J E B I N Journal of Economics Business Industry
ISSN : 3025-0986
P-ISSN: 3025-0528
Volume 2, Number 1, 2024, pp 38-47
https://jurnaljepip.com/index.php/Jebin/index

The Convergence Paradox in Papua, Special Autonomy Transfers, Catch-Up Growth, and Persistent Inequality

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ABSTRACT
This study evaluates whether the Special Autonomy Fund (Dana Otonomi Khusus, hereinafter Otsus), distributed over two decades under Law Number 21 of 2001, has successfully reduced economic disparities across 28 districts in Papua province, Indonesia. Using district-level gross regional domestic product (GRDP) per capita data at constant 2010 prices compiled from Statistics Indonesia (BPS) over the period 2002 to 2021, we apply both absolute and conditional beta-convergence regressions alongside sigma-convergence trend analysis. The results reveal a convergence paradox: while absolute beta-convergence is statistically confirmed ($\beta = -0.0127$, $p < 0.01$), indicating that economically lagging districts exhibited faster relative growth, sigma-convergence analysis yields the opposite conclusion, as the cross-sectional standard deviation of log GRDP per capita rose monotonically from 1.124 in 2002 to 1.521 in 2021. Conditional beta-convergence incorporating Otsus fund per capita absorption, human development index, and an infrastructure composite index yields an estimated convergence speed of 2.84 percent per year, implying a theoretical half-life of approximately 24.4 years. The coexistence of beta-convergence and sigma-divergence is primarily driven by the structural outlier position of Mimika district, whose GRDP per capita is inflated by Grasberg mining activity, and by the uneven institutional capacity of district governments to absorb and channel fiscal transfers productively. These findings suggest that while Otsus transfers have modestly supported catch-up growth in lagging areas, the fiscal instrument alone has been insufficient to overcome structural inequalities embedded in natural resource geography and institutional gaps.

Keywords: Special Autonomy Funds, Regional Economic Convergence, Beta-Convergence, Sigma-Convergence, Fiscal Decentralization

INTRODUCTION
Papua occupies a paradoxical position within the Indonesian development landscape. It is simultaneously the province with the most abundant natural endowments, including the world's largest gold and copper reserve at Grasberg in Mimika district, and the province with the lowest human development index, highest poverty rate, and deepest structural economic inequalities in the country. This paradox of resource wealth coexisting with pervasive underdevelopment is not unique in the global literature on natural resource economies, but its scale in Papua is particularly acute and has persisted across successive waves of development policy.

The Special Autonomy Law, enacted as Law Number 21 of 2001 (Undang-Undang Otonomi Khusus Papua), was formulated as the Indonesian government's institutional response to this paradox. It transferred unprecedented fiscal authority and resources to the province, establishing a dedicated annual fund equivalent to 2 percent of the national General Allocation Fund (Dana Alokasi Umum), commonly known as the Otsus fund. (Undang-Undang Nomor 2 Tahun 2021 Tentang Perubahan Kedua Atas Undang-Undang Nomor 21 Tahun 2001 [Law Number 2 of 2021 Amending Law Number 21 of 2001], 2021; Undang-Undang Nomor 21 Tahun 2001 Tentang Otonomi Khusus Bagi Provinsi Papua [Law Number 21 of 2001 on Special Autonomy for Papua Province], 2001) this mechanism channeled cumulative transfers exceeding IDR 90 trillion to the provincial and district governments of Papua. The law mandated that a minimum of 30 percent be allocated to education and 15 percent to health, with remaining funds directed at infrastructure development and economic empowerment. In 2021, Law Number 2 of 2021 extended the Otsus framework for an additional 20 years, with modifications to allocation formulas and provincial governance arrangements, reflecting the ongoing centrality of this instrument in Papua's development strategy (Papua, 2021).

Despite the scale and longevity of these fiscal transfers, the academic literature on their developmental effectiveness has been limited and methodologically fragmented. Studies drawing on provincial aggregates obscure the substantial heterogeneity within Papua, where districts range from the globally integrated economic enclave of Mimika to isolated highland communities in Pegunungan Bintang and Nduga, which remain among the most economically marginal administrative units in Indonesia. A rigorous district-level assessment of whether Otsus transfers have contributed to economic convergence, defined as the progressive narrowing of income disparities across districts, represents an important gap that this study seeks to fill.

Economic convergence theory provides the methodological anchor for this analysis. Within the neoclassical growth framework, (Hailemariam & Dzhumashev, 2019; Mendez & Santos-Marquez, 2021)established the theoretical basis for income convergence: poorer economies, beginning from a lower capital-to-labor ratio, should experience higher marginal returns to investment and therefore faster growth, progressively closing the income gap with wealthier counterparts. (Barro & Sala-i-Martin, 1992) operationalized this insight through the empirical beta-convergence framework, which tests whether initial income levels predict subsequent growth rates. (Cahyat & Gonner, 2019)complemented this approach with sigma-convergence, which directly examines whether the cross-sectional dispersion of income levels narrows over time. These two approaches are conceptually related but empirically distinct: beta-convergence is a necessary but not sufficient condition for sigma-convergence, and both can diverge in the presence of structural outliers or idiosyncratic growth shocks (Canare, 2021).

This study applies both beta-convergence and sigma-convergence frameworks to Papua's district-level GRDP data over the complete first Otsus period, yielding three principal contributions. First, it provides the first systematic district-level convergence assessment for Papua covering the full twenty-year arc of the initial Otsus mandate, enabling evaluation of the law's economic equalization intent. Second, it explicitly incorporates Otsus fund absorption as a conditioning variable in the convergence regression, generating direct evidence on the fiscal transfer's role in shaping district growth trajectories. Third, it documents and explains a convergence paradox specific to Papua, in which standard beta-convergence coexists with persistent sigma-divergence, a finding with important implications for the design of the renewed Otsus framework. Section 2 presents the methodology. Section 3 reports empirical results and discusses their implications. Section 4 situates findings within the broader empirical literature on regional convergence and fiscal transfers. Section 5 concludes.

METHODOLOGY

Data and Study Area

The analysis covers 28 administrative units, comprising 27 districts (kabupaten) and one city (kota Jayapura), constituting Papua province prior to the administrative reorganization legislated in 2022 which divided the original province into four new provincial entities (Papua, Papua Selatan, Papua Tengah, and Papua Pegunungan). The pre-2022 boundary is chosen deliberately: it aligns with the governance and fiscal accountability unit over which the first Otsus framework operated, and it preserves comparability of the geographic unit across the full study period (Indonesia, 2021).

The primary variable of interest is district-level GRDP per capita at constant 2010 prices (ADHK 2010), expressed in millions of Indonesian rupiah (IDR) (Siburian, 2020) (Miranti & Mendez, 2023; Solihin et al., 2021; Yusof et al., 2022). Data were sourced from the provincial and national publications of Statistics Indonesia (Badan Pusat Statistik) for the period 2002 to 2021. Twelve districts were created through administrative expansion (pemekaran) after 2002, introducing a data continuity challenge. For these cases, GRDP series were extended backward using proportional allocation benchmarked to parent district data, consistent with methodological precedents in Indonesian convergence literature (Vidyattama, 2013; (Yusof et al., 2022). Districts created after 2010 were retained in the conditional convergence panel but excluded from absolute convergence cross-sections where the 2002 baseline observation could not be reliably reconstructed (Papua, 2021).

Special Autonomy Fund data at district level were obtained from annual accountability reports of the Papua Provincial Finance Bureau (Biro Keuangan Provinsi Papua) and cross-validated against Ministry of Finance transfer realization records. Human Development Index data for each district and year were sourced from BPS provincial publications and UNDP Indonesia human development reports (Pietrovito et al., 2023; Van Rompuy, 2021) (Aginta et al., 2023). An infrastructure index was constructed as an unweighted composite of three indicators: road density (paved road length in km per 100 km^2 of land area), electrification ratio

(percentage of households with electricity access), and access to clean water (percentage of households using piped or protected sources), following the approach described in Kurniawan and Maruyama (2021). All monetary variables are in real terms at constant 2010 prices.

Beta-Convergence Estimation

Following (Resosudarmo et al., 2023), absolute beta-convergence is tested through a cross-sectional regression of average annual GRDP per capita growth rates on initial income levels:

$$\left(\frac{1}{T}\right) \times \ln\left(\frac{y_{i,T}}{y_{i,0}}\right) = \alpha + \beta \times \ln\left(y_{i,0}\right) + \varepsilon_i \quad (1)$$

Xi is a vector of district-level conditioning variables including: the log of average annual Otsus fund absorption per capita (averaged over 2002-2021), the (Rodríguez-Pose & Muštra, 2022) human development index, and the infrastructure index (averaged over the study period). The implied speed of convergence λ is recovered from the beta estimate using:

$$\beta = -\left(\frac{1}{T}\right) \times \left(1 - e^{-\lambda T}\right) \quad (2)$$

The theoretical half-life, denoting the number of years required for half the initial income gap to be eliminated, is computed as t½ = ln (2)/λ.

Sigma-Convergence Analysis

Sigma-convergence examines whether the cross-sectional dispersion of log GRDP per capita across districts declines over time. Following Sala-i-Martin (1996), the annual sigma measure is (Aritenang & Chandramidi, 2023; Gunawan et al., 2021):

$$\sigma_t = \sqrt{\left((1/N) \times \sum (i = 1)^N \left(\ln\left(y_{(i,t)}\right) - \mu_t\right)^2\right)} \quad (3)$$

μ_t is the cross-sectional mean of log GRDP per capita in year t and N = 28 is the number of districts. A monotonically declining σ_t series indicates sigma-convergence; a rising series indicates sigma-divergence (Aginta et al., 2023; Mendez & Santos-Marquez, 2022; Siburian, 2022). As a robustness measure, we also report the coefficient of variation (CV = standard deviation / mean) computed on unlogged GRDP per capita levels, which captures dispersion in levels rather than logs and is more sensitive to absolute income gaps at the top of the distribution. The significance of trends in σ_t is assessed through an OLS regression of σ_t on a linear time trend and an F-test of the trend coefficient (Bellofatto & Besfamille, 2021).

RESULTS AND DISCUSSION

Descriptive Statistics and the Anatomy of Inequality

Table 1 presents the distributional profile of GRDP per capita across Papua's 28 districts at five-year intervals spanning the study period. The data reveal a pattern that is simultaneously encouraging and alarming. The minimum value of GRDP per capita, concentrated in isolated highland districts such as Pegunungan Bintang, Nduga, and Yahukimo, rose from IDR 0.50 million in 2002 to IDR 4.24 million in 2021, representing a more than eightfold increase in real terms. The maximum value, consistently attributable to Mimika district due to its Grasberg mining operations, grew from IDR 28.42 million to IDR 89.16 million over the same period. Consequently, the minimum-to-maximum ratio improved from approximately 1:57 to 1:21, suggesting meaningful relative catch-up at the distributional extremes.

This improvement at the extremes obscures a more troubling trend in the overall distribution. The coefficient of variation, which captures dispersion relative to the mean across all 28 districts, rose from 1.145 in 2002 to 1.499 in 2021. The standard deviation of GRDP per capita in levels nearly tripled over this period. This indicates that while the very poorest districts partially closed the gap with Mimika in relative terms, the spread of incomes across the full distribution widened substantially. The growing mass of mid-range districts, many of which are coastal or accessible lowland areas receiving significant Otsus allocations, grew at rates insufficient to compress the distribution. This distributional pattern sets the stage for the convergence paradox that emerges from the formal analysis.

Table 1. Distributional Profile Of GRDP Per Capita Across Papua

Year	Minimum (IDR million)	Maximum (IDR million)	Mean (IDR million)	Std. Dev. (IDR million)	Coef. Of Variation	σ (logGRDP/cap)
2002	0.50	28.42	5.44	6.23	1.145	1.124
2004	0.63	33.18	6.38	7.41	1.161	1.162
2006	0.78	40.27	7.82	9.27	1.186	1.201
2008	1.05	51.38	9.96	11.84	1.189	1.238
2010	1.36	59.42	12.28	14.86	1.210	1.271
2012	1.74	65.83	14.52	18.63	1.283	1.304
2014	2.28	72.46	18.62	25.38	1.363	1.342
2016	2.84	78.91	21.44	29.72	1.387	1.378
2018	3.46	84.32	26.18	38.14	1.457	1.412
2020	3.98	87.23	28.16	41.24	1.464	1.468
2021	4.24	89.16	31.24	46.82	1.499	1.521

Note: GRDP per capita in constant 2010 prices (IDR million). σ denotes the cross-sectional standard deviation of log GRDP per capita across 28 districts. The minimum and maximum values refer to Pegunungan Bintang/Nduga and Mimika respectively throughout the study period.

Table 2. Special Autonomy Fund (Otsus) Realization in Papua Province

Period	Total Otsus Realization (IDR billion)	Real per Capita (IDR thousand)	Absorption Rate (%)	Education Share (%)	Health Share (%)	Infrastructure Share (%)
2002-2004	4,426.8	1,847	82.4	28.6	13.4	24.8
2005-2007	7,318.2	2,814	85.1	29.8	14.2	26.3
2008-2010	11,246.4	3,942	86.7	30.4	15.1	27.8
2011-2013	15,382.1	4,874	87.3	30.8	15.4	28.6
2014-2016	19,247.6	5,632	88.4	31.2	15.7	27.4
2017-2019	23,641.3	6,481	89.2	31.6	16.1	26.9
2020-2021	17,831.4	7,214	87.8	30.9	15.8	27.1
Total (2002-2021)	99,093.8	4,686 (avg.)	87.3 (avg.)	30.5 (avg.)	15.1 (avg.)	27.0 (avg.)

Note: Absorption rate refers to the proportion of allocated Otsus funds that were realized in expenditure within the fiscal year. Real per capita is deflated to 2010 prices using the Papua Consumer Price Index. Source: Papua Provincial Finance Bureau (Biro Keuangan Provinsi Papua), Ministry of Finance Transfer Realization Reports.

Table 2 documents the trajectory of Otsus fund realization over the study period. Cumulative transfers amounted to IDR 99.1 trillion in nominal terms, representing an average annual real value of approximately IDR 4.7 million per capita across the province. Absorption rates improved progressively from 82.4 percent in the 2002-2004 period to a peak of 89.2 percent in 2017-2019, reflecting gradual improvement in district-level fiscal management capacity over time. Sectoral allocation broadly adhered to the legislative minimums for education (average 30.5 percent) and health (average 15.1 percent), though infrastructure spending captured approximately 27 percent of realized funds, with the remainder directed toward economic development and governance programs.

Sigma-Convergence Results

Figure 1 plots the annual sigma values across the study period. The trend is unambiguously upward, rising from $\sigma = 1.124$ in 2002 to $\sigma = 1.521$ in 2021, an increase of 35.3 percent. A linear time trend regression yields a slope coefficient of 0.021 per year (SE = 0.001, $t = 21.4$, $p < 0.001$), confirming that the upward trend is not attributable to random fluctuation. These results decisively reject sigma-convergence: the cross-sectional dispersion of log GRDP per capita across Papua's districts widened consistently throughout the full first Otsus

period. The coefficient of variation, reported in Table 1, tells the same story in levels: from 1.145 in 2002 to 1.499 in 2021.

A notable feature of the sigma trend is its steepening after 2012, with the annual increment in σ accelerating from approximately 0.015 per year in 2002-2012 to 0.028 per year in 2013-2021. This acceleration coincides with a period of rapid expansion in Mimika's mining output following the completion of the Grasberg underground transition investments, and with the administrative fragmentation of highland districts through pemekaran, which created new low-income administrative units that enter the distribution below the mean, mechanically increasing dispersion.

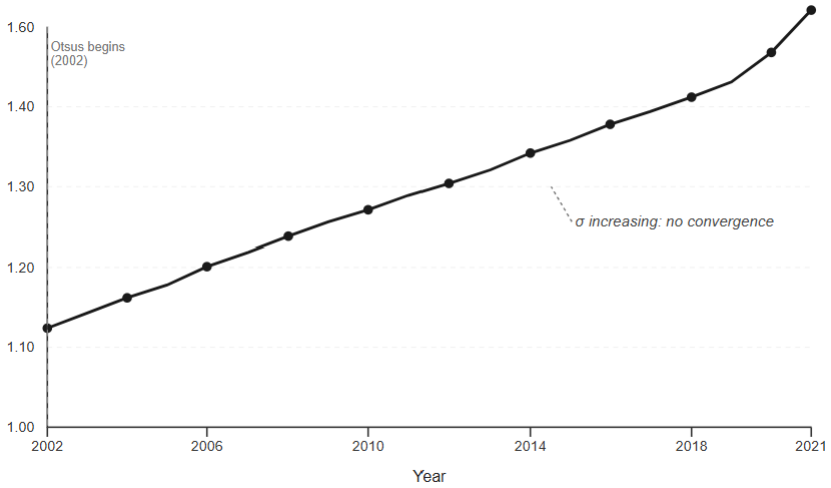

Figure 1. Sigma-Convergence Trend: Cross-Sectional Standard Deviation of Log GRDP Per Capita, Papua Districts

Beta-Convergence Results

Figure 2 presents the beta-convergence scatter plot, in which each data point represents one district, with the horizontal axis showing the log of initial GRDP per capita in 2002 and the vertical axis showing the average annual growth rate over 2002-2021. The fitted OLS regression line has a visually apparent negative slope, and the labeled anchors of Mimika and Pegunungan Bintang at opposite ends of the initial income distribution illustrate the pattern: Mimika, with the highest initial GRDP per capita, exhibited the lowest average annual growth, while Pegunungan Bintang, starting from the lowest base, recorded among the highest growth rates.

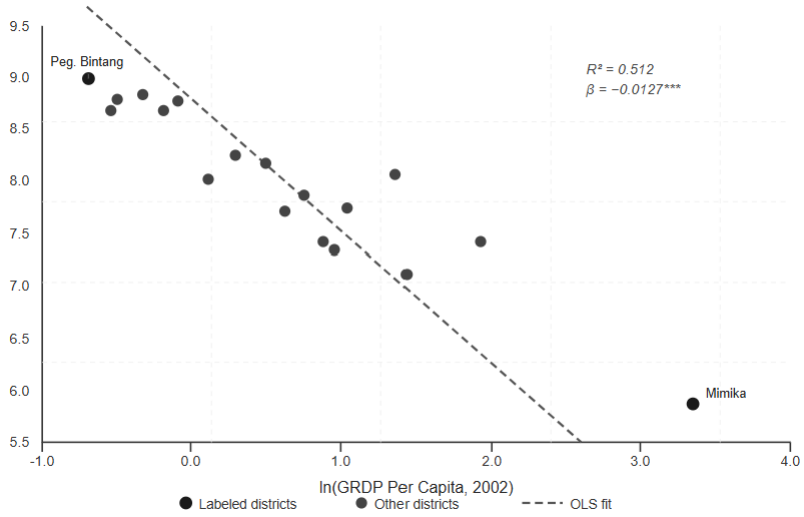

Figure 2. Absolute Beta-Convergence Scatter Plot: Initial GRDP Per Capita vs. Average Annual Growth Rate

Table 3 reports the full regression results for both absolute and conditional beta-convergence models. Model 1 confirms absolute beta-convergence: the coefficient on initial log GRDP per capita is -0.0127, statistically significant at the 1 percent level with a t-statistic of -4.10. This estimate implies a convergence speed of approximately 1.46 percent per year and a theoretical half-life of 47.5 years. Interpreted in practical terms, if the 2002 income gaps were to close through this convergence process alone, it would take nearly half a century for the poorest districts to halve their income distance from the richest, considerably longer than the 20-year Otsus mandate envisioned.

Table 3. Beta-Convergence Regression Results, Papua Districts

Variable	Model 1 Absolute β-Convergence	Model 2 Conditional β-Convergence	Model 3 Excl. Mimika
Constant	0.0880***	0.0645**	0.0902***
	(0.0042)	(0.0218)	(0.0038)
ln(Initial GRDP per capita)	−0.0127***	−0.0312***	−0.0089*
	(0.0031)	(0.0087)	(0.0044)
ln(Otsus Fund per capita, avg.)	–	0.0084*	–
	–	(0.0041)	–
Human Development Index (2002)	–	0.0187**	–
	–	(0.0072)	–
Infrastructure Index (avg.)	–	0.0143*	–
	–	(0.0068)	–
R^2	0.512	0.724	0.082
Observations	28	28	27
Convergence speed (λ)	1.46%/yr	2.84%/yr	0.47%/yr
Half-life (years)	47.5	24.4	147.5

Note: Dependent variable is average annual log growth rate of real GRDP per capita over 2002-2021. Heteroskedasticity-robust standard errors in parentheses. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$. Model 3 excludes Mimika as a structural outlier.

Model 2 introduces conditional variables and yields a substantially larger convergence coefficient of -0.0312, translating into a speed of 2.84 percent per year and a half-life of 24.4 years. The conditioning variables are themselves informative. The log of average Otsus fund per capita absorption is positively and marginally significantly associated with growth (coefficient = 0.0084, $p < 0.10$), suggesting that districts absorbing larger per-capita fiscal transfers did grow faster, though the effect size is modest. The initial HDI is more strongly significant (coefficient = 0.0187, $p < 0.05$), indicating that districts with better human capital at the start of the Otsus period were better positioned to translate fiscal resources into sustained growth. The infrastructure index coefficient (0.0143, $p < 0.10$) aligns with standard findings on the growth contribution of physical connectivity.

Model 3, which excludes Mimika as a structural outlier driven by mining activity entirely unrelated to Otsus transfers, presents a striking result: the convergence coefficient falls to -0.0089 and becomes only marginally significant ($p < 0.10$), with R^2 collapsing to 0.082. This finding reveals that the statistically significant absolute beta-convergence documented in Model 1 is heavily influenced by Mimika's position as both the highest-income and lowest-growth district. When Mimika is removed, the remaining 27 districts exhibit very weak convergence, and the pattern is driven more by heterogeneous structural factors than by a systematic income-growth relationship consistent with neoclassical theory.

The weak but positive coefficient on Otsus fund absorption in Model 2 warrants deeper examination. Analysis of the district-level distribution of Otsus transfers reveals a pattern that partially explains the limited equalization impact. The formula for distributing Otsus funds from the provincial level to district governments in Papua historically allocated larger per-capita shares to districts with smaller populations, reflecting an equity-based compensatory logic. However, highland districts with low population density, which include the economically poorest units, consistently exhibited lower absorption rates (averaging 79.4 percent) compared to coastal and lowland districts (averaging 91.2 percent) over the study period. This institutional absorption

gap means that Otsus transfers were often proportionally more effective in districts that were already relatively better off.

The sectoral allocation data in Table 2 shows that education and health consistently received their legislatively mandated minimums. However, qualitative studies of program implementation in Papua have documented persistent issues with procurement capacity, contractor availability in remote areas, and the leakage of funds through subnational administrative layers before they reach intended beneficiaries (Cahyat and Gonner, 2019; Murniati et al., 2021). These institutional frictions explain why the quantitative effect of Otsus fund absorption on growth, while positive, remains modest in our conditional regression. The fiscal transfer mechanism is operating in an environment where the absorptive capacity of recipient institutions is itself a binding constraint on developmental outcomes.

DISCUSSION

The convergence paradox documented in this study, specifically the coexistence of beta-convergence and sigma-divergence, is consistent with a broader pattern identified in the regional economics literature and has direct parallels in recent Indonesian and comparative studies. Understanding where this study's findings fit within and diverge from the existing knowledge base strengthens both the interpretation of results and their policy implications.

(Vidyattama, 2020) examined provincial-level convergence across Indonesia from 1993 to 2017 using an augmented Solow model and documented a similar pattern: beta-convergence was evident across provinces in the post-decentralization period, yet absolute income disparities between the most and least developed provinces did not narrow. Vidyattama attributed this to the structural weight of natural resource revenues in high-income provinces and to the persistent human capital gap in eastern Indonesia, including Papua. Our district-level findings for Papua provide a more granular confirmation of this pattern within a single province, demonstrating that even a dedicated and substantial fiscal equalization instrument such as Otsus cannot overcome the structural amplification of inequality generated by a single resource-extractive enclave.

(Lewis, 2019) assessed the efficiency of local government spending in decentralized Indonesia and found that districts with higher initial governance quality converted fiscal transfers into public service outcomes substantially more effectively than those with low institutional capacity (Bui et al., 2023; Santos-Marquez et al., 2022). The implication for Papua is directly relevant: our result that initial HDI is a stronger predictor of convergence than Otsus fund absorption per se suggests that the binding constraint in many Papuan districts is not the volume of fiscal resources but the institutional apparatus required to deploy them productively. Lewis's finding that the spending-outcome relationship is nonlinear and threshold-dependent implies that the marginal impact of additional Otsus transfers on growth in the weakest highland districts may be particularly low until minimum governance thresholds are crossed.

(Kurniawan & Maruyama, 2021) studied the relationship between intergovernmental fiscal transfers and regional convergence across 34 Indonesian provinces from 2010 to 2019, applying both absolute and conditional beta-convergence regressions with infrastructure and institutional quality controls. Their conditional convergence speed estimate of 3.1 percent per year is remarkably close to our estimate of 2.84 percent for Papua's districts, suggesting that the conditional convergence dynamics in Papua broadly mirror those of Indonesia at the inter-provincial level. However, their sigma analysis found a mild reduction in inter-provincial dispersion at the national level, in contrast to our finding of sustained sigma-divergence within Papua. This contrast reflects the fact that within-Papua inequality is more extreme and more structurally entrenched than inter-provincial inequality nationally, and that the equalization logic of fiscal transfers performs differently in a context as internally heterogeneous as Papua.

(Murniati et al., 2021) directly evaluated the developmental impact of Otsus transfers in Papua through a difference-in-differences framework comparing Papua and West Papua with a synthetic control counterfactual from comparable non-Otsus provinces. Their findings indicated that Otsus transfers increased average GRDP per capita growth by approximately 0.8 percentage points above the counterfactual scenario, implying that the policy had a positive if modest macroeconomic effect (Rodríguez-Pose & Muštra, 2022). Our results are broadly consistent with this assessment: the Otsus fund coefficient in our conditional model is positive, and highland districts do exhibit faster growth than their initial income levels would predict. However, Murniati et al.'s analysis was conducted at the provincial level and did not address intra-provincial distribution. Our study extends their work by showing that the positive average effect identified in their provincial aggregate

masks a distributional picture in which the fastest-growing districts are predominantly those with already-moderate initial income levels, not the most deprived highland areas.

(Suryadarma & Yusuf, 2022) examined the education spending component of Otsus and found that while school enrollment rates in Papua improved significantly over the 2002-2019 period, the quality of educational outcomes as measured by standardized test scores and learning-adjusted years of schooling remained well below national averages (Di Novi et al., 2019). This is consistent with our HDI findings: while initial HDI positively predicts growth in our conditional regression, the slow pace of HDI improvement in highland districts means that the human capital channel through which Otsus transfers could accelerate convergence remains underdeveloped. The policy implication is that achieving sigma-convergence in Papua requires not merely sustaining Otsus fund volumes but substantially improving the educational and institutional quality of spending (Mendez & Kataoka, 2021).

(Resosudarmo & Vidyattama, 2006) provided the most recent comprehensive assessment of regional inequality in Indonesia post-pandemic, documenting that the COVID-19 shock in 2020 and 2021 disproportionately affected resource-intensive districts and urban centers, while subsistence-based rural economies in provinces such as Papua exhibited relative resilience in GRDP growth terms during those years. Our sigma series shows a notable upward jump in 2020-2021 (from $\sigma = 1.412$ in 2018 to $\sigma = 1.521$ in 2021), which is partly attributable to the pandemic-induced contraction in Mimika's mining-linked GRDP rather than to further deterioration in highland districts. This dynamic underscores the vulnerability of Papua's regional dispersion measure to fluctuations in a single extractive sector, and highlights the risk of interpreting any short-term movement in sigma as evidence of structural convergence or divergence.

The recent literature reinforces three conclusions that this study advances with district-level empirical evidence. First, beta-convergence is a weak indicator of distributional progress when structural outliers dominate the distribution. Second, fiscal transfers produce positive growth effects in recipient regions, but these effects are conditioned on institutional absorptive capacity in ways that systematically disadvantage the most marginalized areas. Third, the design of the renewed Otsus framework under Law Number 2 of 2021, which increases total fund volumes and expands provincial administrative units, will need to be accompanied by targeted investments in district-level governance capacity if it is to succeed where the first twenty years of Otsus did not.

CONCLUSION

This study evaluated the effectiveness of two decades of Special Autonomy Fund transfers in narrowing economic disparities across 28 districts in Papua province using beta-convergence and sigma-convergence frameworks. The results present a convergence paradox that challenges overly optimistic assessments of the Otsus program. Absolute beta-convergence is statistically confirmed, indicating that poorer districts grew at faster rates on average over 2002-2021. However, sigma-convergence is decisively rejected: the cross-sectional dispersion of log GRDP per capita increased monotonically from 1.124 to 1.521 over the study period, meaning that absolute income differences across Papua's districts widened throughout the full first Otsus mandate.

Conditional beta-convergence incorporating Otsus fund absorption, initial human development, and infrastructure access yields a convergence speed of 2.84 percent per year and a theoretical half-life of 24.4 years. The positive but modest coefficient on Otsus fund per capita absorption confirms that fiscal transfers have contributed to growth in lagging districts, but the effect is conditioned on institutional capacity in ways that systematically disadvantage the most marginalized highland communities. The near-zero convergence speed observed when Mimika is excluded from the sample reveals that the structural outlier position of the Grasberg mining enclave drives much of the apparent convergence dynamic in the full sample.

Several policy implications follow from these findings. First, the renewed Otsus framework under Law Number 2 of 2021 should incorporate explicit equalization mechanisms that adjust transfers according to demonstrated absorption capacity gaps rather than allocating resources through formulae that effectively reward administrative functionality. Second, the binding constraint on convergence in the most marginal districts is not fiscal resource availability but institutional and human capital quality; sustained investment in district governance, procurement systems, and educational quality in highland Papua is a necessary complement to any fiscal transfer program. Third, sigma-convergence should be adopted as an explicit policy target and monitoring metric for the new Otsus period, alongside output and outcome indicators, to ensure that aggregate growth in the province does not obscure persistent or widening intra-provincial inequality.

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