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Financial Performance Moderates Fiscal Independence and Priority Expenditure on Human Development Index

Kinerja Keuangan Memoderasi Kemandirian Fiskal dan Belanja Prioritas Terhadap Indeks Pembangunan Manusia

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Abstract

Massive intergovernmental transfers to newly autonomous regencies in Papua consistently fail to accelerate human development amidst fragile local tax bases and volatile budget execution. This study evaluated how regional financial performance moderated the effects of fiscal independence, education expenditure, and health expenditure on the Human Development Index across twenty newly autonomous Papuan regencies from 2018 to 2024. A balanced census panel of 140 observations was analyzed using Fixed Effects Moderated Regression Analysis. Empirical estimates demonstrate that education expenditure exerts a strong positive direct effect on human development, whereas fiscal independence and health expenditure show statistically insignificant effects because subsistence economies limit local taxation and extreme alpine transport costs erode healthcare purchasing power. Although standalone financial performance negatively affects human development due to conservative revenue target setting, financial performance significantly moderates and strengthens the positive effect of education expenditure. These novel contingency findings prescribe enforcing educational earmarks alongside subsidized highland logistics.

Abstrak

Transfer fiskal antarpemerintah yang masif ke kabupaten pemekaran baru di Papua gagal mempercepat pembangunan manusia di tengah rapuhnya basis pajak lokal dan volatilitas anggaran. Penelitian ini mengevaluasi bagaimana kinerja keuangan daerah memoderasi pengaruh kemandirian fiskal, belanja pendidikan, dan belanja kesehatan terhadap Indeks Pembangunan Manusia pada dua puluh kabupaten pemekaran Papua dari 2018 hingga 2024. Panel sensus seimbang sebanyak 140 observasi dianalisis menggunakan pendekatan Fixed Effects Moderated Regression Analysis. Estimasi empiris membuktikan bahwa belanja pendidikan memberikan pengaruh langsung positif yang kuat terhadap pembangunan manusia, sedangkan kemandirian fiskal dan belanja kesehatan tidak signifikan secara statistik karena ekonomi subsisten membatasi perpajakan lokal serta mahalnya transportasi pegunungan menggerus daya beli anggaran kesehatan. Meskipun kinerja keuangan secara parsial berpengaruh negatif terhadap pembangunan manusia akibat penetapan target pendapatan yang konservatif, kinerja keuangan secara signifikan memoderasi dan memperkuat pengaruh positif alokasi belanja pendidikan. Temuan kontinjensi baru ini merekomendasikan penegakan alokasi anggaran pendidikan beserta subsidi logistik wilayah pegunungan.

A. INTRODUCTION

1. Background

Asymmetric fiscal decentralization in resource-rich yet lagging jurisdictions confronts a persistent developmental paradox: massive intergovernmental transfers frequently fail to generate commensurate gains in human welfare. In Indonesia, this fiscal-welfare disconnect is most pronounced across the Newly Autonomous Regions (*Daerah Otonom Baru*, or DOB) of Papua—namely Papua Selatan, Papua Tengah, and Papua Pegunungan—which were statutorily carved out of parent Papua Province in 2022 to shorten administrative spans of control and accelerate basic service delivery.[1] Since the enactment of the Special Autonomy (*Otonomi Khusus*, or Otsus) regime in 2001 and its regulatory overhaul in 2021, the Papuan provinces have received trillions of rupiah annually in earmarked block grants and infrastructure supplements designed explicitly to finance education and healthcare.[2]

Yet audited macro-fiscal and welfare statistics reveal a stark divergence between transfer inflows and human capital outcomes. By 2024, while the national Human Development Index (HDI) reached the high category at 75.02, the three newly established Papuan provinces recorded the lowest scores in the republic: 68.86 in Papua Selatan, 60.25 in Papua Tengah, and 54.43 in Papua Pegunungan, with highland regencies such as Nduga languishing at 38.88.[3] This human development deficit coincides with acute subnational fiscal fragility. Across the twenty regencies constituting these three DOB provinces, own-source revenue (*Pendapatan Asli Daerah*, or PAD) contributes a negligible share of total regional revenue, averaging 3.44 percent in Papua Selatan, 8.15 percent in Papua Tengah (heavily skewed by mining-enclave Mimika at 34.39 percent), and 1.31 percent in landlocked Papua Pegunungan in 2024, compared with a national district average of 17.83 percent.[4]

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[1] Republic of Indonesia, *Undang-Undang Nomor 14 Tahun 2022 Tentang Pembentukan Provinsi Papua Selatan*, *Undang-Undang Nomor 15 Tahun 2022 Tentang Pembentukan Provinsi Papua Tengah*, and *Undang-Undang Nomor 16 Tahun 2022 Tentang Pembentukan Provinsi Papua Pegunungan* (Jakarta: Sekretariat Negara, 2022), Art. 3 para. (1).

[2] Republic of Indonesia, *Undang-Undang Nomor 21 Tahun 2001 Tentang Otonomi Khusus Bagi Provinsi Papua* and *Undang-Undang Nomor 2 Tahun 2021 Tentang Perubahan Kedua Atas Undang-Undang Nomor 21 Tahun 2001 Tentang Otonomi Khusus Bagi Provinsi Papua* (Jakarta: Sekretariat Negara, 2021), Art. 34 para. (3)(e)(2) and Art. 36; Kementerian Keuangan Republik Indonesia, *Laporan Keuangan Pemerintah Pusat (LKPP) Tahun 2018–2024* (Jakarta: Kementerian Keuangan RI, 2025), 112–128.

[3] Badan Pusat Statistik, *Indeks Pembangunan Manusia 2024*, vol. 19 (Jakarta: Badan Pusat Statistik, 2025), 15–22, 73–76.

[4] Badan Pusat Statistik, *Statistik Keuangan Pemerintah Kabupaten/Kota 2024–2025* (Jakarta: Badan Pusat Statistik, 2025), 11–18, 45–52.

Simultaneously, priority social expenditure allocations exhibit marked compliance gaps and structural distortions. Although national constitutional mandates require subnational governments to allocate at least 20 percent of their budgets to education and 10 percent to healthcare, regency-level education spending in 2024 averaged only 14.34 percent in Papua Pegunungan and 19.25 percent in Papua Tengah, while health allocations averaged between 11.00 percent and 15.05 percent but were severely eroded in real purchasing power by extreme highland construction and air-cargo logistics costs.[5] Compounding these allocative shortfalls is extreme volatility in regional financial performance—measured by the ratio of realized PAD to targeted PAD—which ranged in 2024 from 10.30 percent in conflict-affected Nduga to 977.83 percent in Tolikara, following a peak of 1,644.25 percent in Puncak in 2020.[6] Whether subnational fiscal capacity and priority social outlays can overcome structural deprivation in newly autonomous districts depends fundamentally on the quality of local budget execution.

This empirical anomaly sits at the intersection of three competing theoretical paradigms in public economics: fiscal federalism, human capital investment, and public accountability. Classical fiscal federalism posits that devolving revenue authority and expenditure discretion to subnational governments enhances allocative efficiency because local authorities possess superior informational access to constituent preferences and local cost functions.[7] Extending this framework to developing economies, Bahl and Bird argue that fiscal independence hardens the local budget constraint; jurisdictions that finance a larger share of expenditure from own-source taxation face stronger political incentives to spend prudently than transfer-dependent jurisdictions prone to fiscal illusion.[8]

Simultaneously, Human Capital Theory, as formulated by Becker and expanded in development economics by Todaro and Smith, conceptualizes public expenditures on schooling and healthcare not as current bureaucratic consumption, but as productive

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[5] Badan Pusat Statistik, *Statistik Keuangan Pemerintah Kabupaten/Kota*, 53–68; Badan Pusat Statistik, *Indeks Kemahalan Konstruksi Provinsi Dan Kabupaten/Kota 2025*, vol. 16 (Jakarta: Badan Pusat Statistik, 2025), 12–18, 118–125, https://www.bps.go.id/id/publication/2025/10/01/935f3f46173c68d21b6c5126/indeks-kemahalan-konstruksi-provinsi-dan-kabupaten-kota-2025.html.

[6] Badan Pusat Statistik, *Statistik Keuangan Pemerintah Kabupaten/Kota*, 45–68; Kementerian Keuangan Republik Indonesia, *Laporan Realisasi Anggaran Pendapatan Dan Belanja Daerah (APBD) Kabupaten/Kota 2018–2024* (Jakarta: Direktorat Jenderal Perimbangan Keuangan, 2025), 1–20.

[7] Wallace E. Oates, *Fiscal Federalism* (New York: Harcourt Brace Jovanovich, 1972), 31–38.

[8] Roy Bahl and Richard M. Bird, *Fiscal Decentralization and Local Finance in Developing Countries: Development from Below* (Cheltenham: Edward Elgar Publishing, 2018), 18–24, 394–402.

capital formation that raises labor productivity, cognitive capability, and life expectancy over multi-year gestation horizons.[9] However, neither decentralization theory nor human capital theory automatically guarantees that budget appropriations convert into public goods. Drawing on Bovens's public accountability framework, the translation of fiscal inputs into societal outcomes is contingent upon institutional accountability relations across democratic, constitutional, and cybernetic dimensions.[10] Where subnational financial management operates as a cybernetic learning and anti-leakage mechanism, high financial performance reinforces the productivity of social spending; conversely, where local bureaucracies decouple formal audit compliance and revenue-target attainment from substantive service delivery, nominal fiscal capacity and statutory spending shares fail to improve human welfare.[11]

Recent empirical scholarship examining the nexus between fiscal decentralization, social expenditure, and human development reflects unresolved tensions across three thematic fronts. First, studies investigating fiscal autonomy and intergovernmental transfers report conflicting welfare effects depending on institutional thresholds and transfer dependency. In a cross-national panel estimation of fifty countries using fixed effects and instrumental variables, Jin and Jakovljevic identify an inverted U-shaped relationship between fiscal decentralization and HDI, demonstrating that while moderate decentralization improves welfare, excessive devolution to subnational units lacking administrative capacity diminishes human development.[12] Within Indonesia, Sofilda, Hamzah, and Kusairi analyze 484 districts using static and dynamic System-GMM estimators and find that while regional independence and intergovernmental transfers stimulate regional economic growth, fiscal decentralization indicators exhibit unstable and occasionally negative signs across specifications.[13] Fitrianti et al. attribute this subnational underperformance to the flypaper effect, showing across Indonesian

[9] Gary S. Becker, *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*, 3rd ed. (Chicago: University of Chicago Press, 1993), 17–21, https://doi.org/10.7208/chicago/9780226041223.001.0001; Michael P. Todaro and Stephen C. Smith, *Economic Development*, 13th ed. (Harlow: Pearson, 2020), 390–405.
[10] Mark Bovens, "Public Accountability," in *The Oxford Handbook of Public Management*, ed. Ewan Ferlie, Laurence E. Lynn Jr., and Christopher Pollitt (Oxford: Oxford University Press, 2005), 184–185, 192–195.
[11] Bovens, "Public Accountability," 193–195.
[12] Hui Jin and Mihajlo Jakovljevic, "Fiscal Decentralization and the Human Development Index: A Cross-Border Empirical Study," *Sustainability* 15, no. 11 (2023): 8784, at 5–9, https://doi.org/10.3390/su15118784.
[13] Eleonora Sofilda, Muhammad Zilal Hamzah, and Suhal Kusairi, "Analysis of Fiscal Decentralisation, Human Development, and Regional Economic Growth in Indonesia," *Cogent Economics & Finance* 11, no. 1 (2023): 2220520, at 8–12, https://doi.org/10.1080/23322039.2023.2220520.

provinces that heavy reliance on central transfers suppresses local tax effort and induces routine overhead expansion rather than productive public investment.[14] Together, these studies suggest that fiscal independence ratios cannot operate as reliable drivers of human development when own-source revenues remain below a critical capacity threshold and central grants dominate local budgets.

A second body of literature evaluates the sectoral productivity of priority education and health expenditures, exposing sharp divergence between the two channels. Using Autoregressive Distributed Lag (ARDL) modeling in Iraq, Abdallah and Saloom demonstrate that educational expenditure generates robust positive long-run elasticities for human development by expanding schooling attainment and workforce capability.[15] Corroborating this educational channel in Indonesia, Susilo et al. apply Arellano-Bond dynamic panel GMM estimation across thirty-four provinces and confirm that education spending significantly accelerates provincial HDI convergence; paradoxically, however, their dynamic specifications reveal that public health expenditure exerts a negative or statistically insignificant effect on HDI.[16] While macro-panel studies often struggle to explain why health outlays underperform relative to education outlays, subnational field evidence from Papua illuminates the underlying structural bottlenecks. Lelyana and Sarjito document that in remote Papuan regencies, geographic isolation, reliance on expensive pioneer aviation for medical supply chains, and acute shortages of clinical personnel consume the bulk of nominal health budgets in logistical overhead before basic curative or preventive care reaches indigenous settlements.[17] Consequently, whereas educational investments—such as affirmative boarding schools, teacher deployment, and university scholarship partnerships—directly elevate expected and mean years of schooling within shorter administrative cycles, health appropriations encounter severe physical and logistical depreciation.

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[14] Retno Fitrianti et al., "Flypaper Effect: Analysis of Financial Transfers from the Central Government to Provincial Regions in Indonesia," *Public and Municipal Finance* 14, no. 1 (2025): 58–61, https://doi.org/10.21511/pmf.14(1).2025.05.

[15] Zina Imad Abdallah and Taamem Mohammad Saloom, "Analysis of the Productivity of Educational Expenditures and Their Impact on Human Development in Iraq," *Journal of Economics and Administrative Sciences* 30, no. 144 (2024): 391–394, https://doi.org/10.33095/mc1xxy50.

[16] Susilo et al., "The Impact of Fiscal Decentralization on Human Development Index Convergence in Indonesia: An Arellano-Bond GMM Dynamic Panel Data Estimation," *Forum for Social Economics* (2026): 14–21, https://doi.org/10.1080/07360932.2025.2610937.

[17] Nora Lelyana and Aris Sarjito, "Effectiveness of Mobile Health Services in Remote Papua under Indonesia's Minister of Health Regulation No. 90 of 2015," *Society* 12, no. 2 (2024): 899–905, https://doi.org/10.33019/society.v12i2.760.

A third stream of literature examines local government financial performance, yet reveals a pervasive methodological blind spot regarding its structural role. Existing empirical models predominantly specify regional financial performance ratios—such as revenue effectiveness, fiscal independence, and spending efficiency—as direct exogenous predictors of macroeconomic growth or welfare. For instance, Zein et al. employ path analysis across districts in Banten Province and report that regional financial effectiveness and independence ratios directly promote economic growth and are partially mediated by capital expenditure.[18] However, treating revenue effectiveness as an unconditional direct determinant of HDI overlooks two critical institutional realities in newly autonomous and transfer-dependent districts. Methodologically, prior studies rarely test whether financial performance functions as a moderating contingency factor that conditions the marginal effectiveness of fiscal capacity and sectoral budgets. Substantively, standard revenue-effectiveness ratios (realized PAD divided by targeted PAD) are vulnerable to strategic target lowballing, whereby local executives set artificially conservative own-source revenue targets during budget formulation to manufacture triple-digit realization rates for formal audit compliance, while simultaneously allocating over 60 percent of total expenditure to bureaucratic personnel and routine operations.

To the best of our knowledge, no prior peer-reviewed study has modeled regional financial performance as a moderating contingency variable governing the simultaneous transmission of fiscal independence, education expenditure, and health expenditure into human development within Indonesia's Newly Autonomous Regions of Papua.[19] Unlike prior studies that treat financial performance as a direct predictor of economic growth or an administrative outcome of fiscal transfers, this study conceptualizes regional financial performance as an institutional moderator within a balanced panel of all twenty DOB Papuan regencies from 2018 to 2024, spanning the pre-reform Special Autonomy regime, the 2021 statutory revision, and the 2022–2024 post-proliferation transition.

This study argues that in transfer-dependent, geographically isolated newly autonomous regencies, regional financial performance does not uniformly enhance fiscal channels; rather, it selectively moderates and strengthens the positive effect of education

[18] Mohamad Harry Mulya Zein et al., "Examining the Role of Local Government's Financial Performance and Capital Expenditure in Increasing Economic Growth in Banten Province, Indonesia (2018–2022)," *Journal of Risk and Financial Management* 17, no. 10 (2024): 456, at 7–11, https://doi.org/10.3390/jrfm17100456.
[19] Bovens, "Public Accountability," 192–195; Sofilda, Hamzah, and Kusairi, "Analysis of Fiscal Decentralisation," 2220520, at 10–12; Susilo et al., "Impact of Fiscal Decentralization," 18–21.

expenditure on the Human Development Index, while failing to moderate fiscal independence and health expenditure. Furthermore, when evaluated in isolation, headline revenue-effectiveness ratios correlate negatively with human development because artificial target lowballing and bureaucratic overhead absorption divert resources from capital formation, whereas non-trivial own-source revenue constraints and prohibitive highland air-logistics costs neutralize the direct impacts of fiscal independence and health outlays. For public-finance scholars, these findings demonstrate the necessity of contingent, sector-disaggregated specification when evaluating asymmetric decentralization in frontier regions. For central and regional policymakers, the analysis implies that Special Autonomy oversight must shift from rewarding formal revenue-target realization toward enforcing outcome-based educational earmarks and establishing centrally subsidized air-cargo logistics corridors to protect the real purchasing power of highland health budgets.

2. Research Questions

To evaluate how subnational fiscal capacity and priority social allocations interact with budget-execution governance under asymmetric decentralization, this study addresses two overarching research questions: (1) To what extent do fiscal independence, education expenditure allocation, health expenditure allocation, and regional financial performance directly affect the Human Development Index across the regencies of the Newly Autonomous Regions of Papua during the 2018–2024 budgeting period? (2) Does regional financial performance significantly moderate—by strengthening or weakening—the effects of fiscal independence, education expenditure allocation, and health expenditure allocation on the Human Development Index across these newly autonomous regencies?

Anchored in fiscal federalism, human capital theory, and public accountability theory, seven testable hypotheses are formulated for empirical adjudication in Section B:

a. H_1 (Fiscal Independence Direct Channel): Fiscal independence exerts a statistically significant positive effect on the Human Development Index ($\beta_1 > 0$).
b. H_2 (Education Expenditure Direct Channel): Education expenditure allocation exerts a statistically significant positive effect on the Human Development Index ($\beta_2 > 0$).
c. H_3 (Health Expenditure Direct Channel): Health expenditure allocation exerts

a statistically significant positive effect on the Human Development Index ($\beta_3 > 0$)

d. H_4 (Financial Performance Direct Channel): Regional financial performance exerts a statistically significant positive effect on the Human Development Index ($\beta_4 > 0$).

e. H_5 (Moderated Fiscal Independence Channel): Regional financial performance positively moderates the effect of fiscal independence on the Human Development Index ($\beta_5 > 0$).

f. H_6 (Moderated Education Expenditure Channel): Regional financial performance positively moderates the effect of education expenditure on the Human Development Index ($\beta_6 > 0$).

g. H_7 (Moderated Health Expenditure Channel): Regional financial performance positively moderates the effect of health expenditure on the Human Development Index ($\beta_7 > 0$).

3. Research Methods

Research design. This study employs a quantitative, explanatory panel econometric design rooted in a positivist epistemological framework to estimate causal and contingent relationships between subnational fiscal instruments and human development outcomes. A census (saturated sampling) design is applied across all twenty regencies (*kabupaten*) located within the three Newly Autonomous Regions carved out of parent Papua Province under Laws No. 14, 15, and 16 of 2022: Papua Selatan (4 regencies: Merauke, Boven Digoel, Mappi, Asmat), Papua Tengah (8 regencies: Mimika, Dogiyai, Deiyai, Nabire, Paniai, Intan Jaya, Puncak, Puncak Jaya), and Papua Pegunungan (8 regencies: Nduga, Jayawijaya, Lanny Jaya, Tolikara, Mamberamo Tengah, Yalimo, Yahukimo, Pegunungan Bintang).[20] Observing all twenty regencies continuously over a seven-year budgeting horizon (2018–2024) yields a balanced panel of $N = 140$ regency-year observations. Econometrically, a static Fixed Effects Model (FEM) combined with Moderated Regression Analysis (MRA) is theoretically justified on two grounds. First, cross-sectional fixed effects (α_i) control for unobserved, time-invariant structural heterogeneity across regencies—such as landlocked alpine topography versus coastal access, baseline mineral endowments, and entrenched local institutional norms—that

[20] Republic of Indonesia, *Undang-Undang Nomor 14, 15, Dan 16 Tahun 2022*, Art. 3 para. (1).

would otherwise induce omitted-variable bias if correlated with fiscal regressors.[21] Second, incorporating multiplicative interaction terms within the MRA framework operationalizes Bovens's public accountability theory by testing whether the marginal welfare returns to fiscal autonomy and priority social spending depend conditionally on the level of regional financial performance.

Data and variables. The empirical analysis relies exclusively on audited secondary macro-fiscal and demographic panel data. Regency-level Human Development Index series are retrieved from official publications of Statistics Indonesia (*Badan Pusat Statistik*, or BPS), which computes HDI as the geometric mean of normalized indices across longevity (life expectancy at birth), knowledge (expected years of schooling and mean years of schooling), and decent living standards (adjusted real per capita expenditure).[22] Fiscal realization and target series—comprising realized own-source revenue (PAD), targeted PAD, total regional revenue, education sector expenditure, health sector expenditure, and total regional expenditure—are compiled from audited regional budget realization reports (*Laporan Realisasi Anggaran Pendapatan dan Belanja Daerah*, or LRA APBD) consolidated by the Directorate General of Fiscal Balance (*Direktorat Jenderal Perimbangan Keuangan*, or DJPK) of the Ministry of Finance and audited by the Audit Board of the Republic of Indonesia (BPK RI) for fiscal years 2018 through 2024.[23] The continuous 2018–2024 window captures three distinct institutional phases: the terminal phase of the initial Special Autonomy Law (2018–2020), the enactment of the revised Special Autonomy governance framework under Law No. 2 of 2021 (2021), and the post-proliferation administrative transition following the creation of the three DOB provinces (2022–2024). Table 1 details the operational definitions, measurement units, and authoritative sources for all variables.

Table 1. Variable Operationalization and Data Sources

Variable Name	Symbol	Role	Operational Formula and Unit	Data Source
Human Development Index	HDI_{it}	Dependent	Composite geometric index (0–100 scale)	BPS (2018–2024)
Fiscal Independence	KF_{it}	Independent	$(\text{PAD}_{it}/\text{Total Revenue}_{it}) \times 100$ (%)	DJPK MoF (2018–2024)
Education Expenditure	BP_{it}	Independent	$\left(\text{Education}_{it}/\text{Total Spending}_{it}\right) \times 100$ (%)	DJPK MoF (2018–2024)

[21] Jeffrey M. Wooldridge, *Econometric Analysis of Cross Section and Panel Data*, 2nd ed. (Cambridge, MA: MIT Press, 2010), 300–315.
[22] Badan Pusat Statistik, *Indeks Pembangunan Manusia 2024*, 15–22; Todaro and Smith, *Economic Development*, 46–51.
[23] Kementerian Keuangan Republik Indonesia, *Laporan Realisasi Anggaran Pendapatan Dan Belanja Daerah*, 1–20.

Health Expenditure	BK_{it}	Independent	$(\text{Health}_{it}/\text{Total Spending}_{it}) \times 100$ (%)	DJPK MoF (2018–2024)
Financial Performance	KK_{it}	Moderator	$(\text{Realized PAD}_{it}/\text{Targeted PAD}_{it}) \times 100$ (%)	DJPK MoF (2018–2024)
Spending Efficiency	EF_{it}	Robustness	$(\text{Realized Spending}_{it}/\text{Realized Revenue}_{it}) \times 100$ (%)	DJPK MoF (2018–2024)

Source: Author's compilation based on BPS and DJPK Ministry of Finance documentation (2026).

Collection and cleaning. Data collection followed a structured archival documentation protocol cross-referencing DJPK fiscal balance tables against BPK-audited regency financial statements. All twenty regencies reported complete realizations across all seven years, ensuring a balanced panel ($N = 140$) with zero missing observations. Prior to estimation, raw ratio series were converted into consistent decimal proportions and screened for multivariate outliers and high-leverage observations using three diagnostic metrics: Studentized Deleted Residuals, Cook's Distance, and Mahalanobis Distance. Screening confirmed severe positive skewness and extreme outliers in the raw data—most notably in regional financial performance (KK_{it}), where Puncak Regency recorded an effectiveness ratio of 1,644.25 percent (16.4425) in 2020 due to emergency pandemic aviation reconciliations booked under miscellaneous lawful PAD against an artificially lowballed target of Rp1.12 billion. Because initial Ordinary Least Squares residuals severely violated Gaussian normality (Jarque-Bera $= 164.1578, p = 0.000000$) and stepwise deletion of outlier regency-years failed to restore normality while degrading the balanced panel into an unbalanced structure, a two-sided 1 percent winsorizing transformation was applied to all independent and moderating variables. Winsorizing replaces extreme tail values beyond the 1st and 99th percentiles with the nearest boundary percentile value, dampening the distortionary leverage of accounting anomalies while preserving all 140 observations and full degrees of freedom across the twenty regencies. Following 1 percent winsorizing, residual normality was fully satisfied (Jarque-Bera $= 1.937106, p = 0.379632 > 0.05$).

Estimation and validation. Panel estimation is executed in EViews 10 across two sequential specifications. Equation (1) estimates the baseline direct effects of fiscal capacity, priority spending, and financial performance on human development, while Equation (2) incorporates the Moderated Regression Analysis (MRA) interaction terms:

$$HDI_{it} = \alpha_i + \beta_1 KF_{it} + \beta_2 BP_{it} + \beta_3 BK_{it} + \beta_4 KK_{it} + \varepsilon_{it}$$

$$HDI_{it} = \alpha_i + \beta_1 KF_{it} + \beta_2 BP_{it} + \beta_3 BK_{it} + \beta_4 KK_{it} + \beta_5 (KF_{it} \times KK_{it}) + \beta_6 (BP_{it} \times KK_{it}) + \beta_7 (BK_{it} \times KK_{it}) + \varepsilon_{it}$$

where $i = 1,2,\ldots,20$ indexes the twenty DOB Papuan regencies; $t = 2018,2019,\ldots,2024$ indexes the budget year; α_i denotes the regency-specific fixed-effect intercept capturing time-invariant cross-sectional heterogeneity; β_1 through β_4 represent the direct partial regression slopes of the constitutive fiscal variables; β_5, β_6, and β_7 measure the moderating interaction effects of regional financial performance on fiscal independence, education expenditure, and health expenditure, respectively; and ε_{it} is the idiosyncratic disturbance term.

To select the optimal panel estimator, sequential specification tests were conducted. The Chow Likelihood Ratio test strongly rejected Pooled Least Squares in favor of the Fixed Effects Model (Cross-section $F = 76.735994, p = 0.0000$; Cross-section $\chi^2 = 365.088500, p = 0.0000$), and the Hausman specification test rejected the Random Effects Model in favor of Fixed Effects (Cross-section random $\chi^2 = 41.661542$,d.f. $= 4, p = 0.0000$), rendering the Breusch-Pagan Lagrange Multiplier test unnecessary. Classical diagnostic validation encompassed the Jarque-Bera normality test, a pairwise correlation matrix check for multicollinearity (confirming all inter-regressor correlations remained below the 0.90 threshold, with the highest correlation between KF_{it} and BP_{it} at $r = 0.68962$), and the Panel Cross-Section Heteroskedasticity Likelihood Ratio test. Because the LR test rejected homoskedasticity across regencies (LR $= 138.7822$,d.f. $= 20, p = 0.0000$), Equation (2) is estimated via Fixed Effects with White cross-section heteroskedasticity-consistent standard errors and degrees-of-freedom correction to ensure asymptotically valid inference.[24]

Economically, the parameters of Equation (2) are interpreted through partial derivatives. For any fiscal regressor $X_{k,it} \in \{KF_{it}, BP_{it}, BK_{it}\}$, the conditional marginal effect on HDI_{it} is given by $\partial HDI_{it}/\partial X_{k,it} = \beta_k + \beta_{k+4} KK_{it}$. A statistically significant positive interaction coefficient ($\beta_{k+4} > 0, p < 0.05$) indicates synergistic (enhancing) moderation, meaning that higher revenue-execution effectiveness amplifies the human development return of each percentage-point increase in fiscal capacity or priority spending. Individual hypotheses are evaluated via two-tailed partial t-tests at the $\alpha = 0.05$ significance threshold, overall model fit is verified via the simultaneous F-test and Adjusted R^2, and parameter stability is cross-checked in Section B by re-estimating Equation (2) using the expenditure efficiency ratio (EF_{it}) as an alternative moderator.

[24] Wooldridge, *Econometric Analysis of Cross Section and Panel Data*, 328–331.

Four methodological limitations inherent to this empirical design warrant explicit acknowledgment. First, because KF_{it} (PAD/Total Revenue) and KK_{it} (Realized PAD/ Target PAD) both contain realized own-source revenue in their numerators, their multiplicative interaction ($KF_{it} \times KK_{it}$) may exhibit mechanical numerator coupling; replacing KK_{it} with the expenditure efficiency ratio (EF_{it}) in the robustness model directly tests whether findings are driven by this shared component. Second, while White cross-section standard errors correct for contemporaneous cross-sectional heteroskedasticity and serial correlation, the cross-sectional dimension ($N = 20$ regency clusters) lies near the lower asymptotic boundary for cluster-robust covariance estimation. Third, entering uncentered multiplicative terms ($X_{k,it} \times KK_{it}$) alongside main effects can elevate collinearity between constitutive and interaction slopes, requiring verification against pairwise correlation thresholds. Fourth, because 1 percent winsorizing compresses extreme tail realizations in KK_{it}, point estimates are evaluated alongside the expenditure-efficiency robustness check in Section B to ensure structural stability. Table 2 maps each hypothesis from Section A.2 to its corresponding econometric parameter, inferential test, decision rule, and reporting location in Section B.

Table 2. Traceability Matrix Mapping Hypotheses to Econometric Models and Section B Outputs

Hypothesis	Path (Sign)	Parameter	Decision Rule	Section B Output
H_1	$KF_{it} \rightarrow HDI_{it}$ (+)	β_1	t-test ($\beta_1 > 0, p < 0.05$)	Table 3 (MRA FEM)
H_2	$BP_{it} \rightarrow HDI_{it}$ (+)	β_2	t-test ($\beta_2 > 0, p < 0.05$)	Table 3 (MRA FEM)
H_3	$BK_{it} \rightarrow HDI_{it}$ (+)	β_3	t-test ($\beta_3 > 0, p < 0.05$)	Table 3 (MRA FEM)
H_4	$KK_{it} \rightarrow HDI_{it}$ (+)	β_4	t-test ($\beta_4 > 0, p < 0.05$)	Table 3 (MRA FEM)
H_5	$KF_{it} \times KK_{it} \rightarrow HDI_{it}$ (+)	β_5	t-test ($\beta_5 \neq 0, p < 0.05$)	Tables 3 and 4
H_6	$BP_{it} \times KK_{it} \rightarrow HDI_{it}$ (+)	β_6	t-test ($\beta_6 \neq 0, p < 0.05$)	Tables 3 and 4
H_7	$BK_{it} \times KK_{it} \rightarrow HDI_{it}$ (+)	β_7	t-test ($\beta_7 \neq 0, p < 0.05$)	Tables 3 and 4

Source: Author's methodological design (2026).

B. RESULTS

1. Acute Fiscal Dependence Coexists with Skewed Revenue Realization Across Newly Autonomous Regencies

Summary statistics across the balanced panel of twenty Newly Autonomous Region (*Daerah Otonom Baru*, or DOB) regencies in Papua from 2018 to 2024 ($N = 140$) reveal a pronounced structural asymmetry between subnational human development, own-source fiscal capacity, and reported revenue-realization ratios. As presented in Table 3, the regional Human Development Index (HDI_{it}) records a panel mean of 54.23 points and a median of 51.35 points on a 0–100 scale, placing the aggregate DOB territory in the low

human development classification (< 60 points) and trailing the 2024 national benchmark of 75.02 by more than twenty points.[25] Cross-sectional dispersion is substantial (SD = 9.94), spanning a 47.43-point gulf between conflict-affected, landlocked Nduga Regency in Papua Pegunungan (Min = 29.42 in 2018) and resource-extractive Mimika Regency in Papua Tengah (Max = 76.85 in 2024). The positive divergence between the mean (54.23) and median (51.35) confirms right-skewed welfare clustering, wherein coastal and mining enclaves pull the regional average upward while highland regencies remain concentrated below the 55-point threshold.

Table 3. Descriptive Statistics of Panel Variables ($N = 140$, 2018–2024)

Variable	Mean	Std. Dev.	Minimum	Maximum
HDI_{it} (index points)	54.2304	9.9393	29.4200	76.8500
KF_{it} (decimal ratio)	0.0326	0.0484	0.0014	0.3439
BP_{it} (decimal ratio)	0.1258	0.0560	0.0277	0.3694
BK_{it} (decimal ratio)	0.1295	0.0414	0.0002	0.2581
KK_{it} (decimal ratio)	1.7349	2.1130	0.1030	16.4426

Source: Author's calculation using EViews 10 based on audited BPS and DJPK Ministry of Finance panel data (2026).
Notes: Fiscal ratios are expressed in decimal proportions (0.01 = 1%). Panel medians are 51.3450 for HDI_{it}, 0.0176 for KF_{it}, 0.1174 for BP_{it}, 0.1270 for BK_{it}, and 1.1532 for KK_{it}.

Fiscal capacity indicators in Table 3 underscore extreme transfer dependency. Fiscal independence (KF_{it}), measured as realized own-source revenue (PAD) divided by total regional revenue, averages only 0.0326 (3.26 percent) with a median of 0.0176 (1.76 percent), indicating that intergovernmental transfers finance nearly 97 percent of subnational budgets across the sample. Its standard deviation (0.0484) exceeds the mean, reflecting the contrast between Deiyai Regency's near-zero autonomy (0.14 percent in 2018) and Mimika Regency's mining-driven capacity (34.39 percent in 2024). Priority expenditure shares show divergent statutory compliance. Education expenditure (BP_{it}) averages 0.1258 (12.58 percent of total regional expenditure; median = 11.74 percent; SD = 0.0560), falling well short of Indonesia's 20 percent constitutional mandate and the 30 percent Special Autonomy earmark rule, with realizations ranging from 2.77 percent in Puncak (2023) to 36.94 percent in Paniai (2024). Conversely, health expenditure (BK_{it}) averages 0.1295 (12.95 percent; median = 12.70 percent; SD = 0.0414), satisfying the statutory 10 percent threshold on average despite an anomalous single-year contraction to 0.02 percent in Boven Digoel (2024) and a peak of 25.81 percent in Tolikara (2024). Regional financial performance (KK_{it}), proxied by the PAD revenue-effectiveness ratio,

[25] Badan Pusat Statistik, *Indeks Pembangunan Manusia 2024*, vol. 19 (Jakarta: Badan Pusat Statistik, 2025), 15–22, 73–76.

averages 1.7349 (173.49 percent; median = 115.32 percent) with extreme dispersion (SD = 2.1130), spanning from 10.30 percent in Nduga (2024) to an outlier of 1,644.26 percent in Puncak (2020) driven by emergency pandemic aviation reconciliations booked against a lowballed PAD target of Rp1.12 billion.

Pre-estimation specification and diagnostic tests confirm the econometric validity of the Fixed Effects Moderated Regression Analysis (MRA) framework. In the panel model-selection sequence, the Chow Likelihood Ratio test strongly rejects the Pooled Least Squares estimator in favor of cross-sectional Fixed Effects (Cross-section $F = 76.7360$,d.f. $= 19,116, p = 0.0000$; Cross-section $\chi^2 = 365.0885$,d.f. $= 19, p = 0.0000$), confirming significant unobserved regency-specific intercepts. Subsequently, the Hausman specification test rejects the Random Effects estimator in favor of the Fixed Effects Model (Cross-section random $\chi^2 = 41.6615$,d.f. $= 4, p = 0.0000$), establishing that unobserved regency heterogeneity correlates with the fiscal regressors.[26] While raw panel residuals initially departed from Gaussian normality due to extreme accounting outliers in KK_{it} (Jarque-Bera $= 164.1578, p = 0.0000$), applying a two-sided 1 percent winsorizing transformation across the independent and moderating variables successfully restored residual normality (Jarque-Bera $= 1.9371, p = 0.3796 > 0.05$; skewness $= 0.2595$; kurtosis $= 3.2503$) while preserving the balanced panel of $N = 140$ observations.[27] Pairwise correlation diagnostics verify the absence of severe multicollinearity among the constitutive regressors, as all correlation coefficients remain well below the 0.90 threshold: $r(KF, BP) = 0.6896$, $r(KF, BK) = 0.5224$, $r(KF, KK) = 0.4582$, $r(BK, KK) = 0.3973$, $r(BP, BK) = 0.2830$, and $r(BP, KK) = 0.2235$. Finally, because the Panel Cross-Section Heteroskedasticity Likelihood Ratio test rejects homoskedastic error variance across the twenty regencies (LR $= 138.7822$,d.f. $= 20, p = 0.0000$), all inferential statistics in Table 4 are computed using Fixed Effects with White cross-section heteroskedasticity-consistent standard errors.[28]

[26] Jeffrey M. Wooldridge, *Econometric Analysis of Cross Section and Panel Data*, 2nd ed. (Cambridge, MA: MIT Press, 2010), 300–315; Badi H. Baltagi, *Econometric Analysis of Panel Data*, 6th ed. (Cham: Springer, 2021), 23–31.
[27] Rand R. Wilcox, *Introduction to Robust Estimation and Hypothesis Testing*, 4th ed. (Cambridge, MA: Academic Press, 2017), 29–34; Joseph F. Hair et al., *Multivariate Data Analysis*, 8th ed. (Harlow: Pearson, 2021), 85–92.
[28] James H. Stock and Mark W. Watson, "Heteroskedasticity-Robust Standard Errors for Fixed Effects Panel Data Regression," *Econometrica* 76, no. 1 (2008): 155–174, https://doi.org/10.1111/j.0012-9682.2008.00821.x.

2. Education Expenditure Drives Human Development While Administrative Revenue Effectiveness Erodes Welfare

Table 4 reports the Fixed Effects MRA parameter estimates, robust standard errors, t-statistics, and p-values for Equation (2). Collectively, the fiscal capacity, priority expenditure, financial performance, and interaction regressors account for an Adjusted R^2 of 0.9677 ($R^2 = 0.9738$), with a simultaneous F-statistic of 161.3078 ($p = 0.0000$), confirming that the specified panel model explains 96.77 percent of the variance in regency-level human development across the newly autonomous Papuan provinces while leaving 3.23 percent to external factors. The baseline constant ($\beta_0 = 51.6629$,SE $= 0.8623, t = 59.9152, p = 0.0000$) anchors the conditional mean HDI across the twenty regencies at 51.66 points when constitutive fiscal ratios and interaction terms are evaluated at zero.

Table 4. Fixed Effects Moderated Regression Estimates for Human Development Index ($N = 140$)

Variable	Coefficient	Std. Error	t-Statistic	p-Value
Constant (C)	51.66293	0.86227	59.91523	0.0000***
Fiscal Independence (KF_{it})	2.84872	8.44622	0.33728	0.7365
Education Expenditure (BP_{it})	22.45440	6.83730	3.28410	0.0014***
Health Expenditure (BK_{it})	-3.85876	3.50395	-1.10126	0.2731
Financial Performance (KK_{it})	-0.42919	0.13621	-3.15106	0.0021***
$KF_{it} \times KK_{it}$	2.03634	1.40686	1.44744	0.1505
$BP_{it} \times KK_{it}$	1.63665	0.74869	2.18602	0.0309
$BK_{it} \times KK_{it}$	1.98256	1.04452	1.89805	0.0602*

Source: Author's estimation using EViews 10 (2026).
Notes: Dependent variable is HDI_{it} (0–100 points). Estimation uses Panel Least Squares with cross-section Fixed Effects, 1 percent winsorized regressors, and White cross-section heteroskedasticity-consistent standard errors. Model fit: $R^2 = 0.973764$; Adjusted $R^2 = 0.967727$; F-statistic = 161.3078 (Prob(F) = 0.0000). Significance levels: *** $p < 0.01$, $p < 0.05$, * $p < 0.10$.

Evaluating the direct constitutive channels yields mixed verdicts across the first four hypotheses (H_1–H_4). First, fiscal independence (KF_{it}) exhibits a positive point estimate ($\beta_1 = 2.8487$,SE $= 8.4462, t = 0.3373$) that is statistically indistinguishable from zero ($p = 0.7365 > 0.05$). Consequently, H_1 **is not supported**: marginal increases in the own-source revenue share of regency budgets fail to generate statistically significant improvements in human development because PAD averages only 3.26 percent of total revenue and is heavily absorbed by routine bureaucratic operations (which consumed 61.62 to 72.47 percent of total outlays in regencies such as Mimika, Puncak, Boven Digoel, and Paniai in 2024).

Second, education expenditure allocation (BP_{it}) exerts a highly significant positive direct effect on the Human Development Index ($\beta_2 = 22.4544$,SE $= 6.8373, t =$

$3.2841, p = 0.0014 < 0.01$), confirming that H_2 **is supported**. In terms of economic magnitude, because BP_{it} is scaled as a decimal proportion (where 0.01 represents 1 percentage point of total regional spending), a 1 percentage-point increase in the budget share allocated to education directly raises a regency's HDI by 0.2245 index points, holding other variables constant. Scaling this effect to a policy-relevant shift, raising a lagging highland regency's education allocation by 10 percentage points (for instance, from the sample mean of 12.58 percent to 22.58 percent to satisfy the 20 percent constitutional mandate) predicts an immediate direct gain of 2.25 HDI points—equivalent to nearly one-quarter of the panel's cross-sectional standard deviation (SD = 9.94). Evaluated at the sample means ($\overline{BP} = 0.1258, \overline{HDI} = 54.2304$), the implied direct point elasticity of human development with respect to the education expenditure share is $\varepsilon_{HDI,BP} = \beta_2(\overline{BP}/\overline{HDI}) = 0.0521$, indicating that a 10 percent relative expansion in the education budget share corresponds to a 0.52 percent rise in aggregate HDI.

Third, health expenditure allocation (BK_{it}) displays a negative but statistically insignificant coefficient ($\beta_3 = -3.8588$,SE $= 3.5040, t = -1.1013, p = 0.2731 > 0.05$), meaning that H_3 **is not supported**. Despite regencies allocating an average of 12.95 percent of their budgets to the health sector, nominal health appropriations do not translate into contemporaneous gains in life expectancy or composite HDI within the seven-year observation window.

Fourth, regional financial performance (KK_{it}) exerts a statistically significant *negative* direct effect on the Human Development Index ($\beta_4 = -0.4292$,SE $= 0.1362, t = -3.1511, p = 0.0021 < 0.01$). Because the estimated coefficient is negative rather than positive as hypothesized, H_4 **is not supported**. In economic magnitude, each 100 percentage-point (1.00 decimal unit) increase in the ratio of realized PAD to targeted PAD is associated with a 0.4292-point contraction in HDI (an implied elasticity at sample means of $\varepsilon_{HDI,KK} = -0.0137$), demonstrating that standalone over-realization of conservative revenue targets coincides with lower human welfare across newly autonomous Papuan districts.

3. Financial Performance Selectively Amplifies the Education Expenditure Channel

The Moderated Regression Analysis interaction terms in the lower panel of Table 4 test whether regional financial performance acts as a contingency factor conditioning the transmission of fiscal autonomy and priority social spending into human development

(H_5–H_7). The empirical estimates reveal a highly selective moderation pattern across the three fiscal channels.

First, the interaction between fiscal independence and regional financial performance ($KF_{it} \times KK_{it}$) yields a positive coefficient ($\beta_5 = 2.0363$,SE $= 1.4069, t = 1.4474$) that fails to reach statistical significance at the 5 percent threshold ($p = 0.1505 > 0.05$). Accordingly, H_5 **is not supported**: high PAD target realization rates do not empower own-source revenue shares to drive human development when the underlying local tax base remains structurally negligible.

Second, the interaction between education expenditure and regional financial performance ($BP_{it} \times KK_{it}$) is positive and statistically significant ($\beta_6 = 1.6367$,SE $= 0.7487, t = 2.1860, p = 0.0309 < 0.05$), providing direct empirical confirmation that H_6 **is supported**. Because both the constitutive education expenditure slope ($\beta_2 = 22.4544, p = 0.0014$) and the multiplicative interaction slope ($\beta_6 = 1.6367, p = 0.0309$) are positive and statistically significant, regional financial performance operates as a synergistic (enhancing) quasi-moderator of educational investment. Differentiating Equation (2) with respect to education expenditure defines the conditional marginal effect of educational budget shares on human development as a linear function of regional financial performance:

$$\frac{\partial HDI_{it}}{\partial BP_{it}} = 22.45440 + 1.63665KK_{it}$$

Evaluating this marginal derivative across the empirical distribution of KK_{it} illustrates the substantive amplification achieved through stronger budget execution. In a regency operating at the panel minimum financial performance ($KK = 0.1030$, or 10.30 percent realization, as in Nduga), a 1 percentage-point (0.01) increase in the education expenditure share generates 0.2262 HDI points (slope $= 22.6230$). At the panel median financial performance ($KK = 1.1532$, or 115.32 percent realization), the marginal return rises to 0.2434 HDI points per percentage-point of education spending (slope $= 24.3418$), representing a 7.60 percent enhancement over the baseline slope. At the panel mean financial performance ($KK = 1.7349$, or 173.49 percent realization), the marginal return expands further to 0.2529 HDI points per percentage-point of educational allocation (slope $= 25.2939$), a 12.65 percent amplification over the unmoderated baseline effect. Thus, while higher revenue-effectiveness ratios do not directly raise welfare in isolation ($\beta_4 < 0$), coupling effective revenue administration with dedicated education

appropriations substantially magnifies the human capital yield of every rupiah directed toward schooling.

Third, the interaction between health expenditure and regional financial performance ($BK_{it} \times KK_{it}$) yields a positive point estimate ($\beta_7 = 1.9826$,SE $= 1.0445, t = 1.8981$) with a two-tailed p-value of 0.0602. Evaluated against the pre-specified $\alpha = 0.05$ significance criterion, H_7 **is not supported**. Although the interaction approaches marginal significance at the 10 percent level, regional financial performance fails to robustly overcome the structural and logistical bottlenecks impeding health expenditure conversion in the DOB Papuan regencies.

4. Expenditure Efficiency Robustness Confirms Selective Educational Moderation

To verify that the moderation findings in Table 4 are not statistical artifacts of proxy selection or mechanical numerator coupling between fiscal independence ($KF_{it} =$ PAD/Total Revenue) and PAD-based financial performance ($KK_{it} =$ Realized PAD/ Targeted PAD), Equation (2) was re-estimated by replacing KK_{it} with an expenditure-side governance indicator: the regional spending efficiency ratio ($EF_{it} =$ [Realized Total Expenditure/Realized Total Revenue] $\times$ 100).[29] Table 5 compares the interaction coefficients, t-statistics, and p-values between the baseline revenue-effectiveness model and the alternative expenditure-efficiency robustness model.

Table 5. Robustness Comparison of Moderation Paths Using Expenditure Efficiency ($N = 140$)

Moderated Path	Baseline β (KKit)	Baseline p-Value	Robust β (EFit)	Robust p-Value
$KF_{it} \times$ Moderator $\rightarrow HDI_{it}$ (H_5)	2.03634	0.1505	-34.38576	0.1352
$BP_{it} \times$ Moderator $\rightarrow HDI_{it}$ (H_6)	1.63665	0.0309	46.04635	0.0402
$BK_{it} \times$ Moderator $\rightarrow HDI_{it}$ (H_7)	1.98256	0.0602*	-20.21733	0.8188

Source: Author's estimation using EViews 10 based on Thesis Appendix 7 robustness outputs (2026).
Notes: Baseline model specifies KK_{it} (Realized PAD/Target PAD) as the moderator; Robust model specifies EF_{it} (Realized Expenditure/Realized Revenue) as the alternative moderator. The direct partial effect of EF_{it} on HDI_{it} in the robustness specification is statistically insignificant ($p > 0.05$). Significance levels: $p < 0.05$, * $p < 0.10$.

As documented in Table 5, the hypothesis verdicts remain invariant across both governance proxies at the 5 percent significance level. First, the direct partial effect of the

[29] Abdul Halim, *Akuntansi Keuangan Daerah*, 4th ed. (Jakarta: Salemba Empat, 2020), 128–136; Mahmudi, *Manajemen Kinerja Sektor Publik*, 3rd ed. (Yogyakarta: UPP STIM YKPN, 2019), 140–148.

expenditure efficiency ratio (EF_{it}) on HDI_{it} is statistically insignificant ($p > 0.05$), corroborating the rejection of H_4 by confirming that administrative budget ratios do not automatically generate direct human development gains. Second, the interaction between fiscal independence and expenditure efficiency ($KF_{it} \times EF_{it}$) remains statistically insignificant ($\beta_5 = -34.3858, p = 0.1352 > 0.05$), confirming that the rejection of H_5 is structurally robust and not driven by shared PAD numerators. Third, the interaction between education expenditure and expenditure efficiency ($BP_{it} \times EF_{it}$) remains positive and statistically significant ($\beta_6 = 46.0464, t = 2.0761, p = 0.0402 < 0.05$), reinforcing support for H_6 and confirming that disciplined budget execution consistently amplifies the welfare returns of educational investment. Fourth, the interaction between health expenditure and expenditure efficiency ($BK_{it} \times EF_{it}$) turns negative and completely noisy ($\beta_7 = -20.2173, t = -0.2296, p = 0.8188 > 0.05$), confirming that the marginal 10 percent significance observed in the baseline model ($p = 0.0602$) is fragile and validating the rejection of H_7.

C. DISCUSSION

1. Subsistence Tax Bases, Routine Overhead Absorption, and Target Lowballing Neutralize Fiscal Autonomy

The empirical rejection of the direct fiscal independence hypothesis ($H_1: \beta_1 = 2.8487, p = 0.7365$), the direct financial performance hypothesis ($H_4: \beta_4 = -0.4292, p = 0.0021$), and the moderated fiscal independence hypothesis ($H_5: \beta_5 = 2.0363, p = 0.1505$) exposes a fundamental breakdown in the revenue-side transmission chain across the Newly Autonomous Regions (*Daerah Otonom Baru*, or DOB) of Papua. Decomposing this result into a structural sequence of shock → channel → outcome falsifies the unconditional predictions of First-Generation Fiscal Federalism in frontier economies while validating the institutional threshold conditions of Second-Generation Fiscal Decentralization theory.[30] In classical fiscal federalism, an exogenous or policy-driven expansion in the own-source revenue share (shock) is predicted to harden the local budget constraint and align public expenditure with constituent welfare preferences (channel), thereby accelerating human capital accumulation (outcome).[31] Across the

[30] Wallace E. Oates, *Fiscal Federalism* (New York: Harcourt Brace Jovanovich, 1972), 31–38; Roy Bahl and Richard M. Bird, *Fiscal Decentralization and Local Finance in Developing Countries: Development from Below* (Cheltenham: Edward Elgar Publishing, 2018), 18–24, 394–402.
[31] Oates, *Fiscal Federalism*, 35; Bahl and Bird, *Fiscal Decentralization and Local Finance*, 20–24.

twenty DOB Papuan regencies, however, this transmission channel is severed by an acute threshold deficit: because own-source revenue (*Pendapatan Asli Daerah*, or PAD) averages only 3.26 percent of total regional revenue—and drops below 1 percent in highland regencies such as Nduga (0.30 percent), Puncak (0.64 percent), Puncak Jaya (0.77 percent), and Pegunungan Bintang (0.77 percent)—local tax effort lacks the critical mass required to finance development programs independently. Outside the mining enclave of Mimika (34.39 percent fiscal independence), the regional economy remains anchored in subsistence agriculture and informal trade, constrained by extreme rural poverty rates reaching 24.5 percent in Asmat and 25.7 percent in Mappi.

When nearly 97 percent of subnational budgets is financed through central Intergovernmental Transfers (*Transfer ke Daerah*, or TKD) and Special Autonomy (*Otonomi Khusus*, or Otsus) block grants, marginal fluctuations in own-source revenue trigger a severe flypaper and overhead-absorption effect rather than productive social investment.[32] Audited 2024 budget realizations confirm that incremental regional revenues are systematically captured by routine bureaucratic maintenance, with operating and personnel expenditures consuming 72.47 percent of total regional spending in Paniai, 68.12 percent in Boven Digoel, 67.71 percent in Puncak, and 61.62 percent in Mimika. Because incremental PAD is absorbed by administrative overhead rather than capital formation, fiscal independence exerts no statistically significant leverage on the Human Development Index.

Even more revealing is the negative and statistically significant direct slope of regional financial performance ($\beta_4 = -0.4292, p = 0.0021$), which directly refutes the naive accountability assumption that higher revenue-target realization ratios reflect superior public management. Operationalizing Bovens's public accountability framework alongside Sow and Razafimahefa's subnational efficiency model clarifies the underlying agency pathology: in transfer-dependent jurisdictions with weak monitoring forums, bureaucratic actors decouple formal administrative compliance from substantive welfare delivery.[33] The shock of central audit evaluation—specifically the pursuit of "Highly

[32] Retno Fitrianti et al., "Flypaper Effect: Analysis of Financial Transfers from the Central Government to Provincial Regions in Indonesia," *Public and Municipal Finance* 14, no. 1 (2025): 58–61, https://doi.org/10.21511/pmf.14(1).2025.05; Kementerian Keuangan Republik Indonesia, *Laporan Realisasi Anggaran Pendapatan Dan Belanja Daerah (APBD) Kabupaten/Kota 2018–2024* (Jakarta: Direktorat Jenderal Perimbangan Keuangan, 2025), 1–20.

[33] Mark Bovens, "Public Accountability," in *The Oxford Handbook of Public Management*, ed. Ewan Ferlie, Laurence E. Lynn Jr., and Christopher Pollitt (Oxford: Oxford University Press, 2005), 184–185, 192–195; Moussé Sow and Ivohasina F. Razafimahefa, "Fiscal Decentralization and the Efficiency of Public Service

Effective" (> 100 percent) revenue-realization ratings and unqualified audit opinions (*Wajar Tanpa Pengecualian*, or WTP) from the Audit Board of Indonesia (BPK)—operates through two distortionary channels:

a. Strategic target lowballing: Local executives intentionally depress initial PAD targets during budget formulation so that modest or incidental collections generate inflated percentage realizations, exemplified by Puncak Regency's 1,644.25 percent effectiveness ratio in 2020 (Rp18.41 billion realized from centralized pandemic aviation reconciliations booked as miscellaneous lawful PAD against a lowballed target of Rp1.12 billion) and Tolikara Regency's 977.83 percent ratio in 2024. These artificial surpluses create paper effectiveness without expanding real fiscal space.

b. Audit-induced risk aversion: Because constructing remote schools and clinics under extreme highland logistics inflation carries a high probability of physical delay and BPK audit findings, risk-averse bureaucrats protect their formal financial performance ratings by concentrating disbursements on easily documented urban routine operations. Indeed, although six regencies in Papua Pegunungan secured WTP audit opinions, BPK concurrently uncovered substantive governance failures, including unlawful salary disbursements to retired civil servants.

Consequently, when evaluated independently of priority social spending, higher headline revenue-effectiveness ratios signify bureaucratic target gaming and routine overhead concentration, which crowd out capital formation and reduce human development ($\beta_4 < 0$). For the same structural reason, interacting a negligible PAD base (KF_{it}) with a target-gamed revenue ratio (KK_{it})—or with the expenditure efficiency ratio ($EF_{it}, p = 0.1352$) in Table 5—cannot generate synergistic welfare gains, explaining the robust rejection of H_5.

2. Accountable Budget Execution Amplifies Educational Capital While Logistical Inflation Neutralizes Health Outlays

In contrast to the revenue-side paralysis, the empirical juxtaposition between the education channel (H_2 and H_6 supported) and the health channel (H_3 and H_7 rejected)

Delivery," *IMF Working Paper* no. WP/15/59 (2015): 14–22, https://doi.org/10.5089/9781484351116.001; Boediarso Teguh Widodo, "Evaluasi Dinamis Dampak Fiskal Otonomi Khusus Terhadap Efisiensi Layanan Publik Dan Pertumbuhan Ekonomi Di Provinsi Papua, Papua Barat Dan Aceh Tahun 2011–2017," *Kajian Ekonomi dan Keuangan* 3, no. 1 (2019): 31–53, https://doi.org/10.31685/kek.v3i1.463.

demonstrates that the welfare productivity of subnational public expenditure depends on its vulnerability to physical supply-chain friction and its coupling with cybernetic financial governance.

The strong positive direct effect of education expenditure ($\beta_2 = 22.4544, p = 0.0014$; elasticity $\varepsilon_{HDI,BP} = 0.0521$) and its significant positive moderation by both revenue effectiveness ($\beta_6 = 1.6367, p = 0.0309$) and expenditure efficiency ($\beta_6 = 46.0464, p = 0.0402$ in Table 5) validate Becker's Human Capital Theory while operationalizing the cybernetic learning dimension of Bovens's accountability model.[34] In the educational transmission chain, a budgetary allocation shock directed toward schooling operates through human-embodied and institutional channels—scholarship partnerships, boarding school operations, and teacher deployment—that partially bypass local physical construction bottlenecks. Under the Master Plan for the Acceleration of Development in Papua (*Rencana Induk Percepatan Pembangunan Papua*, or RIPPP 2022–2041) and its *Papua Cerdas* pillar, regencies that couple high budget shares with disciplined financial execution convert funds directly into Expected Years of Schooling (HLS) and Mean Years of Schooling (RLS). A prominent empirical illustration is Mappi Regency in Papua Selatan, which allocated 26.06 percent of its 2024 APBD to education (exceeding the 20 percent constitutional mandate) to finance full undergraduate scholarships for 100 indigenous Papuan (*Orang Asli Papua*, or OAP) students—primarily women—at national institutions such as Universitas Negeri Jakarta in elementary teacher education, informatics, and English, advancing a five-year target of 1,000 indigenous graduates. Similarly, Papua Tengah institutionalized *Sekolah Asrama Taruna* (boarding schools) and all-day schooling (*Sekolah Sepanjang Hari*, or SSH) in Nabire to insulate students from geographic isolation.

Crucially, the positive interaction coefficient ($\beta_6 > 0$) proves that regional financial performance functions as a necessary catalyst for these educational outlays. When high revenue-realization discipline and expenditure efficiency are applied specifically to an expanded education budget ($\partial HDI/\partial BP = 22.4544 + 1.6367KK$), cybernetic financial accountability ensures predictable cash disbursement for dormitory nutrition, scholarship stipends, and remote teacher incentives while curbing administrative

[34] Gary S. Becker, *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education*, 3rd ed. (Chicago: University of Chicago Press, 1993), 17–21, https://doi.org/10.7208/chicago/9780226041223.001.0001; Bovens, "Public Accountability," 193–195.

leakage, thereby boosting the marginal HDI return of education spending by 12.65 percent at the sample mean of financial performance. This finding also exposes a critical policy paradox: although education spending yields an exceptional marginal welfare return ($\beta_2 = 22.4544$), average allocations in Papua Pegunungan (14.34 percent) and Papua Tengah (19.25 percent) remain below the 20 percent APBD constitutional floor and the 30 percent Special Autonomy earmark, leaving more than 600,000 school-age children across Papua out of school. Underperformance in regional educational attainment is therefore driven by under-allocation rather than low spending productivity.

Conversely, the statistical insignificance of direct health expenditure ($\beta_3 = -3.8588, p = 0.2731$) and moderated health expenditure across both governance proxies ($\beta_7 = 1.9826, p = 0.0602$ in Table 4; $\beta_7 = -20.2173, p = 0.8188$ in Table 5) falsifies the linear assumption that meeting statutory input floors—such as the 12.95 percent average health allocation exceeding the 10 percent Law No. 36/2009 threshold—automatically improves life expectancy. Decomposing the health transmission chain reveals four structural barriers that consume nominal health appropriations before clinical outcomes materialize:

a. Logistics inflation and real purchasing-power depreciation: Unlike external university scholarships, healthcare delivery requires continuous physical movement of vaccines, pharmaceuticals, medical equipment, and construction materials into landlocked alpine regencies. In Papua Pegunungan—Indonesia's only entirely landlocked province—air-cargo logistics are severely imbalanced, with 10,251.80 tons of goods unloaded versus only 715.16 tons loaded outward. Reliance on pioneer aviation drives the Construction Cost Index (*Indeks Kemahalan Konstruksi*, or IKK) to the highest levels in the nation against the standard 100 benchmark: Puncak reaches 379.81 (and previously peaked at 418.96), Intan Jaya records 342.93, Puncak Jaya 334.69, Pegunungan Bintang 302.53, and Tolikara 288.59. Consequently, up to three-quarters of a highland regency's nominal health budget is eroded by air-freight tariffs and extreme construction costs rather than expanding clinical coverage.
b. Acute clinical human-resource deficits and procurement non-compliance: Physical health budgets cannot function without medical personnel, yet physician-to-population ratios in remote DOB districts languish at 1:5,019, contributing to a maternal mortality ratio of 239 per 100,000 live births in

Papua Selatan (2023) and stunting prevalence reaching 54.5 percent in Asmat (2022). Prior to mobile clinic interventions (*Puskesmas Bergerak*) in regencies such as Yahukimo, villagers walked two to three days to reach basic care. Simultaneously, slow disbursement of earmarked transfers generates idle year-end balances (SILPA) and contract irregularities, as reflected in Papua Tengah's 2024 qualified audit opinion (*Wajar Dengan Pengecualian*, or WDP) due to unfulfilled procurement specifications.

c. Armed conflict and security force majeure: Periodic armed escalations by the West Papua National Liberation Army (TPNPB-OPM) and local electoral conflicts—such as the 2018 Nduga infrastructure attacks and subsequent destruction of rural clinics—force the evacuation of doctors, midwives, and nurses, halting immunization and maternal care regardless of budget availability.

d. Gestation lags and source-of-funds decoupling: Improvements in life expectancy at birth require multi-decade cumulative investments in sanitation and nutrition, whereas school enrollment indicators respond within shorter budget cycles.[35] Moreover, because regency health budgets are 97 percent funded by central transfers (DAU, DAK, and Otsus) while KK_{it} measures local PAD target realization, local revenue effectiveness lacks financial leverage over transfer-financed health programs.

3. Scholarly Debate and Cross-Context Elevation in Asymmetric Decentralization

Confronting these empirical estimates with contemporary public-finance literature clarifies why subnational fiscal instruments diverge across institutional settings. Table 6 synthesizes the position of the present study relative to eight core empirical investigations.

Table 6. Comparative Synthesis of Empirical Studies on Decentralization and Human Development

Study	Context	Method	Key Estimate	Relation to Study
Jin and Jakovljevic (2023)	50 countries (1991–2020)	Panel FE and IV-2SLS	Inverted-U decentralization curve	Confirms capacity threshold
Sofilda et al. (2023)	484 Indonesian districts	FEM and System-GMM	Independence positive; decentralization unstable	Extends via MRA moderator
Susilo et al. (2026)	34 Indonesian provinces	Arellano-Bond GMM	Education positive; health negative	Confirms sectoral divergence

[35] Michael P. Todaro and Stephen C. Smith, *Economic Development*, 13th ed. (Harlow: Pearson, 2020), 390–405.

Fitrianti et al. (2025)	Indonesian provinces	Panel regression	Transfers induce flypaper effect	Explains H_1 insignificance
Abdallah and Saloom (2024)	Iraq (2004–2023)	Time-series ARDL	Education spending positive long-run	Confirms H_2 productivity
Lelyana and Sarjito (2024)	Remote Papua regencies	Policy case analysis	Air logistics erode health delivery	Explains H_3 and H_7 failure
Zein et al. (2024)	8 Banten districts	Panel path analysis	Effectiveness directly raises growth	Refutes direct H_4 positivity
Sow and Razafimahefa (2015)	Developing countries	Panel stochastic frontier	Decentralization reduces efficiency	Confirms negative H_4 slope

Source: Author's synthesis of prior empirical literature and Section B estimations (2026).

Placing the parameter magnitudes from Table 4 and Table 5 in dialogue with the studies in Table 6 yields three substantive scholarly contributions:

a. Resolving the decentralization-welfare paradox: Our finding that fiscal independence is statistically insignificant ($\beta_1 = 2.8487, p = 0.7365$) contrasts with district-level evidence from industrialized Western Indonesian jurisdictions such as Banten, where Zein et al. report positive direct returns from fiscal independence and effectiveness ratios, and partially diverges from Sofilda, Hamzah, and Kusairi's national System-GMM estimate showing positive growth effects of regional independence across 484 districts.[36] This divergence stems from sample composition and structural threshold effects: whereas national panels are dominated by Java and Sumatra municipalities with diversified manufacturing and service tax bases, the twenty DOB Papuan regencies operate at a 3.26 percent PAD share where Fitrianti et al.'s flypaper effect dominates.[37] Our results align directly with Jin and Jakovljevic's cross-national IV-2SLS demonstration of an inverted-U curve and Sow and Razafimahefa's finding that devolving fiscal authority to subnational units lacking institutional capacity degrades public service efficiency—extending both studies by proving that administrative target lowballing turns headline revenue effectiveness significantly negative ($\beta_4 = -0.4292$).[38]

[36] Mohamad Harry Mulya Zein et al., "Examining the Role of Local Government's Financial Performance and Capital Expenditure in Increasing Economic Growth in Banten Province, Indonesia (2018–2022)," *Journal of Risk and Financial Management* 17, no. 10 (2024): 456, at 7–11, https://doi.org/10.3390/jrfm17100456; Eleonora Sofilda, Muhammad Zilal Hamzah, and Suhal Kusairi, "Analysis of Fiscal Decentralisation, Human Development, and Regional Economic Growth in Indonesia," *Cogent Economics & Finance* 11, no. 1 (2023): 2220520, at 8–12, https://doi.org/10.1080/23322039.2023.2220520.
[37] Fitrianti et al., "Flypaper Effect," 58–61.
[38] Hui Jin and Mihajlo Jakovljevic, "Fiscal Decentralization and the Human Development Index: A Cross-Border Empirical Study," *Sustainability* 15, no. 11 (2023): 8784, at 5–9, https://doi.org/10.3390/su15118784; Sow and Razafimahefa, "Fiscal Decentralization and the Efficiency of Public Service Delivery," 16–20.

b. Adjudicating the education-versus-health productivity gap: Our large positive education slope ($\beta_2 = 22.4544, \varepsilon_{HDI,BP} = 0.0521$) and insignificant negative health slope ($\beta_3 = -3.8588, p = 0.2731$) strongly confirm Susilo et al.'s Arellano-Bond dynamic GMM results across thirty-four Indonesian provinces, which similarly identified positive HDI convergence from education spending alongside negative or null returns from health spending.[39] Whereas Susilo et al.'s provincial aggregation could not isolate the subnational transmission bottleneck, integrating our regency-level panel with Lelyana and Sarjito's field evidence demonstrates that extreme IKK cost inflation (302.53–379.81) and pioneer aviation dependence selectively tax logistics-intensive healthcare while allowing scholarship- and boarding-based educational investments to succeed.[40]

c. Establishing financial governance as a selective moderator: Our confirmation of H_6 ($\beta_6 = 1.6367$ for revenue effectiveness; $\beta_6 = 46.0464$ for expenditure efficiency) extends Abdallah and Saloom's ARDL evidence on educational productivity by demonstrating that subnational budget execution acts as a multiplicative amplifier of schooling outlays rather than a standalone driver of welfare.[41]

Elevating these findings beyond Indonesia situates the DOB Papua experience within the global macroeconomic discourse on asymmetric fiscal federalism, spatial poverty traps, and subnational resource governance. Across the developing world, central governments frequently deploy asymmetric fiscal autonomy and massive block grants to pacify and develop peripheral, conflict-affected, or resource-extractive regions. Cross-country comparison with structurally analogous jurisdictions reveals consistent macroeconomic regularities. In post-conflict, oil-transfer-dependent Iraq (2004–2023), Abdallah and Saloom show that public educational expenditures remain productive for

[39] Susilo et al., "The Impact of Fiscal Decentralization on Human Development Index Convergence in Indonesia: An Arellano-Bond GMM Dynamic Panel Data Estimation," *Forum for Social Economics* (2026): 14–21, https://doi.org/10.1080/07360932.2025.2610937.

[40] Nora Lelyana and Aris Sarjito, "Effectiveness of Mobile Health Services in Remote Papua under Indonesia's Minister of Health Regulation No. 90 of 2015," *Society* 12, no. 2 (2024): 899–905, https://doi.org/10.33019/society.v12i2.760; Badan Pusat Statistik, *Indeks Kemahalan Konstruksi Provinsi Dan Kabupaten/Kota 2025*, vol. 16 (Jakarta: Badan Pusat Statistik, 2025), 118–125.

[41] Zina Imad Abdallah and Taamem Mohammad Saloom, "Analysis of the Productivity of Educational Expenditures and Their Impact on Human Development in Iraq," *Journal of Economics and Administrative Sciences* 30, no. 144 (2024): 391–394, https://doi.org/10.33095/mc1xxy50.

human development over the long run despite security fragility, mirroring our finding that education outlays ($\beta_2 = 22.4544$) act as the primary driver of HDI in conflict-affected Papua.[42] Similarly, across developing-country panels in ASEAN and the 50-nation sample analyzed by Jin and Jakovljevic (1991–2020) and Sow and Razafimahefa, health expenditure shares frequently exhibit flat or insignificant short-run elasticities when decentralized to newly created subnational units before basic transport connectivity, clinical staffing, and procurement accountability are established.[43]

To avoid the local context trap, explicit boundary conditions must be stated. The selective moderation mechanism identified in this study generalizes to transfer-dependent (> 85 percent grant reliance), geographically isolated or landlocked subnational jurisdictions in developing economies characterized by narrow subsistence tax bases, high physical logistics inflation, and asymmetric autonomy transfers—such as remote highland, archipelagic, or post-conflict frontier districts in Archipelagic Southeast Asia, Sub-Saharan Africa, and the Andean region. Conversely, these parameter patterns should not be generalized to urbanized, fiscally autonomous metropolitan jurisdictions (where own-source revenue exceeds 25–50 percent of total revenue, road logistics are integrated, and competitive private healthcare markets operate), in which own-source revenue mobilization and public health outlays experience far lower logistical depreciation.

4. Theoretical Contributions, Policy Implications, and Methodological Limitations

Contributions. Theoretically, this study advances fiscal federalism and public accountability scholarship by demonstrating that subnational financial performance operates as a sector-specific contingency moderator rather than an unconditional positive determinant of human welfare, reconciling why formal budget compliance can coexist with stagnant human development under agency decoupling. Empirically, it provides the first census-level balanced panel evaluation ($N = 140$) across all twenty regencies of Indonesia's newly established Papuan provinces (Papua Selatan, Papua Tengah, and Papua Pegunungan) across the 2018–2024 Special Autonomy transition, quantifying both the direct elasticity of education spending ($\varepsilon = 0.0521$) and its 12.65 percent governance

[42] Abdallah and Saloom, "Analysis of the Productivity of Educational Expenditures," 391–394.
[43] Jin and Jakovljevic, "Fiscal Decentralization and the Human Development Index," 8784, at 7–9; Sow and Razafimahefa, "Fiscal Decentralization and the Efficiency of Public Service Delivery," 18–22.

amplification. From a policy standpoint, the study establishes that overcoming human development traps in newly proliferated frontier districts requires pairing mandatory educational earmarks with outcome-based audit metrics while insulating health budgets from extreme geographical cost inflation.

Policy and managerial implications. Three concrete policy prescriptions follow directly from the verified empirical mechanisms:

a. Enforcing outcome-based educational earmarks and digital budget integration (from the $\beta_2 > 0$ and $\beta_6 > 0$ mechanism): Because education expenditure is the sole fiscal instrument that robustly elevates HDI and is significantly amplified by financial execution efficiency, regency governments in Papua Pegunungan (14.34 percent average allocation) and Papua Tengah (19.25 percent) must strictly enforce the constitutional 20 percent APBD floor and the 30 percent Special Autonomy education earmark. Local executives should reallocate routine bureaucratic overhead toward replicable, high-yield human capital models—specifically full university scholarship partnerships (modeled on Mappi Regency) and rural boarding schools (*Sekolah Asrama Taruna* and *Sekolah Sepanjang Hari*)—while integrating the Regional Government Information System (SIPD) with the Special Autonomy Finance Information System (SIKD Otsus) to eliminate disbursement delays and year-end SILPA accumulation.

b. Reforming central fiscal evaluation and subsidizing highland air-cargo corridors (from the $\beta_4 < 0$ and insignificant β_3, β_7 mechanisms): The Ministry of Home Affairs, the Ministry of Finance, and the Papua Steering Committee (*Badan Pengarah Percepatan Pembangunan Otonomi Khusus Papua*, or BP3OKP) must terminate the use of raw PAD revenue-effectiveness ratios and administrative absorption rates as primary performance benchmarks, as these metrics incentivize target lowballing ($\beta_4 = -0.4292$). Central oversight must transition to outcome-based accountability tied to net enrollment gains, stunting reduction, and BPKP internal audit verification. Simultaneously, to prevent nominal health allocations from being consumed by air-freight inflation in landlocked regencies where IKK exceeds 300–379 points, the central government should establish a dedicated pioneer air-cargo logistics subsidy for medical supplies, vaccines, and health-facility construction

materials.

c. Establishing humanitarian security zones for basic service personnel (from the structural attrition mechanism): Because armed conflict and horizontal instability periodically force the abandonment of rural clinics and schools in highland regencies such as Nduga, Puncak, and Intan Jaya, BP3OKP, regional governments, and security forces must collaborate with indigenous customary (*adat*) councils to designate schools and *Puskesmas* as neutral humanitarian peace zones with guaranteed physical protection and hardship incentives for deployed educators and clinicians.

Limitations and future research directions. The findings of this study are bounded by four methodological constraints that define specific trajectories for future econometric inquiry. First, although substituting the expenditure efficiency ratio (EF_{it}) in Table 5 confirmed that the moderation results are not driven by shared PAD numerators between KF_{it} and KK_{it}, both proxies remain ratio-based accounting indicators; future studies should construct composite frontier efficiency indices using Data Envelopment Analysis (DEA) or Stochastic Frontier Analysis (SFA) to measure technical service-delivery efficiency directly. Second, while White cross-section standard errors control for heteroskedasticity across the census of $N = 20$ DOB regencies, future research expanding the cross-sectional boundary across all thirty-eight districts and cities of greater Papua (incorporating parent Papua, Papua Barat, and Papua Barat Daya) can apply dynamic System-GMM or bias-corrected Least Squares Dummy Variable (LSDVC) estimators to model multi-year autoregressive gestation lags in health and longevity outcomes. Third, because secondary APBD realizations do not disaggregate the internal composition of sectoral spending between personnel salaries and frontline clinical or instructional capital, future researchers should integrate spatial GIS accessibility indices, IKK deflators, and mixed-methods field audits of *Dana Otsus* utilization to isolate the real purchasing-power elasticity of social spending in frontier economies.

D. CONCLUSIONS

Addressing the fiscal-welfare paradox across the twenty regencies of the Newly Autonomous Regions of Papua from 2018 to 2024, this study demonstrates that translating asymmetric autonomy funds into human development depends selectively on sectoral allocation and budget-execution accountability rather than aggregate revenue

ratios. Concerning the first research question on direct fiscal channels, education expenditure serves as the sole positive fiscal driver of the Human Development Index, whereas fiscal independence and health expenditure exert statistically insignificant effects due to narrow subsistence tax bases and severe highland air-logistics cost inflation, and standalone regional financial performance correlates negatively with human welfare because conservative revenue-target lowballing coexists with heavy routine bureaucratic overhead. Concerning the second research question on institutional contingency, regional financial performance—whether measured through own-source revenue effectiveness or expenditure efficiency—significantly moderates and amplifies the positive human development returns of education expenditure, yet fails to moderate the structurally constrained fiscal independence and health expenditure channels. Sustaining human capital convergence across newly proliferated frontier provinces therefore requires central and subnational authorities to replace administrative revenue-realization benchmarks with outcome-based accountability, enforce mandatory educational spending floors for affirmative scholarships and boarding schools, and establish subsidized pioneer aviation corridors that protect highland health budgets from logistical depreciation.

REQUIRED STATEMENTS

CRediT authorship contribution statement. S.F.: Conceptualization, Methodology, Software, Formal analysis, Investigation, Data curation, Writing – original draft. R.P.: Conceptualization, Methodology, Validation, Supervision, Writing – review & editing. I.P.: Methodology, Validation, Formal analysis, Supervision, Writing – review & editing.

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https://www.bps.go.id). The processed balanced panel dataset ($N = 140$) and EViews 10 estimation outputs are available from the corresponding author upon reasonable request.

Ethics statement. This study analyzed macro-level secondary data available in the public domain. Therefore, ethical approval and informed consent were not required.

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