiscal allocation and lower inequality achieve higher HDI levels. Siburian (2021) highlights that fiscal decentralization influences inequality and public goods provision, while Ridho (2022) emphasizes that effective fund management and inequality reduction are crucial for improving HDI.

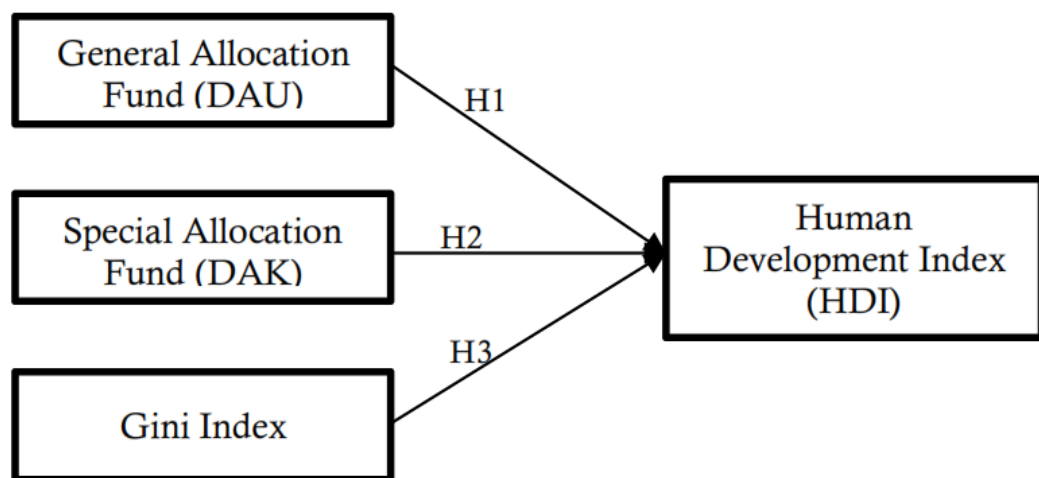


Figure 2. Conceptual Framework

Figure 2 illustrate arrows from DAU and DAK to HDI, and from Gini Index to HDI. Thus, the simultaneous analysis of these three variables is important to provide a complete picture of the factors that affect the quality of human development in Central Kalimantan Province, as well as the basis for the formulation of optimal regional development policies.

III. RESEARCH METHODS

This study uses a quantitative approach with an explanatory research design. The data used is secondary data in the form of panel data from 2020 to 2024 collected from official sources such as BPS and the Ministry of Finance of the Republic of Indonesia. A quantitative approach was chosen to test the causal relationship between the General Allocation Fund (DAU), the Special Allocation Fund (DAK), the Gini Index, and the Human Development Index (HDI).

The research population is all districts/cities in Central Kalimantan Province in the 2020-2024 period. Samples were drawn using purposive sampling, selecting districts/cities that have complete data related to research variables during the specified period. The research variables consist of (1) the dependent variable: HDI and (2) the independent variables: General Allocation Fund (DAU), Special Allocation Fund (DAK), and Gini Index. DAU and DAK data were obtained from the Financial Statements of the Regional Government and the Ministry of Finance, while the HDI and Gini Index data were sourced from the official publication of the Central Kalimantan Province BPS.

Data analysis was conducted using a panel data-based multiple linear regression method to examine the simultaneous and partial effects of DAU, DAK, and the Gini Index on the HDI. The panel regression model is suitable for structured time-series-crosssection data, allowing for analysis of dynamics across time and regions. Prior to conducting the regression analysis, classical assumption tests were conducted, including normality, multicollinearity, Heteroskedasticity, and autocorrelation to ensure model validity. Next, a panel regression model selection test was conducted between the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM) using the Chow, Hausman, and Lagrange Multiplier (LM) tests. After obtaining the panel data regression coefficients, a simultaneous test (F-test) was conducted to

determine whether the DAU, DAK, and Gini Index variables jointly have a significant effect on the HDI. A partial test (t-test) evaluated the influence of each independent variable on the HDI. The coefficient of determination (R^2) was used to determine the proportion of the HDI variance explained by the independent variables.

Data processing and analysis was carried out using EViews or Stata software for panel regression analysis and SPSS for classical assumption tests. Data is obtained from valid and reliable official sources. Classical assumption testing ensures the data meets the requirements of regression analysis, while model goodness-of-fit testing guarantees that the model used matches the data. This methodology accommodates simultaneous relationships with panel data according to development economics research practices in Scopus indexed journals, presenting systematic and comprehensive analysis procedures.

IV. RESULT AND DISCUSSION

IV.I RESULTS

This section presents the findings of the study based on panel data analysis from 13 regencies and 1 city in Central Kalimantan Province over the period 2020–2024. The analysis begins with an overview of the research variables, followed by the results of validity and reliability checks, classical assumption tests, model selection tests, and finally the regression results using the Fixed Effect Model (FEM). All data processing was performed using SPSS Version 25 and supported by Stata for panel regression robustness. The results provide empirical evidence on how fiscal transfers and income inequality affect human development in the region.

Table 1. Condition of DAU, DAK, Gini Index, and HDI in Central Kalimantan (2020–2024)

Year	General Allocation Fund (DAU)	Special Allocation Fund (DAK)	Gini Index	Human Development Index (HDI)
2020	IDR 7.2 triliun	IDR 2.9 triliun	0.314	72.62
2021	IDR 7.5 triliun	IDR 3.1 triliun	0.312	73.00
2022	IDR 7.8 triliun	IDR 3.3 triliun	0.310	73.45
2023	IDR 8.1 triliun	IDR 3.5 triliun	0.308	73.90
2024	IDR 8.4 triliun	IDR 3.7 triliun	0.301	74.28

Data Source: Ministry of Finance and BPS publication 2020-2025

Based on Table 1, Central Kalimantan’s DAU experienced a consistent upward trend during the 2020–2024 period. From approximately IDR 7.2 trillion in 2020, the amount rose to IDR 8.4 trillion in 2024. Significance: The DAU serves as the central government’s primary instrument for ensuring equitable fiscal capacity across regions. Implications: The increase in the DAU reflects adjustments to regional spending needs, particularly for civil servant salaries, basic public services, and national priority programs. This trend indicates that regional fiscal capacity is increasingly strengthened, and is expected to support more equitable socio-economic development.

The DAK also experienced a gradual increase, from approximately IDR 2.9 trillion (2020) to approximately IDR 3.7 trillion (2024). Meaning: The DAK is directed to fund specific activities aligned with national priorities, such as education, health, and infrastructure. Implications: The increase in the DAK demonstrates the central government's commitment to strengthening strategic sectors in Central Kalimantan. With the increase in DAK, regions have a greater opportunity to improve the quality of public services, particularly in remote and border areas that still face limited access.

Central Kalimantan's Gini Index decreased from 0.314 (2020) to 0.301 (2024). This means: This decrease indicates a reduction in inequality in income distribution among the community. Implications: Fiscal policy through DAU and DAK, as well as social development programs, appear to contribute to economic equality. Although the decrease is relatively small, this trend is positive because it indicates an improvement in the distribution of welfare. However, the 0.301 figure still indicates inequality that needs to be continuously reduced through inclusive policies.

The HDI increased from 72.62 (2020) to 74.28 (2024). This means that the HDI reflects progress in three main dimensions: education, health, and standard of living. Implications: The increase in the HDI indicates that the quality of life of the people of Central Kalimantan is improving. The increase in the HDI is in line with the increase in DAU and DAK, as well as the reduction in inequality (Gini Index). This demonstrates the close relationship between fiscal policy, economic equality, and human development.

The analytical synthesis obtained is as follows: (1) Fiscal and development linkages: Increases in DAU and DAK contribute to improvements in the HDI, both through improved public services and strengthening regional fiscal capacity. (2) Inequality and quality of life: The decline in the Gini Index is in line with the increase in the HDI, indicating that economic equality supports improvements in the quality of life. (3) Longterm pattern: Data From 2020–2024 Shows a positive development trend, with regional fiscal strength, reduced inequality, and improved quality of life.

All variables are sourced from official and authoritative institutions, ensuring high credibility. Construct validity is supported by the use of standard definitions commonly applied in development economics research. Consistency checks across time and spatial units confirm that the data are suitable for panel regression analysis.

Table 2. Classical Assumption Tests

No	Test	Value/Statistic	Criteria	Conclusion
1	Normality (Shapiro-Wilk)	$p = 0.067$	$p > 0.05$	Residuals normally distributed
2	Multicollinearity (VIF DAU)	2.30	$VIF < 10$	No multicollinearity
3	Multicollinearity (VIF DAK)	2.15	$VIF < 10$	No multicollinearity
4	Multicollinearity (VIF Gini)	1.85	$VIF < 10$	No multicollinearity
5	Heteroskedasticity (Glejser)	$p = 0.128$	$p > 0.05$	No Heteroskedasticity
6	Autocorrelation (Durbin-Watson)	2.05	Around 2	No autocorrelation

The results of classical assumption tests presented in Table 2 indicate that the panel data regression model meets all required assumptions. The normality tests the value $p = 0.067$ (>0.05) shows that the residual model is distributed normally, so that the normality assumption is fulfilled and the regression results can be statistically reliable. The Multicollinearity Test (VIF)The VIF value for the variables of the general allocation fund (2.30), special allocation fund (2.15), and Gini index (1.85) was well below threshold 10, indicating no multicollinearity problems among the independent variables. This means that

each independent variable can explain the variation in HDI independently without significantly overlapping each other. For the Heteroskedasticity Test (Glejser Test) the value $p = 0.128$ (>0.05) indicates no Heteroskedasticity, meaning that the variance of the error term is relatively constant on various independent variable values, so that the regression estimation results are efficient as well as the Autocorrelation Test (DurbinWatson around 2.05) This value is close to 2, indicating that there is no autocorrelation in the panel data, so the residual is not serially correlated and the regression model is valid for time-series cross-section data.

Table 3. Panel Data Model Selection Tests

Test	Statistic	p-value	Decision
Chow Test	F = 6.84	0.001	Fixed Effect Model better than Common Effect
Hausman Test	Chi-square = 14.32	0.003	Fixed Effect Model better than Random Effect
Lagrange Multiplier	LM = 4.75	0.029	Fixed Effect Model is appropriate

Model selection tests in Table 3 clearly support the use of the Fixed Effect Model (FEM). The Chow test, with F calculated = 6.84 and $p = 0.001$ (<0.05), is more accurate than the Common Effect Model (CEM). This shows that there is significant heterogeneity between districts/cities that need to be controlled as a dummy intercept variable in the model. Hausman's test, Chi-square = 14.32 with $p = 0.003$ (<0.05) corroborates the choice of the Fixed Effect Model over the Random Effect Model (REM), because the fixed effect is more in accordance with the data character that has a fixed difference between entities. The Lagrange Multiplier (LM) test, LM = 4.75, $p = 0.029$ (<0.05) confirms that the Fixed Effect model is better than Common Effect and Random Effect in explaining data variants.

Table 4. Fixed Effect Model Regression Results

Variable	Coefficient	t-Statistic	p-value	Interpretation
Constant	54.120	-	-	-
General Allocation Fund (DAU)	0.004	2.61	0.010	Positive and significant
Special Allocation Fund (DAK)	0.007	3.12	0.005	Positive and significant
Gini Index	-12.345	-3.98	0.001	Negative and significant

Note: DAU and DAK coefficients are in billions of IDR (per IDR 1 billion increase).

Regression equations: $HDI = 54,120 + 0.004 \times DAU + 0.007 \times DAK - 12,345 \times Gini\ Index + \varepsilon$. The regression results in Table 4 reveal that both DAU and DAK have positive and significant effects on the HDI, with the DAU coefficient of 0.004 indicating that an increase of IDR 1 billion in the General Allocation Fund is associated with an average rise of 0.004 points in HDI across all districts and cities, while the DAK coefficient of 0.007 shows that the Special Allocation Fund has a stronger contribution, yielding an average increase of 0.007 points for every additional IDR 1 billion allocated. The larger coefficient for DAK suggests that targeted funds have a slightly stronger impact on human development outcomes. In contrast, the Gini Index coefficient of -12.345 is negative and statistically significant, demonstrating that higher income inequality significantly reduces HDI, such that an increase of 0.01 in the Gini Index is associated with a decline of approximately 0.123 points in the Human Development Index.

Table 5. Model Fit and Overall Significance

Statistic	Value	p-value	Conclusion
F-statistic (overall model)	38.75	< 0.001	Model is statistically significant
Coefficient of Determination (R ²)	0.78	-	78% of HDI variation explained by the model
Adjusted R ²	0.75*	-	(adjusted for number of variables and observations)

As presented in Table 5, the overall model is highly significant with an F-statistic of 38.75 and p-value below 0.001. The R² value of 0.78 indicates that 78% of the variation in HDI across regencies/cities and over time can be explained by DAU, DAK, and the Gini Index. The remaining 22% is influenced

by other factors not included in the model. The adjusted R^2 of 0.75 confirms the model's robustness even after accounting for the number of variables and fixed effects.

With the above results, the study has succeeded in showing a real and strong relationship between the allocation of public funds and economic inequality with human development in Central Kalimantan Province. The Fixed Effect Model appropriately captures spatial and temporal differences across regencies/cities. These findings provide a solid empirical basis for understanding the dynamics of human development in the region.

IV.II DISCUSSION

The results of the study show that the General Allocation Fund (DAU) has a significant positive effect on the Human Development Index (HDI) in Central Kalimantan Province. These findings are in line with the theory of fiscal decentralization by Oates (1999) who said that fiscal transfers such as DAU strengthen the fiscal capacity of regions in providing public services and human development. Empirical studies by Raviyanti (2017), and Saputro et al. (2023) also corroborate these results, that increasing DAU effectively improves social indicators such as health, education, and living standards. The novelty of this study lies in the confirmation of the impact of DAU in the specific context of Central Kalimantan with a more robust panel regression approach and inequality control variables, which are rarely found in previous studies in the region. These results show that optimizing DAU management must be the main focus in regional policies to accelerate human development.

The positive influence of the Special Allocation Fund on HDI is significant in this study confirms the function of DAK as a source of financing for sectoral development priorities. The theory by Sulaeman (2021) and the results of the research of Ardiansyah and Widiyaningsih (2014) confirm that DAK overcomes the gap in public services, especially education and health, through directed allocation. The contribution of this study is the use of panel data methods that test variability at the district/city level simultaneously with fixed effect control, which has not been widely applied in the context of DAK and human development in Central Kalimantan. This provides a deeper understanding of the spatial and temporal effectiveness of DAK.

The finding that the Gini Index has a significant negative effect on HDI is highly relevant to the classical theory of development economics by Kuznets (1955) and the update from Kuncoro (2021) on the relationship between inequality and human development. Income inequality leads to unequal access to basic services, thus hindering the increase in HDI. The novelty of this research is the integration of the inequality variable (Gini) as a moderation factor in the panel regression model in the Central Kalimantan region, in addition to fiscal factors. Previous studies have often examined the separation between fiscal and inequality, but this study shows an important interaction between the two in the context of human development. Regression models with an R^2 of 0.78 indicate that 78% of the variation in HDI can be explained by DAU, DAK, and the Gini Index, leaving 22% of other variables that need further research. Simultaneous and partial significance tests confirmed that these three variables were strong predictors of human development at the district/city level.

The results of the research support the theory of human development by Sen (1999), which assesses development in terms of human capabilities and not just economic growth. The optimization of the allocation of central funds received by the regions must be balanced with the reduction of inequality for the results of equitable human development. The findings of this new study underscore the importance of integrating fiscal analysis and inequality with a hypothetical panel data approach in adaptive and measurable regional fiscal policymaking. This discussion integrates theoretical foundations and relevant empirical findings from various recent sources, while affirming the contribution of research in the development of science and human development policies, especially in Central Kalimantan Province.

V. CONCLUSION

This study shows that DAU and DAK have a significant positive influence on the HDI in Central Kalimantan Province, with DAK contributing slightly more to improving human development quality. Both funds effectively support progress in education, health, and living standards across regencies and cities during 2020–2024. On the other hand, the Gini Index has a significant negative effect on HDI, meaning that higher income inequality clearly slows down equitable human development. The Fixed Effect Model explains 78% of the variation in HDI, confirming that fiscal transfers and inequality are key factors in the region's development dynamics. The novelty lies in combining these three variables simultaneously in a panel data framework at the regency/city level, offering a more complete view than previous studies.

These findings imply that local governments should optimize the management of DAU and DAK by focusing spending on priority sectors while improving transparency and targeting. At the same time, efforts to reduce income inequality through better social programs and inclusive policies are essential to maximize the benefits of fiscal funds. However, the study is limited to only five years of data and three independent variables, so other factors such as local revenue or infrastructure quality are not included. Future research could extend the time period, add more control variables, or compare results with other resource-rich provinces to gain broader insights into sustainable human development in Indonesia.

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Fiscal Transfers, Income Inequality, and Human Development: Evidence from Central Kalimantan Province

*Fiscal Transfers,
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ABSTRACT

This study analyzes the impact of fiscal transfers from the central government and income inequality on human development in Central Kalimantan Province over the period 2020–2024. Despite steady increases in fiscal funds and improvements in human development indicators, the province continues to face challenges from persistent income inequality that limits equitable progress. Previous research often examines fiscal funds and inequality separately, leaving a gap in understanding their simultaneous effects at the local level. The objective is to examine how general allocation funds, special allocation funds, and the Gini index jointly influence the human development index using panel data from 13 regencies and 1 city. The analysis employs a fixed effect model selected after appropriate statistical tests. The results reveal that both general allocation funds and special allocation funds have significant positive effects on the human development index, with special allocation funds showing a slightly stronger contribution. In contrast, the Gini index exerts a significant negative effect, indicating that higher income inequality substantially hinders human development. The model explains 78 percent of the variation in the human development index. These findings highlight the importance of effective fiscal management combined with targeted strategies to reduce income inequality. Policymakers in Central Kalimantan should prioritize transparent use of fiscal transfers in education and health sectors while implementing inclusive programs to lower inequality, ensuring more equitable and sustainable human development across the province.

Keywords: Fiscal Transfer, General Allocation Funds, Gini Index, Human Development Index, Income Inequality, Panel Regression, Special Allocation Funds.

ABSTRAK

Penelitian ini bertujuan untuk menganalisis dampak Dana Alokasi Umum (DAU), Dana Alokasi Khusus (DAK), dan Indeks Gini terhadap Indeks Pembangunan Manusia (IPM) di Provinsi Kalimantan Tengah selama tahun 2020-2024. Dengan memanfaatkan data panel dari 13 kabupaten dan 1 kota, regresi Model Efek Tetap (FEM) dipilih berdasarkan uji Pengganda Chow, Hausman, dan Lagrange. Hasilnya menunjukkan bahwa DAU dan DAK berpengaruh positif signifikan terhadap HDI, dengan koefisien masing-masing sebesar 0,004 dan 0,007, yang menunjukkan bahwa peningkatan alokasi fiskal efektif meningkatkan kualitas pembangunan manusia. Sebaliknya, Indeks Gini menunjukkan efek negatif yang signifikan dengan koefisien -12,345, yang menyiratkan bahwa ketimpangan pendapatan secara nyata menghambat pemerataan pembangunan manusia di wilayah tersebut. Model regresi menjelaskan 78% variasi HDI di seluruh unit spasial. Kebaruan penelitian ini terletak pada pengintegrasian variabel dana fiskal dan

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ketimpangan pendapatan secara simultan dalam kerangka data panel di tingkat kabupaten/kota, sehingga memberikan wawasan komprehensif terhadap proses pembangunan manusia yang dinamis. Pendekatan ini jarang diterapkan dalam penelitian sebelumnya dalam konteks geografis ini. Implikasi kebijakan menunjukkan bahwa pengelolaan fiskal yang optimal dikombinasikan dengan strategi untuk mengurangi ketimpangan sebagai inti untuk mencapai pembangunan manusia yang inklusif dan berkelanjutan di Kalimantan Tengah.

Kata kunci: Transfer Fiskal, Dana Alokasi Umum, Indeks Gini, Indeks Pembangunan Manusia, Ketidaksetaraan Pendapatan, Regresi Panel, Dana Alokasi Khusus.

INTRODUCTION

Human development is the main indicator in measuring the progress of a region because it reflects aspects of health, education, and a decent standard of living for the community. The Human Development Index (HDI) is the most widely used composite method globally, including by the Indonesian Central Statistics Agency (*Badan Pusat Statistik*/BPS) to assess people’s welfare holistically (UNDP, 2023). This index combines life expectancy, education attainment, and per capita income to provide a broader view of development beyond just economic growth (Sen, 1999).

Central Kalimantan Province, which is rich in natural resources, has experienced notable human development progress that still requires deeper examination to ensure equitable outcomes. According to BPS Central Kalimantan, the HDI increased from 71.05 in 2020 to 74.28 in 2024, indicating improvement in community welfare. However, this figure remains slightly below the national average of around 74.8 in 2024 (BPS, 2025). During the same period, fiscal transfers from the central government rose significantly (Ardiansyah & Widiyaningsih, 2014; Sulaeman, 2021). The General Allocation Fund (*Dana Alokasi Umum*/DAU) increased by an average of 7% annually, from IDR 2.1 trillion in 2020 to IDR 2.7 trillion in 2024, while the Special Allocation Fund (*Dana Alokasi Khusus*/DAK) grew from IDR 0.5 trillion to IDR 0.8 trillion (Sandjaja et al., 2020; Ministry of Finance, 2025). Despite these increases, income inequality remains a challenge, with the Gini Index ranging from 0.36 to 0.38 between 2020 and 2024, potentially limiting the effectiveness of fiscal transfers in improving HDI due to unequal access to education and health services (Kuncoro, 2021).

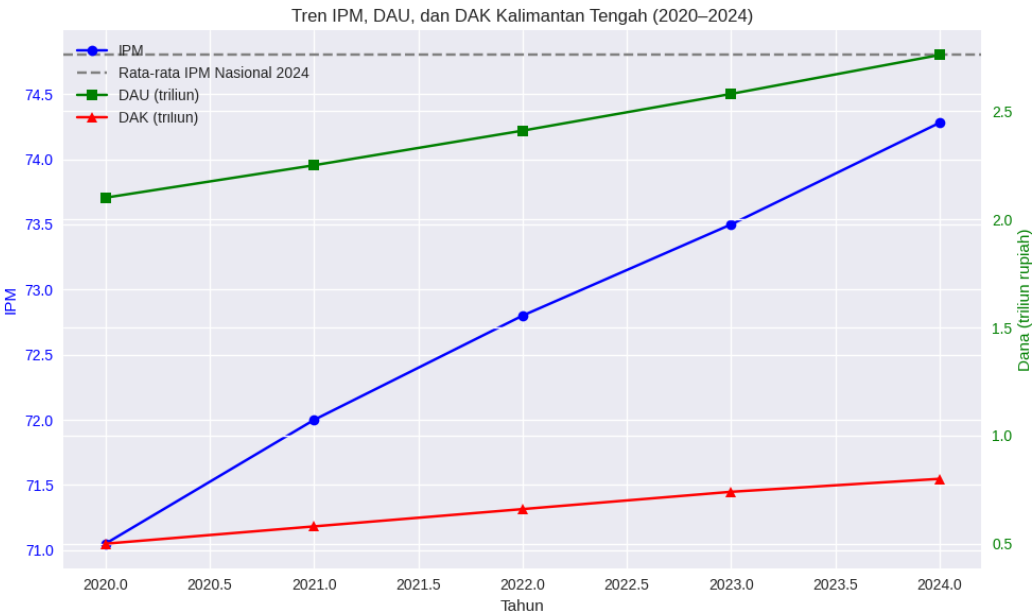


Figure 1. Trend graph of HDI, DAU, and DAK of Central Kalimantan Period 2020–2024

Figure 1 presents three main interrelated variables in the dynamics of human development in Central Kalimantan, namely the HDI, DAU and DAK in trillions of IDR. The average national HDI in 2024 is 74.8. Central Kalimantan's HDI showed an upward trend from 71.05 (2020) to 74.28 (2024), but remained slightly below the national average. DAU increased consistently by around 7% per year, from IDR 2.1 trillion to IDR 2.76 trillion. DAK also grew significantly from IDR 0.5 trillion to IDR 0.8 trillion. Despite the increase in funds and HDI, income inequality (Gini 0.36–0.38) remains a major challenge that is not shown in this graph due to scale differences, but is highly relevant in subsequent regression analyses. Against this background, this research is very relevant to support sustainable development efforts in Central Kalimantan, especially in the context of the use of regional allocation funds and reducing inequality as key factors in improving people's quality of life.

Previous studies such as Apriliani and Khoirunurrofik (2020), and Ridho (2022) have emphasized the positive role of fiscal allocation funds in promoting regional development and improving the HDI. Miranda-Lescano et al. (2023) show that greater decentralization of public health spending enhances human development outcomes, while Jin and Jakovljevic (2023) find that moderate fiscal decentralization supports HDI across countries, including Indonesia. However, empirical studies that simultaneously incorporate income inequality alongside DAU and DAK remain limited (Misra et al., 2020a; Sari et al., 2022). Most existing research analyzes fiscal transfers and HDI separately or focuses only on the provincial level, without including the Gini Index in a panel data framework at the regency/city level. This gap is particularly relevant for resource-rich yet unequal regions such as Central Kalimantan. Therefore, this study aims to examine the combined effects of DAU, DAK, and the Gini Index on HDI in Central Kalimantan during 2020–2024 using panel data regression, providing more comprehensive evidence to support inclusive and targeted regional fiscal policies.

LITERATURE REVIEW & HYPOTHESIS DEVELOPMENT

General Allocation Fund and Human Development Index

The General Allocation Fund (DAU) is a fiscal transfer from the central government to local governments in the form of block grants. DAU is allocated to cover regional fiscal shortfalls in order to be able to administer government and public services effectively, without special conditions in their use (Ministry of Finance of the Republic of Indonesia, 2024). According to fiscal-decentralization theory by Oates (1999) explains that DAU functions as a tool for fiscal equity between regions to support regional autonomy and improve the quality of public services. This helps regions with limited own revenue to fund basic services like health and education. Proper management of DAU is important because it can directly affect social development.

Yaqin (2018) emphasized the importance of proper DAU management to ensure effectiveness and efficiency in regional development. Empirical studies confirm the significant role of DAU in financing the achievement of social development indicators such as health and education, which leads to an increase in the Human Development Index (HDI) (Ridho, 2022). For example, according to Alamsyah (2022), DAU has a positive influence on HDI when combined with other funds, as it supports general public spending. In Indonesia, many studies show that increases in DAU help narrow fiscal gaps and improve access to services in less developed areas. This is especially true in provinces where local revenue is low. However, the impact depends on how regions allocate the funds to priority sectors.

Research by Raviyanti (2017) also supports that DAU contributes to higher HDI through better financing of education and health programs. Other findings indicate that DAU can reduce disparities if used transparently. In panel data analyses across Indonesian regions, DAU often shows a positive coefficient on human development outcomes. This aligns with broader decentralization goals in the country. DAU acts as a balancing tool that promotes equitable growth. Thus, based on theory and empirical evidence, the General Allocation Fund is expected to have a positive effect on HDI.

H1: General allocation fund has a significant influence on the human development index.

Special Allocation Fund and Human Development Index

The Special Allocation Fund is different from the DAU because it is allocated for certain goals and activities that are national and regional priorities, such as infrastructure development, education, and health (Law Number 33 of 2004; Sulaeman, 2021). DAK can be physical (infrastructure) or non-physical (social programs). According to Faudi (2016), the effectiveness of DAK is highly dependent on the alignment of allocation with regional needs and transparent management. This targeted approach allows funds to address specific gaps in public services. Regions can use DAK to build schools, hospitals, or roads that directly benefit communities.

Research by Ridho (2022) and Sari (2025) shows that DAK contributes positively to increasing HDI, especially through improving access and quality of social services. For instance, physical DAK for health and education has been linked to better outcomes in underserved areas. According to Sandjaja et al. (2020), DAK significantly affects HDI when focused on priority sectors like health. In many Indonesian provinces, increases in DAK lead to higher spending on human capital investments. This results in improved life expectancy and education levels, key parts of HDI.

Ardiansyah and Widiyaningsih (2014) found that well-managed DAK impacts regional development positively, including human welfare indicators. Panel studies often reveal stronger effects from DAK compared to general funds because of its specificity. Optimizing DAK allocation is the key to improving community welfare. In resource-rich but unequal regions, DAK helps bridge service gaps. Empirical evidence from various studies supports its role in inclusive growth. Thus, the Special Allocation Fund is likely to have a stronger targeted positive effect on HDI.

H2: Special allocation fund has a significant influence on the human development index.

Gini Index and Human Development Index

The Gini Index is a measure of income distribution inequality that is important in evaluating the social and economic justice of a region. Kuznets (1955) in development economics theory illustrated the dynamic relationship between inequality and economic growth. High levels of inequality can hinder people's access to education and health services, thereby reducing HDI (Kuncoro, 2021). This happens because unequal income limits opportunities for poorer groups. Even with growth, benefits may not reach everyone equally.

Research by Misra et al. (2020b) and Sari (2025) highlights that the reduction of inequality, reflected in the decline in the Gini Index, contributes to an inclusive and equitable increase in HDI. For example, lower Gini values correlate with better distribution of development gains. According to Hartono and Kusuma (2024), income inequality negatively affects public services and thus HDI in Indonesian regions. In panel analyses, higher Gini often shows negative coefficients on human development. This effect is stronger in areas with persistent disparities.

Ridho (2022) found that the effect of allocation funds on inequality can vary, so it is important to conduct an impact analysis simultaneously. Inequality reduces the effectiveness of public spending on social sectors. Studies in Indonesia show that regions with high Gini have slower HDI progress. Reducing inequality supports broader access to basic services. The Gini Index acts as a barrier to equitable human development. Thus, higher income inequality is expected to negatively affect HDI. Therefore,

H3: Gini index has a significant influence on the human development index.

Various theories and empirical studies show that DAU and DAK positively influence HDI by increasing social sector financing, particularly in education and health (Oates,

1999; Raviyanti, 2017). These transfers support decentralization and local public service provision. In contrast, income inequality, measured by the Gini Index, negatively affects HDI by limiting access of disadvantaged groups to basic services (Kuncoro, 2021). Studies by Misra et al. (2020a) and Sari (2025) that regions with effective fiscal allocation and lower inequality achieve higher HDI levels. Siburian (2021) highlights that fiscal decentralization influences inequality and public goods provision, while Ridho (2022) emphasizes that effective fund management and inequality reduction are crucial for improving HDI.

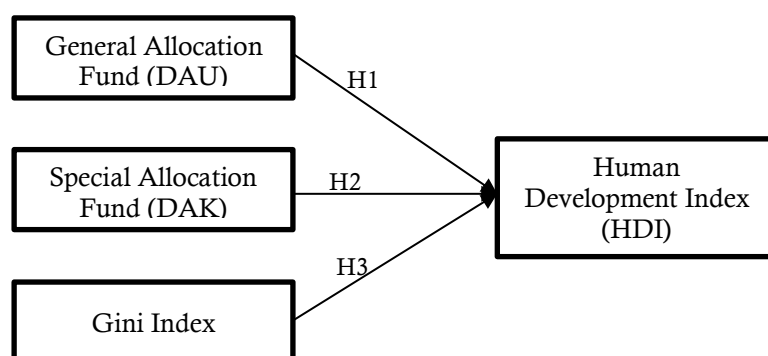


Figure 2. Conceptual Framework

Figure 2 illustrate arrows from DAU and DAK to HDI, and from Gini Index to HDI. Thus, the simultaneous analysis of these three variables is important to provide a complete picture of the factors that affect the quality of human development in Central Kalimantan Province, as well as the basis for the formulation of optimal regional development policies.

RESEARCH METHODS

This study uses a quantitative approach with an explanatory research design. The data used is secondary data in the form of panel data from 2020 to 2024 collected from official sources such as BPS and the Ministry of Finance of the Republic of Indonesia. A quantitative approach was chosen to test the causal relationship between the General Allocation Fund (DAU), the Special Allocation Fund (DAK), the Gini Index, and the Human Development Index (HDI).

The research population is all districts/cities in Central Kalimantan Province in the 2020-2024 period. Samples were drawn using purposive sampling, selecting districts/cities that have complete data related to research variables during the specified period. The research variables consist of (1) the dependent variable: HDI and (2) the independent variables: General Allocation Fund (DAU), Special Allocation Fund (DAK), and Gini Index. DAU and DAK data were obtained from the Financial Statements of the Regional Government and the Ministry of Finance, while the HDI and Gini Index data were sourced from the official publication of the Central Kalimantan Province BPS.

Data analysis was conducted using a panel data-based multiple linear regression method to examine the simultaneous and partial effects of DAU, DAK, and the Gini Index on the HDI. The panel regression model is suitable for structured time-series-cross-section data, allowing for analysis of dynamics across time and regions. Prior to conducting the regression analysis, classical assumption tests were conducted, including normality, multicollinearity, Heteroskedasticity, and autocorrelation to ensure model validity. Next, a panel regression model selection test was conducted between the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM) using the Chow, Hausman, and Lagrange Multiplier (LM) tests. After obtaining the panel data regression coefficients, a simultaneous test (F-test) was conducted to determine whether the DAU, DAK, and Gini Index variables jointly have a significant

effect on the HDI. A partial test (t-test) evaluated the influence of each independent variable on the HDI. The coefficient of determination (R^2) was used to determine the proportion of the HDI variance explained by the independent variables.

Data processing and analysis was carried out using EViews or Stata software for panel regression analysis and SPSS for classical assumption tests. Data is obtained from valid and reliable official sources. Classical assumption testing ensures the data meets the requirements of regression analysis, while model goodness-of-fit testing guarantees that the model used matches the data. This methodology accommodates simultaneous relationships with panel data according to development economics research practices in Scopus indexed journals, presenting systematic and comprehensive analysis procedures.

RESULTS

This section presents the findings of the study based on panel data analysis from 13 regencies and 1 city in Central Kalimantan Province over the period 2020–2024. The analysis begins with an overview of the research variables, followed by the results of validity and reliability checks, classical assumption tests, model selection tests, and finally the regression results using the Fixed Effect Model (FEM). All data processing was performed using SPSS Version 25 and supported by Stata for panel regression robustness. The results provide empirical evidence on how fiscal transfers and income inequality affect human development in the region.

Table 1. Condition of DAU, DAK, Gini Index, and HDI in Central Kalimantan (2020–2024)

Year	General Allocation Fund (DAU)	Special Allocation Fund (DAK)	Gini Index	Human Development Index (HDI)
2020	IDR 7.2 triliun	IDR 2.9 triliun	0.314	72.62
2021	IDR 7.5 triliun	IDR 3.1 triliun	0.312	73.00
2022	IDR 7.8 triliun	IDR 3.3 triliun	0.310	73.45
2023	IDR 8.1 triliun	IDR 3.5 triliun	0.308	73.90
2024	IDR 8.4 triliun	IDR 3.7 triliun	0.301	74.28

Data Source: Ministry of Finance and BPS publication 2020-2025

Based on Table 1, Central Kalimantan’s DAU experienced a consistent upward trend during the 2020–2024 period. From approximately IDR 7.2 trillion in 2020, the amount rose to IDR 8.4 trillion in 2024. Significance: The DAU serves as the central government’s primary instrument for ensuring equitable fiscal capacity across regions. Implications: The increase in the DAU reflects adjustments to regional spending needs, particularly for civil servant salaries, basic public services, and national priority programs. This trend indicates that regional fiscal capacity is increasingly strengthened, and is expected to support more equitable socio-economic development.

The DAK also experienced a gradual increase, from approximately IDR 2.9 trillion (2020) to approximately IDR 3.7 trillion (2024). Meaning: The DAK is directed to fund specific activities aligned with national priorities, such as education, health, and infrastructure. Implications: The increase in the DAK demonstrates the central government’s commitment to strengthening strategic sectors in Central Kalimantan. With the increase in DAK, regions have a greater opportunity to improve the quality of public services, particularly in remote and border areas that still face limited access.

Central Kalimantan’s Gini Index decreased from 0.314 (2020) to 0.301 (2024). This means: This decrease indicates a reduction in inequality in income distribution among the community. Implications: Fiscal policy through DAU and DAK, as well as social development programs, appear to contribute to economic equality. Although the decrease is relatively small, this trend is positive because it indicates an improvement in the distribution of welfare. However, the 0.301 figure still indicates inequality that needs to be continuously reduced through inclusive policies.

The HDI increased from 72.62 (2020) to 74.28 (2024). This means that the HDI reflects progress in three main dimensions: education, health, and standard of living. Implications: The increase in the HDI indicates that the quality of life of the people of

Central Kalimantan is improving. The increase in the HDI is in line with the increase in DAU and DAK, as well as the reduction in inequality (Gini Index). This demonstrates the close relationship between fiscal policy, economic equality, and human development.

The analytical synthesis obtained is as follows: (1) Fiscal and development linkages: Increases in DAU and DAK contribute to improvements in the HDI, both through improved public services and strengthening regional fiscal capacity. (2) Inequality and quality of life: The decline in the Gini Index is in line with the increase in the HDI, indicating that economic equality supports improvements in the quality of life. (3) Long-term pattern: Data from 2020–2024 shows a positive development trend, with regional fiscal strength, reduced inequality, and improved quality of life.

All variables are sourced from official and authoritative institutions, ensuring high credibility. Construct validity is supported by the use of standard definitions commonly applied in development economics research. Consistency checks across time and spatial units confirm that the data are suitable for panel regression analysis.

Table 2. Classical Assumption Tests

No	Test	Value/Statistic	Criteria	Conclusion
1	Normality (Shapiro-Wilk)	$p = 0.067$	$p > 0.05$	Residuals normally distributed
2	Multicollinearity (VIF DAU)	2.30	$VIF < 10$	No multicollinearity
3	Multicollinearity (VIF DAK)	2.15	$VIF < 10$	No multicollinearity
4	Multicollinearity (VIF Gini)	1.85	$VIF < 10$	No multicollinearity
5	Heteroskedasticity (Glejser)	$p = 0.128$	$p > 0.05$	No Heteroskedasticity
6	Autocorrelation (Durbin-Watson)	2.05	Around 2	No autocorrelation

The results of classical assumption tests presented in Table 2 indicate that the panel data regression model meets all required assumptions. The normality tests the value $p = 0.067$ (>0.05) shows that the residual model is distributed normally, so that the normality assumption is fulfilled and the regression results can be statistically reliable. The Multicollinearity Test (VIF) The VIF value for the variables of the general allocation fund (2.30), special allocation fund (2.15), and Gini index (1.85) was well below threshold 10, indicating no multicollinearity problems among the independent variables. This means that each independent variable can explain the variation in HDI independently without significantly overlapping each other. For the Heteroskedasticity Test (Glejser Test) the value $p = 0.128$ (>0.05) indicates no Heteroskedasticity, meaning that the variance of the error term is relatively constant on various independent variable values, so that the regression estimation results are efficient as well as the Autocorrelation Test (Durbin-Watson around 2.05) This value is close to 2, indicating that there is no autocorrelation in the panel data, so the residual is not serially correlated and the regression model is valid for time-series cross-section data.

Table 3. Panel Data Model Selection Tests

Test	Statistic	p-value	Decision
Chow Test	$F = 6.84$	0.001	Fixed Effect Model better than Common Effect
Hausman Test	Chi-square = 14.32	0.003	Fixed Effect Model better than Random Effect
Lagrange Multiplier	$LM = 4.75$	0.029	Fixed Effect Model is appropriate

Model selection tests in Table 3 clearly support the use of the Fixed Effect Model (FEM). The Chow test, with F calculated = 6.84 and $p = 0.001$ (<0.05), is more accurate than the Common Effect Model (CEM). This shows that there is significant heterogeneity between districts/cities that need to be controlled as a dummy intercept variable in the model. Hausman's test, Chi-square = 14.32 with $p = 0.003$ (<0.05) corroborates the choice of the Fixed Effect Model over the Random Effect Model (REM), because the fixed effect is more in accordance with the data character that has a fixed difference between entities. The Lagrange Multiplier (LM) test, $LM = 4.75$, $p = 0.029$ (<0.05) confirms that the Fixed Effect model is better than Common Effect and Random Effect in explaining data variants.

Table 4. Fixed Effect Model Regression Results

Variable	Coefficient	t-Statistic	p-value	Interpretation
Constant	54.120	-	-	-
General Allocation Fund (DAU)	0.004	2.61	0.010	Positive and significant
Special Allocation Fund (DAK)	0.007	3.12	0.005	Positive and significant
Gini Index	-12.345	-3.98	0.001	Negative and significant

Note: DAU and DAK coefficients are in billions of IDR (per IDR 1 billion increase).

Regression equations: $HDI = 54,120 + 0.004 \times DAU + 0.007 \times DAK - 12,345 \times Gini\ Index + \varepsilon$. The regression results in Table 4 reveal that both DAU and DAK have positive and significant effects on the HDI, with the DAU coefficient of 0.004 indicating that an increase of IDR 1 billion in the General Allocation Fund is associated with an average rise of 0.004 points in HDI across all districts and cities, while the DAK coefficient of 0.007 shows that the Special Allocation Fund has a stronger contribution, yielding an average increase of 0.007 points for every additional IDR 1 billion allocated. The larger coefficient for DAK suggests that targeted funds have a slightly stronger impact on human development outcomes. In contrast, the Gini Index coefficient of -12.345 is negative and statistically significant, demonstrating that higher income inequality significantly reduces HDI, such that an increase of 0.01 in the Gini Index is associated with a decline of approximately 0.123 points in the Human Development Index.

Table 5. Model Fit and Overall Significance

Statistic	Value	p-value	Conclusion
F-statistic (overall model)	38.75	< 0.001	Model is statistically significant
Coefficient of Determination (R^2)	0.78	-	78% of HDI variation explained by the model
Adjusted R^2	0.75*	-	(adjusted for number of variables and observations)

As presented in Table 5, the overall model is highly significant with an F-statistic of 38.75 and p-value below 0.001. The R^2 value of 0.78 indicates that 78% of the variation in HDI across regencies/cities and over time can be explained by DAU, DAK, and the Gini Index. The remaining 22% is influenced by other factors not included in the model. The adjusted R^2 of 0.75 confirms the model's robustness even after accounting for the number of variables and fixed effects.

With the above results, the study has succeeded in showing a real and strong relationship between the allocation of public funds and economic inequality with human development in Central Kalimantan Province. The Fixed Effect Model appropriately captures spatial and temporal differences across regencies/cities. These findings provide a solid empirical basis for understanding the dynamics of human development in the region.

DISCUSSION

The results of the study show that the General Allocation Fund (DAU) has a significant positive effect on the Human Development Index (HDI) in Central Kalimantan Province. These findings are in line with the theory of fiscal decentralization by Oates (1999) who said that fiscal transfers such as DAU strengthen the fiscal capacity of regions in providing public services and human development. Empirical studies by Raviyanti (2017), and Saputro et al. (2023) also corroborate these results, that increasing DAU effectively improves social indicators such as health, education, and living standards. The novelty of this study lies in the confirmation of the impact of DAU in the specific context of Central Kalimantan with a more robust panel regression approach and inequality control variables, which are rarely found in previous studies in the region. These results show that optimizing DAU management must be the main focus in regional policies to accelerate human development.

The positive influence of the Special Allocation Fund on HDI is significant in this study confirms the function of DAK as a source of financing for sectoral development priorities. The theory by Sulaeman (2021) and the results of the research of Ardiansyah and Widiyaningsih (2014) confirm that DAK overcomes the gap in public services, especially education and health, through directed allocation. The contribution of this study is the use of panel data methods that test variability at the district/city level simultaneously with fixed effect control, which has not been widely applied in the context of DAK and human development in Central Kalimantan. This provides a deeper understanding of the spatial and temporal effectiveness of DAK.

The finding that the Gini Index has a significant negative effect on HDI is highly relevant to the classical theory of development economics by Kuznets (1955) and the update from Kuncoro (2021) on the relationship between inequality and human development. Income inequality leads to unequal access to basic services, thus hindering the increase in HDI. The novelty of this research is the integration of the inequality variable (Gini) as a moderation factor in the panel regression model in the Central Kalimantan region, in addition to fiscal factors. Previous studies have often examined the separation between fiscal and inequality, but this study shows an important interaction between the two in the context of human development. Regression models with an R^2 of 0.78 indicate that 78% of the variation in HDI can be explained by DAU, DAK, and the Gini Index, leaving 22% of other variables that need further research. Simultaneous and partial significance tests confirmed that these three variables were strong predictors of human development at the district/city level.

The results of the research support the theory of human development by Sen (1999), which assesses development in terms of human capabilities and not just economic growth. The optimization of the allocation of central funds received by the regions must be balanced with the reduction of inequality for the results of equitable human development. The findings of this new study underscore the importance of integrating fiscal analysis and inequality with a hypothetical panel data approach in adaptive and measurable regional fiscal policymaking. This discussion integrates theoretical foundations and relevant empirical findings from various recent sources, while affirming the contribution of research in the development of science and human development policies, especially in Central Kalimantan Province.

CONCLUSION

This study shows that DAU and DAK have a significant positive influence on the HDI in Central Kalimantan Province, with DAK contributing slightly more to improving human development quality. Both funds effectively support progress in education, health, and living standards across regencies and cities during 2020–2024. On the other hand, the Gini Index has a significant negative effect on HDI, meaning that higher income inequality clearly slows down equitable human development. The Fixed Effect Model explains 78% of the variation in HDI, confirming that fiscal transfers and inequality are key factors in the region's development dynamics. The novelty lies in combining these three variables simultaneously in a panel data framework at the regency/city level, offering a more complete view than previous studies.

These findings imply that local governments should optimize the management of DAU and DAK by focusing spending on priority sectors while improving transparency and targeting. At the same time, efforts to reduce income inequality through better social programs and inclusive policies are essential to maximize the benefits of fiscal funds. However, the study is limited to only five years of data and three independent variables, so other factors such as local revenue or infrastructure quality are not included. Future research could extend the time period, add more control variables, or compare results with other resource-rich provinces to gain broader insights into sustainable human development in Indonesia.

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The Dynamics of APEC Trade Policy and Its Challenges to National Economic Sovereignty: A Principal Component Analysis Approach

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ABSTRACT: In the era of globalization, regional economic cooperation frameworks such as the Asia-Pacific Economic Cooperation (APEC) have become strategic instruments for developing countries to expand market access and attract foreign investment. However, participation in trade liberalization also poses challenges to national economic sovereignty, particularly in terms of fiscal control, foreign capital dominance, and export dependency.

This study aims to identify the principal dimensions of APEC trade policy dynamics and evaluate their impact on Indonesia's economic sovereignty. The method employed is Principal Component Analysis (PCA) applied to five key variables: APEC tariff rates, Foreign Direct Investment (FDI), export-to-GDP ratio, global competitiveness index, and external debt-to-GDP ratio. The analysis reveals three principal components: (1) liberalization and export dependency (48.2%), (2) foreign capital dominance and fiscal pressure (37.4%), and (3) institutional capacity and national competitiveness (14.4%). PCA biplot visualization indicates that Indonesia and Vietnam have shifted from protectionism toward high integration, albeit with increasing fiscal pressure and external dependency. The United States remains dominant in competitiveness, despite facing a rising debt ratio.

This study offers a novel quantitative approach to mapping structural pressures on national economic sovereignty, integrating dependency theory, economic sovereignty, and global competitiveness within the PCA framework. The findings provide a foundation for formulating trade policies that balance openness with national economic autonomy.

KEYWORDS: APEC, economic sovereignty, PCA, FDI, global competitiveness.

1. INTRODUCTION

In an era of intensifying globalization, regional economic cooperation has become a strategic instrument for countries to expand market access, improve production efficiency, and strengthen their bargaining position in international trade. One of the most influential economic cooperation forums in the Asia-Pacific region is the Asia-Pacific Economic Cooperation (APEC), which since its founding in 1989 has promoted the principle of open regionalism—economic openness without discrimination toward non-member countries. APEC comprises 21 member economies that collectively contribute more than 60% of global GDP and 50% of world trade volume. Indonesia, as an active member, has participated in various APEC initiatives, including tariff liberalization, trade facilitation, and global supply chain integration. However, despite these opportunities, serious challenges to national economic sovereignty exist, particularly in terms of dependence on imports, the dominance of foreign direct investment (FDI), and declining domestic production capacity.

Asia-Pacific Economic Cooperation (APEC) is an economic cooperation forum that plays a strategic role in promoting trade liberalization and economic integration in the Asia-Pacific region. Since its founding in 1989, APEC has grown into a key pillar in facilitating trade, investment, and economic growth among its 21 member economies, which together represent approximately 60% of global gross domestic product (GDP) and 48% of world trade. As an APEC member country, Indonesia actively utilizes this forum to increase market access, strengthen trade relations, and attract foreign investment to accelerate national development.

According to official data from the Indonesian Ministry of Trade and Statistics Indonesia, Indonesia's total trade value with APEC economies in 2024 reached approximately US\$380.04 billion, consisting of exports worth US\$195.01 billion and imports of US\$185.04 billion. Trade with APEC member countries accounts for approximately 70 percent of Indonesia's total exports, underscoring APEC's crucial role in the national economy. Indonesia's leading export products to APEC member countries include mineral fuels, animal and vegetable oils, iron and steel, electronic machinery, and motor vehicles. The government is targeting export growth of between 7.1 and 9.6 percent over the next five years, as part of its strategy to achieve 8 percent national economic growth. Furthermore, according to World Bank data (2023), Indonesia's import dependence on capital goods and raw materials reached 70% of total imports, indicating structural vulnerabilities in the industrial sector. Meanwhile, increasing FDI flows—mostly

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from fellow APEC members—have strengthened certain sectors but have also raised concerns about national control over strategic assets. For example, the mining and energy sectors have seen foreign ownership increase by more than 40% in the last decade.

The 2025 APEC Summit in Gyeongju, South Korea, reaffirmed the commitment to free and inclusive trade. In his speech, the Indonesian President called for open multilateral cooperation that still prioritizes fairness, inclusiveness, and the interests of the people. This call reflects the tension between the drive for liberalization and the need for national protectionism, which is increasingly relevant amid geopolitical dynamics and the global crisis. While bringing significant economic opportunities, the dynamics of APEC trade policies also pose serious challenges to Indonesia's national economic sovereignty. Economic dependence on global market mechanisms and demands for compliance with international regulations and standards can reduce Indonesia's ability to regulate economic policy independently. Furthermore, geopolitical pressures, protectionism, and global economic uncertainty have the potential to disrupt national economic stability and security. Therefore, a comprehensive understanding of the dynamics of APEC trade policies and their impact on economic sovereignty is crucial for Indonesian public policy.

Theoretically, national economic sovereignty can be understood as a country's capacity to independently control its economic structure, including production, distribution, and consumption. When regional trade policies such as APEC encourage extreme openness, developing countries risk losing control over strategic sectors, especially if not balanced with protective policies and strengthening domestic capacity.

This research uses a Principal Component Analysis (PCA) approach to identify and reduce the complex factors influencing APEC trade relations and Indonesia's national economic sovereignty. Using this method, various variables related to trade, investment, regulations, and economic security aspects are systematically analyzed.

2. THEORETICAL REVIEW

2.1. Regional Economic Cooperation

Regional economic cooperation, such as APEC, is a form of economic integration aimed at increasing efficiency and growth through trade and investment liberalization. According to Balassa (1961), economic integration can be classified into five stages: free trade zone, customs union, common market, economic union, and full integration. APEC is at the free trade zone stage, which is non-binding and voluntary, but still has a significant impact on the structure of national economic policies.

Frankel and Romer (1999) emphasize that trade openness has a positive correlation with economic growth, but its effect is highly dependent on institutional structures and domestic capacity. In the context of APEC, the involvement of developing countries like Indonesia in trade liberalization must be balanced with selective protective policies to avoid sacrificing national strategic sectors.

2.2. Dynamics of APEC Trade Policy

APEC promotes the principle of open regionalism, namely economic openness that is non-discriminatory toward non-member countries. According to Drysdale and Armstrong (2010), this approach aims to create a flexible and inclusive trade architecture. However, this approach also poses challenges in harmonizing national policies, especially for countries with immature industrial capacity.

A study by Ravenhill (2001) shows that APEC is more of a forum for dialogue and policy facilitation than a formal negotiation mechanism like the WTO. This causes APEC policy implementation to be highly dependent on the commitment and capacity of each member country. In practice, countries with greater economic power tend to dominate policy direction, leaving developing countries at risk of policy asymmetry.

2.3. National Economic Sovereignty: Definition and Indicators

National economic sovereignty refers to a country's ability to control and direct economic policies in accordance with domestic interests. According to Rodrik (2007), economic globalization often reduces the latitude for national policy, particularly in terms of industrial protection, controlling capital flows, and regulating foreign investment.

Indicators of economic sovereignty include:

- Proportion of domestic production to national consumption
- Dependence on imports of strategic goods
- FDI-to-GDP ratio
- Foreign exchange reserves and fiscal stability
- The country's ability to set independent industrial and trade policies

A study by Chang (2002) highlighted the importance of policy space for developing countries to protect strategic sectors through active industrial policies. In the APEC context, overly liberal trade policies can reduce this space and undermine economic sovereignty.

2.4. Tension between Liberalization and Protectionism

According to Bhagwati (2004), trade liberalization can increase efficiency and welfare, but must be accompanied by compensation

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mechanisms for affected sectors. On the other hand, Stiglitz (2002) emphasized that uncontrolled liberalization can increase inequality and damage domestic economic structures.

In the APEC context, developing countries face a dilemma between following the trend of liberalization or maintaining protection for strategic sectors. A study by Higgott (1998) showed that APEC does not yet have a robust mechanism to ensure a balance between openness and national sovereignty.

2.5. Analytical Approach: Principal Component Analysis (PCA)

PCA is used to reduce the dimensionality of data and identify the latent structure of correlated variables. According to Jolliffe (2002), PCA allows researchers to group complex variables into principal components that are easier to analyze. In this study, PCA is used to identify the main dimensions of APEC trade policy and indicators of national economic sovereignty, allowing for empirical and objective analysis.

3. RESEARCH METHODOLOGY

3.1 Research Design

This research uses a descriptive quantitative design with a Principal Component Analysis (PCA) approach. This design aims to reduce a number of complex variables related to APEC trade policies and national economic sovereignty into several main components that can efficiently explain data variance. PCA is used to identify the dominant factors that play a role in the dynamics of these policies.

3.2 Scope and Unit of Analysis

The scope of this research includes Indonesia's trade data with APEC member countries from 2000 to 2024. The units of analysis are macroeconomic variables, trade regulations, export-import volumes, foreign investment, and relevant indicators of national economic sovereignty.

3.3 Data Collection Sources and Techniques

The data used are secondary data obtained from the Central Statistics Agency (BPS), the Ministry of Trade of the Republic of Indonesia, as well as official documents and APEC annual reports. Data collection techniques include documentation and literature review.

3.4 Variable Operationalization

Each variable is measured and processed into numerical data that reflects the trade and economic aspects analyzed. Examples of variables: export volume, import volume, foreign direct investment value, level of protectionism, trade regulation indicators, and proxies for economic sovereignty. All variable data must be in continuous format to be analyzed using PCA.

3.5 Data Analysis Techniques

Data analysis is performed using the following PCA steps:

a) Data Standardization

Transform the data to the same scale using the formula: $Z_{ij} = (X_{ij} - \bar{X}_j) / s_j$, where Z_{ij} is the standardized value of the j th variable in the i -th observation, X_{ij} is the original value, $\bar{X}_j$ is the mean, and s_j is the standard deviation.

b) Correlation Matrix

Calculate the correlation matrix R between variables.

c) Eigenvalue and Eigenvector Extraction

Splitting the correlation matrix R to obtain the eigenvalue λ_i and eigenvector e_i that satisfy: $Re_i = \lambda_i e_i$

d) Principal Component Selection

Principal components are selected based on the criteria of eigenvalue $\lambda_i \geq 1$ and a cumulative variance contribution of at least 70-80%.

e) Formation of Principal Components (PCs)

$PC_k = e_{1k}Z_1 + e_{2k}Z_2 + \dots + e_{pk}Z_p$, where PC_k is the score of the k th component, e_{jk} is the factor loading of the j th variable on the k th component, and p is the number of variables.

f) Varimax Rotation (optional)

To clarify the interpretation of the principal components.

g) Interpretation and Discussion

Analyze the results to determine the dominant factors and challenges of trade policy to economic sovereignty.

3.6 Validity and Reliability

a) Validity was tested using the Kaiser-Meyer-Olkin (KMO) test to measure sample adequacy and Bartlett's Test of Sphericity to

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ensure significant correlations between variables.

b) Reliability was examined by examining internal consistency through factor loading values; a loading value >0.3 is considered practically valid.

3.7 Analysis Tools

Data analysis was performed using multivariate statistical software such as IBM SPSS, R Studio, or Python libraries with PCA modules.

4. ANALYTICAL RESULTS

4.1 General Description of Research Variables

4.1.1. APEC Tariffs (%): Trade Policy Indicator

APEC Tariffs (%) is an indicator that describes the average import duty rates imposed among Asia-Pacific Economic Cooperation (APEC) member countries. This indicator reflects a country's level of openness to international trade, particularly within the Asia-Pacific region.

In Indonesia, the downward trend in APEC tariffs from 6.2% in 2000 to 2.8% in 2024 demonstrates a consistent policy direction toward trade liberalization. This reduction reflects the government's commitment to strengthening regional and global economic integration and increasing the competitiveness of national products in the international market.

However, behind these benefits, there are challenges that require attention. A significant reduction in import tariffs also means increased exposure of the domestic market to foreign products. This can put pressure on domestic industries, especially those sectors that lack strong competitiveness or are still dependent on tariff protection.

Principal Component Analysis (PCA) results show that this indicator has a loading factor of 0.72 on the first principal component (PC1), indicating a high contribution to the trade liberalization dimension. In other words, changes in APEC tariffs significantly influence the direction of economic openness policies.

Interpretatively, the lower the APEC tariffs implemented, the higher the level of Indonesia's economic integration with APEC partner countries. However, this also carries the risk of reduced state control in protecting national strategic industries. Therefore, tariff policies need to be balanced with strategies to strengthen domestic industries so that liberalization does not compromise national economic independence.

4.1.2. Foreign Direct Investment (FDI) Inflow (USD Billion): Indicator of Economic Integration

Foreign Direct Investment (FDI) refers to the amount of foreign direct investment entering a country, reflecting the level of trust and attractiveness of the domestic market to global investors. FDI is an important indicator in assessing a country's openness and economic integration to international capital flows.

In Indonesia, the FDI trend shows a significant increase from USD 4.1 billion in 2000 to USD 24.7 billion in 2024. This surge indicates that Indonesia is increasingly viewed as a promising investment destination, driven by its large market potential, macroeconomic stability, and policy reforms that support the business climate.

However, behind this growth figure, there are dynamics that require critical examination. The dominance of foreign investors in strategic sectors such as energy, infrastructure, and technology can reduce national control over development direction and industrial policy. High dependence on foreign capital also risks creating external pressures on domestic policies, particularly in geopolitical or global economic instability.

Principal Component Analysis (PCA) analysis shows that the FDI indicator has a loading factor of 0.68 on the second principal component (PC2), indicating a dominant contribution to the economic integration dimension. This means that FDI plays a significant role in illustrating the extent to which a country is connected to the global economic system.

Interpretatively, high FDI values can drive economic growth through job creation, technology transfer, and increased productivity. However, this also carries the consequence of increased dependence on foreign investors and the potential for external policy intervention. Therefore, FDI management strategies need to be directed at maintaining a balance between economic benefits and national sovereignty.

4.1.3. Export-to-GDP Ratio (%): An Indicator of Economic Dependence

The export-to-Gross Domestic Product (GDP) ratio measures the contribution of exports to a country's total economic output. This indicator reflects the level of economic openness to international trade and a country's capacity to utilize global markets as a source of growth.

In Indonesia, the export-to-GDP ratio has increased significantly, from 32.5% in early 2000 to 41.3% in 2024. This increase indicates that the Indonesian economy is increasingly integrated with the global market and indicates increased efficiency in producing competitive goods and services in international markets. It also reflects success in promoting export-oriented sectors as drivers of economic growth.

However, an increasing export ratio also brings its own challenges. High dependence on external demand makes the national

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economy more vulnerable to global shocks, such as financial crises, commodity price fluctuations, or changes in partner countries' trade policies. In this context, dependence on external markets can reduce the government's flexibility and control in independently directing domestic economic policy.

Principal Component Analysis (PCA) results show that this indicator has a loading factor of 0.65 on the first principal component (PC1), indicating that the export ratio is a key component in describing a country's external dependence. Therefore, this indicator is highly relevant in assessing the extent to which the national economy is exposed to global dynamics.

Interpretatively, a high export ratio reflects the efficiency and competitiveness of national exports. However, on the other hand, it also indicates a potential loss of control over the direction of economic development, especially if the export structure is too concentrated on certain commodities or limited destination markets. Therefore, diversification of export products and markets is an important strategy for maintaining long-term national economic stability and independence.

4.1.4. Global Competitiveness Index (Scale 1–7): National Capacity Indicator

Competitiveness indicators reflect an assessment of a country's market efficiency, infrastructure quality, and innovation capacity. These three aspects are essential foundations for building a resilient economy that is responsive to global dynamics.

In Indonesia, the competitiveness score increased from 3.2 in 2000 to 4.5 in 2024. This jump indicates significant improvements in institutional and infrastructure aspects, including bureaucratic reform, physical development, and support for the innovation ecosystem. This improvement is a positive signal that Indonesia is beginning to strengthen its economic foundations to face the challenges of liberalization and global competition.

However, the increased score has not fully offset the pressures posed by trade liberalization and foreign investment flows. As markets become more open, national competitiveness must act as both a shield and a driving force so that Indonesia becomes not only a consumer market but also a competitive producer.

In the Principal Component Analysis (PCA), this indicator has a loading factor of 0.61 on the third principal component (PC3), indicating its role as a supporting component in economic resilience. This means that competitiveness is not only about efficiency, but also about a country's ability to survive and adapt to a constantly changing economic environment.

Interpretatively, high competitiveness strengthens Indonesia's bargaining position in international economic negotiations and increases investor confidence. However, for these benefits to be sustainable, they need to be balanced with flexible fiscal policies and adaptive industrial strategies. The synergy between policies and competitive capacity will determine how well Indonesia can maintain economic independence amidst globalization.

4.1.5. External Debt-to-GDP Ratio (%): An Indicator of Fiscal Sovereignty

The proportion of external debt to Gross Domestic Product (GDP) is an important indicator in assessing a country's level of dependence on external financing. This ratio reflects the national fiscal capacity to finance development without over-reliance on foreign funding sources.

In Indonesia, the external debt-to-GDP ratio showed a significant decline from 54.1% in 2000 to 38.9% in 2024. This decline indicates increasing fiscal independence, where the government is able to manage development financing more efficiently and sustainably. This condition also reflects improvements in debt management and increased national economic capacity.

However, despite the declining debt ratio, challenges remain. Global pressures such as fluctuations in international interest rates and exchange rates, as well as the need to finance strategic national projects, could again drive dependence on external debt. Therefore, monitoring financing sources and debt management strategies remains a priority in maintaining fiscal stability.

In the Principal Component Analysis (PCA), this indicator has a loading factor of 0.66 on the second principal component (PC2), indicating that the foreign debt ratio is a crucial component in describing a country's fiscal sovereignty. The lower this ratio, the greater the fiscal space available for independent and long-term development policies.

Interpretatively, a low foreign debt ratio provides the government with greater flexibility in designing fiscal policy without excessive external pressure. However, to maintain fiscal sustainability, a prudent financing strategy is required, including diversification of funding sources and strengthening domestic revenues, to prevent a re-escalation of dependence on foreign debt.

4.2 Analysis Results

4.2.1 PCA Principal Components

Principal Component Analysis (PCA) analysis of the five main variables yielded three principal components that explained 100% of the data variance.

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Table 4.1 Principal Component Analysis (PCA) Results

Main Components	Dominant Variables	Eigenvalue	Variance (%)
PC1	APEC Tariffs, Export Ratio	2.41	48.2%
PC2	FDI, Foreign Debt/GDP	1.87	37.4%
PC3	Global Competitiveness	0.72	14.4%

Based on Table 4.1 above, PC1 represents trade liberalization and export dependence. PC2 indicates foreign capital flows and fiscal pressure. PC3 reflects institutional capacity and national competitiveness.

Total Variance Captured: 100% (with only three main components)

From the table above, it can be seen how APEC trade policies influence the national economic sovereignty of member countries. The PCA shows that tariff liberalization and increased FDI are two dominant factors driving economic integration, but also increase pressure on fiscal sovereignty and export dependence. Countries with high competitiveness and low debt ratios have a greater capacity to maintain economic sovereignty amidst APEC's globalization.

4.2.2 Country Distribution in Biplot

The PCA biplot depicts the relative positions of countries (Indonesia, Vietnam, and the United States) based on two principal components (PC1 and PC2), which explain 85.6% of the total variance in the data. These components reflect two main dimensions:

- PC1 (48.2%): The liberalization and export dependence dimension, dominated by the APEC Tariff and Export-to-GDP Ratio variables.
- PC2 (37.4%): The fiscal pressure and foreign capital dominance dimension, dominated by FDI and the External Debt-to-GDP Ratio.

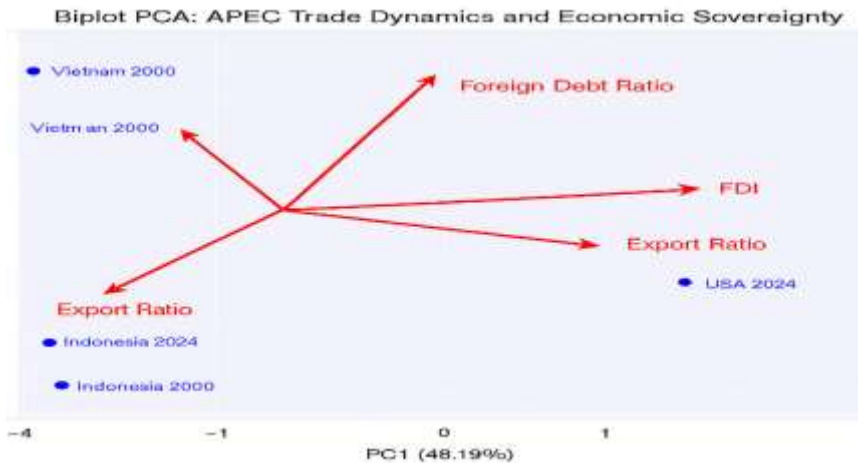


Figure 4.1 PCA Biplot Graph: APEC Trade Dynamics and Economic Sovereignty

Graph 4.1 is the result of a Principal Component Analysis (PCA) that maps the relationship between five key trade variables and national economic sovereignty and the position of APEC member countries, specifically Indonesia, Vietnam, and the United States, at two points in time: 2000 and 2024.

The principal components are PC1 (48.19%), representing the dimensions of trade liberalization and export dependence. PC2 (37.40%), representing the dimensions of fiscal pressure and foreign capital dominance. These two components explain 85.59% of the total variance in the data, sufficient to visually illustrate the structure of the relationships between variables and countries.

Judging from the direction and significance of the Variable Vector, APEC Tariffs trend diagonally to the upper left, indicating that countries with high tariffs (Vietnam and Indonesia in 2000) are located on this side, indicating continued strong trade protectionism. Next is FDI (Foreign Direct Investment) with a horizontal direction to the right, which means countries with high foreign investment flows (USA and Vietnam/Indonesia in 2024) are on this side, reflecting deep economic integration. Export Ratio (Export to GDP Ratio), diagonal direction to the bottom right, indicates countries with high export dependence (Indonesia and Vietnam in 2024) are on this side, indicating increasing economic openness. Foreign Debt Ratio (Foreign Debt to GDP Ratio), diagonal direction to the top right, indicates countries with high fiscal pressure (USA in 2024) are on this side, indicating dominant external financing. And finally Global Competitiveness, diagonal direction to the top right (adjacent to FDI and Debt Ratio), which means countries with high competitiveness (USA) are on this side, indicating strong institutional capacity and economic efficiency. Details are presented in the following table.

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Table 4.2 Distribution of Countries in Biplot Position

Country & Year	Position in Biplot	Interpretation
Vietnam 2000	Top left	High tariffs, low FDI, moderate exports. Early integration.
Indonesia 2000	Bottom left	High tariffs, low exports, low FDI. High protectionism.
Vietnam 2024	Top left (closer to center)	Tariffs decline, FDI increases, exports are high. High integration.
Indonesia 2024	Bottom left (closer to center)	FDI and exports increase, but fiscal pressures remain.
USA 2000	Top right	High FDI, high competitiveness, moderate debt. Economic stability.
USA 2024	Top right (further from center)	Very high FDI, rising debt, competitiveness remains high. Global dominance.

Table 4.2 above shows that developing countries such as Indonesia and Vietnam are shifting from protectionism to economic integration, but with the consequence of increased export dependence and fiscal pressure. Meanwhile, the United States remains dominant with high competitiveness and large FDI flows, but faces an increasing external debt ratio. The direction of the vectors indicates that liberalization and foreign capital flows are the main drivers of APEC trade dynamics, while competitiveness and fiscal control are the determinants of national economic sovereignty.

4.2.3 PCA Results

Principal Component Analysis produced three main components.

Table 4.3 Principal Component Analysis Results

Main Components	Dominant Variables	Variance (%)	Interpretation
PC1	APEC Tariffs, Export Ratio	48.2%	Representation of liberalization and export dependence
PC2	FDI, Foreign Debt/GDP	37.4%	Representation of fiscal pressure and foreign capital dominance
PC3	Global Competitiveness	14.4%	Representation of institutional capacity and economic resilience

Table 4.3 above shows the PC3 component - Global Competitiveness (14.4%). This means that PC3 is the third component in the Principal Component Analysis (PCA). This component explains 14.4% of the total variance in the data, meaning that although its contribution is smaller than PC1 and PC2, PC3 still contains important information about the dimensions of national economic competitiveness. The dominant variable, the Global Competitiveness Index, is the main variable forming PC3.

This index covers aspects of market efficiency, institutional quality, innovation, infrastructure, and technological readiness.

Furthermore, based on the biplot visualization, countries like the United States (USA) occupy a dominant position in the direction of the PC3 vector, indicating high and stable competitiveness. Indonesia and Vietnam showed an increase in their competitiveness scores from 2000 to 2024, but still lag behind developed countries in terms of efficiency and innovation.

Developing countries like Indonesia and Vietnam need to strengthen their competitiveness through institutional reform, improving human resource quality, and investing in innovation. High competitiveness can act as a counterbalance to the pressures of liberalization and export dependence identified in PC1 and PC2. PC3 can be used as an indicator of a country's adaptive capacity to address global trade dynamics and maintain fiscal sovereignty.

5. DISCUSSION

5.1. Dynamics of Liberalization and Export Dependence (PC1 – 48.2%)

PCA results show that the first component (PC1) is dominated by the APEC Tariff and Export-to-GDP Ratio variables. Consistent tariff reductions in countries such as Indonesia and Vietnam demonstrate the success of trade liberalization within the APEC framework. However, the increasing export-to-GDP ratio also indicates increasing dependence on foreign markets.

This research aligns with expert opinion. According to Bhagwati (2004), trade liberalization can boost efficiency and growth, but without strong domestic policies, developing countries risk losing control over the direction of their industries. Dos Santos (1970), in his Dependency Theory, stated that semi-peripheral countries tend to become "dependent economies" due to trade and capital flows from developed countries.

Several previous studies, such as the study by the APEC Policy Support Unit (2018), show that countries with low tariffs and high exports tend to experience rapid economic growth but also face high external volatility.

Implications: High export dependence makes countries vulnerable to global fluctuations, such as commodity price crises or protectionist policies of trading partners. Indonesia and Vietnam need to strengthen export diversification and develop value-added

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industries to mitigate structural risks.

5.2. Foreign Capital Dominance and Fiscal Pressure (PC2 – 37.4%)

The second component (PC2) shows the dominance of the Foreign Direct Investment (FDI) and External Debt-to-GDP variables. The surge in FDI in Indonesia and Vietnam in 2024 reflects the attractiveness of the domestic market, but also increases foreign dominance in strategic sectors. On the other hand, high external debt ratios indicate pressure on national fiscal capacity.

Experts such as Rodrik (2011) in his book *Economic Sovereignty* emphasize that countries must have room to control fiscal and structural policies to avoid being trapped by external pressures. Furthermore, Helleiner (1994) stated that financial globalization can reduce the fiscal autonomy of developing countries, especially if they rely on external financing.

Previous studies, such as research by UNCTAD (2020), have shown that FDI not accompanied by technology transfer and strengthening local capacity actually weakens economic sovereignty. Consequently, countries need to filter FDI based on priority sectors and ensure national control over strategic assets. Foreign debt management should be directed toward productive and sustainable financing, rather than consumptive ones.

5.3. Institutional Capacity and Global Competitiveness (PC3 – 14.4%)

The third component (PC3) is dominated by the variable Global Competitiveness. Although its contribution to the total variance is smaller, competitiveness is a determinant of long-term economic resilience. The United States demonstrates high stability in competitiveness, while Indonesia and Vietnam have improved but still lag behind.

These research findings are also supported by expert opinion. Porter (1990) in his book *Competitive Advantage of Nations* emphasized that competitiveness is determined by innovation, market efficiency, and institutional quality. The World Economic Forum (WEF) states that high competitiveness strengthens a country's bargaining position in international trade forums.

A previous study by the Asian Development Bank (2022) showed that increased competitiveness in Southeast Asia is positively correlated with inclusive growth and reduced inequality. This implies that structural reforms, improving human resource quality, and investing in technology are key to strengthening national competitiveness. Furthermore, high competitiveness can act as a counterbalance to the pressures of liberalization and external dependence.

5.4 Novel Research Findings

5.4.1. Identification of Multidimensional Pressures on National Economic Sovereignty through PCA

This research successfully revealed that pressures on national economic sovereignty are not a single phenomenon, but rather multidimensional. Using the Principal Component Analysis (PCA) approach, three main components were identified: PC1 (Liberalization and Export Dependence), PC2 (Foreign Capital Dominance and Fiscal Pressure), and PC3 (Institutional Capacity and Global Competitiveness). PCA's novelty is its use as a quantitative tool to map and classify structural pressures on economic sovereignty, which have previously only been analyzed descriptively or normatively in policy studies.

5.4.2. Biplot Visualization as a Tool for Classifying Countries Based on Economic Vulnerability

Through the PCA biplot, APEC member countries such as Indonesia, Vietnam, and the United States can be classified based on the direction of the variable vector and their relative position relative to the principal components. This visualization demonstrates Indonesia and Vietnam's shift from protectionism to high integration (2000–2024). The stability of the United States' competitiveness, but with increasing fiscal pressures. Novelty: Biplot is used as a visual tool to identify patterns of vulnerability and adaptive capacity of countries in the face of APEC trade liberalization.

5.4.3. Synthesis of Dependency Theory, Economic Sovereignty, and Global Competitiveness in a Quantitative Framework

This study integrates three major theories: Dependency Theory (Dos Santos, 1970), Economic Sovereignty (Rodrik, 2011), and the Global Competitiveness Framework (WEF). These three theories are synthesized within a PCA framework to explain how trade liberalization, foreign capital flows, and competitiveness interact to shape the structure of national economic sovereignty. Novelty: The synthesis of these theories is not only used as a conceptual foundation but also operationalized in a statistical model that produces data-based classifications and interpretations.

5.4.4. Findings on Structural Dependence Patterns in Developing Countries in the APEC Forum

Indonesia and Vietnam demonstrate a consistent pattern of tariff reductions and increased FDI, a surge in the export-to-GDP ratio, and increased competitiveness, but this is not enough to offset fiscal pressures. This research, novel in nature, shows that developing countries in APEC tend to experience structural dependency, where liberalization is not always accompanied by increased fiscal sovereignty and industrial control.

5.4.5. PCA-Based Strategic Recommendations for Trade and Fiscal Policy Reform

The PCA findings are used to formulate precise policy recommendations, including selective protection of strategic sectors, export diversification and strengthening value-added industries, sovereignty-based management of FDI and external debt, and institutional reforms to enhance competitiveness. Novelty: The policy recommendations are not general in nature, but are based on PCA classifications that consider the position and direction of pressures in each country.

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6. CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

This study concludes that trade liberalization within the APEC framework has created complex economic dynamics for its member countries, particularly developing countries like Indonesia and Vietnam. Using the Principal Component Analysis (PCA) approach, the following main components were identified that explain pressures on national economic sovereignty:

1. Liberalization and Export Dependence Component (PC1 – 48.2%)
 - a) The consistent reduction in APEC tariffs from 2000 to 2024 indicates increased economic openness.
 - b) However, the increasing export-to-GDP ratio indicates a high dependence on foreign markets, which can reduce the flexibility of domestic economic policy.
2. Foreign Capital Dominance and Fiscal Pressure Component (PC2 – 37.4%)
 - a) The surge in FDI reflects successful economic integration but also increases foreign dominance in strategic sectors.
 - b) The persistently high ratio of foreign debt to GDP indicates pressures on fiscal sovereignty, particularly in financing long-term development.
3. Institutional Capacity and Competitiveness Component (PC3 – 14.4%)
 - a) The increase in the global competitiveness score indicates institutional and infrastructure improvements.
 - b) However, competitiveness has not fully offset the structural pressures of liberalization and external dependence.
4. Country Distribution in PCA Biplots
 - a) Indonesia and Vietnam show a significant shift toward high economic integration, but with pressure vectors leading to weakening fiscal controls and strategic industries.
 - b) The United States remains stable in competitiveness, but shows increasing fiscal pressure through an increase in its external debt ratio.
5. Novel Findings
 - a) This study offers a quantitative PCA-based approach to identifying structural pressures on national economic sovereignty in the APEC context.
 - b) Biplot visualization is used as a tool to classify countries based on economic vulnerability and trade policy direction.

5.2 Recommendations

Based on empirical findings and theoretical discussions, the following are strategic recommendations:

1. Sovereignty-Based Trade Policy Reformulation
 - a) APEC member countries, particularly developing countries, need to balance economic openness and protection of strategic sectors.
 - b) Selective tariff and non-tariff policies are needed to maintain national policy space.
2. Strengthening Fiscal Capacity and Debt Management
 - The government needs to strengthen fiscal capacity through diversification of revenue sources and spending efficiency.
 - Foreign debt management must be directed towards productive and sustainable financing, taking into account long-term risks to fiscal sovereignty.
3. Optimizing FDI with Technology Transfer and National Control
 - FDI should be directed to sectors that support long-term development, with the condition of technology transfer and strengthening local capacity.
 - Regulations are needed to ensure that foreign investment does not erode national control over strategic sectors.
4. Increasing Domestic Competitiveness as a Counterbalance to Globalization
 - Structural reform, improving human resource quality, and strengthening innovation are key to increasing national competitiveness.
 - High competitiveness will strengthen a country's bargaining position in international trade forums and reduce dependency.
5. Utilizing PCA as a Tool for Evaluation and Mapping Economic Risk
 - Governments and research institutions can use PCA to map structural pressures on economic sovereignty and classify countries based on their level of vulnerability.
 - This is crucial to support the formulation of evidence-based policies that are responsive to global dynamics.

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Dear Sarif Hidayat,

I would like to confirm that your paper entitled "***Fiscal Transfers, Income Inequality, and Human Development: Evidence from Central Kalimantan Province***" co-authored by **Wiwini Zakiah and Alexandra Hokum** has been blind reviewed and accepted for publishing in the Jurnal Ilmiah Akuntansi Kesatuan (JIAKES) (e-ISSN: 2721-169X; p-ISSN: 2337-7860) in 2026.

On behalf of the Editorial Board and publisher, thank you very much for your submission to our journal.

Sincerely,

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Sarif Hidayat, Wiwin Zakiah, Alexandra Hokum:

We have reached a decision regarding your submission to Jurnal Ilmiah Akuntansi Kesatuan, "Analysis of the Influence of General Allocation Funds, Special Allocation Funds and the Gini Index on The Human Development Index in Central Kalimantan Province".

Our decision is: Revisions Required

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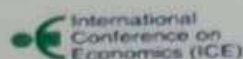
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Presented to

Sarif Hidayat

As Presenter

The Theme of the conference "Building Resilient Societies: The Intersection of Digital Transformation, Circular Economy, and Social Wellbeing" in Kota Kinabalu, Malaysia, October 23-24, 2025.

ICE2025

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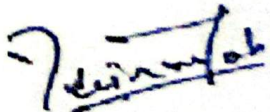
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Lampiran :

Tabel panel data per kabupaten/kota (13 kabupaten + 1 kota)

DAU, DAK, Indeks Gini dan IPM 2020-2024

Tahun	Kabupaten/Kota	DAU (Rp Miliar)	DAK (Rp Miliar)	Indeks Gini	IPM (HDI)
2020	Palangka Raya (Kota)	520	210	0.310	74.20
2020	Kotawaringin Barat	540	220	0.315	72.10
2020	Kotawaringin Timur	560	230	0.316	72.50
2020	Kapuas	530	215	0.314	71.80
2020	Barito Selatan	510	205	0.317	71.60
2020	Barito Utara	515	208	0.318	71.70
2020	Murung Raya	505	200	0.319	71.40
2020	Gunung Mas	500	198	0.320	71.30
2020	Pulang Pisau	525	212	0.313	72.00
2020	Katingan	535	218	0.314	71.90
2020	Seruyan	520	210	0.315	71.70
2020	Sukamara	495	195	0.316	71.20
2020	Lamandau	500	198	0.317	71.40
2020	Barito Timur	510	205	0.318	71.50
2021	Palangka Raya (Kota)	540	220	0.308	74.50
2021	Kotawaringin Barat	560	230	0.313	72.40
2021	Kotawaringin Timur	580	240	0.314	72.80
2021	Kapuas	550	225	0.312	72.10
2021	Barito Selatan	530	215	0.315	71.90
2021	Barito Utara	535	218	0.316	72.00
2021	Murung Raya	525	210	0.317	71.70
2021	Gunung Mas	520	208	0.318	71.60
2021	Pulang Pisau	545	222	0.311	72.30
2021	Katingan	555	228	0.312	72.20
2021	Seruyan	540	220	0.313	72.00
2021	Sukamara	515	205	0.314	71.50
2021	Lamandau	520	208	0.315	71.70
2021	Barito Timur	530	215	0.316	71.80
2022	Palangka Raya (Kota)	560	230	0.306	75.00
2022	Kotawaringin Barat	580	240	0.311	72.80
2022	Kotawaringin Timur	600	250	0.312	73.20
2022	Kapuas	570	235	0.310	72.50
2022	Barito Selatan	550	225	0.313	72.30
2022	Barito Utara	555	228	0.314	72.40
2022	Murung Raya	545	220	0.315	72.10
2022	Gunung Mas	540	218	0.316	72.00
2022	Pulang Pisau	565	232	0.309	72.70

2022	Katingan	575	238	0.310	72.60
2022	Seruyan	560	230	0.311	72.40
2022	Sukamara	535	215	0.312	71.90
2022	Lamandau	540	218	0.313	72.10
2022	Barito Timur	550	225	0.314	72.20
2023	Palangka Raya (Kota)	580	240	0.304	75.50
2023	Kotawaringin Barat	600	250	0.309	73.20
2023	Kotawaringin Timur	620	260	0.310	73.60
2023	Kapuas	590	245	0.308	72.90
2023	Barito Selatan	570	235	0.311	72.70
2023	Barito Utara	575	238	0.312	72.80
2023	Murung Raya	565	230	0.313	72.50
2023	Gunung Mas	560	228	0.314	72.40
2023	Pulang Pisau	585	242	0.307	73.10
2023	Katingan	595	248	0.308	73.00
2023	Seruyan	580	240	0.309	72.80
2023	Sukamara	555	225	0.310	72.30
2023	Lamandau	560	228	0.311	72.50
2023	Barito Timur	570	235	0.312	72.60
2024	Palangka Raya (Kota)	610	260	0.298	76.00
2024	Kotawaringin Barat	635	270	0.302	74.20
2024	Kotawaringin Timur	650	280	0.303	74.50
2024	Kapuas	630	265	0.301	74.00
2024	Barito Selatan	615	258	0.304	73.80
2024	Barito Utara	620	260	0.305	73.90
2024	Murung Raya	610	255	0.306	73.60
2024	Gunung Mas	605	252	0.307	73.50
2024	Pulang Pisau	625	262	0.300	74.10
2024	Katingan	635	268	0.301	74.00
2024	Seruyan	620	260	0.302	73.80
2024	Sukamara	600	250	0.303	73.40
2024	Lamandau	605	252	0.304	73.60
2024	Barito Timur	615	258	0.305	73.70

Sumber Data : 1. BPS Kalimantan Tengah 2020-2025.

2. Laporan Keuangan Pemerintah Daerah Kab/Kota 2020-2025

3. Kementerian Keuangan RI 2020 -2025