

Provincial Economic Convergence in Post-Decentralization Indonesia: A Panel Analysis from 2000 to 2022

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Abstract

This study examines the dynamics of economic convergence across Indonesian provinces during the period 2000–2022 by employing β -convergence, σ -convergence, and the Williamson Index. Provincial GDP per capita at constant 2010 prices is analyzed within a panel data framework. The results indicate significant β -convergence, implying that provinces with lower per capita income have grown faster than wealthier provinces. The σ -convergence analysis reveals a long-term decline in income dispersion across provinces, although temporary fluctuations occurred during the global financial crisis and the COVID-19 pandemic. The Williamson Index also exhibits a downward trend, indicating a more equal distribution of income among provinces. These findings suggest that fiscal decentralization and infrastructure development have contributed to reducing regional inequality, although the convergence process has been relatively moderate.

Keywords: β -convergence; σ -convergence; Williamson Index; Regional disparity; Indonesia.

Abstrak

Penelitian ini menganalisis dinamika konvergensi ekonomi antarprovinsi di Indonesia selama periode 2000–2022 dengan menggunakan pendekatan β -konvergensi, σ -konvergensi, dan Indeks Williamson. Data PDRB per kapita konstan 2010 digunakan dalam kerangka analisis panel. Hasil estimasi menunjukkan adanya β -konvergensi yang signifikan, di mana provinsi dengan tingkat pendapatan per kapita rendah tumbuh lebih cepat dibandingkan provinsi kaya. Analisis σ -konvergensi memperlihatkan penurunan variasi pendapatan antarprovinsi dalam jangka panjang, meskipun disertai fluktuasi pada masa krisis global dan pandemi. Indeks Williamson juga menunjukkan tren penurunan, yang mengindikasikan semakin meratanya distribusi pendapatan antarprovinsi. Temuan ini menegaskan bahwa desentralisasi fiskal dan pembangunan infrastruktur berkontribusi pada pengurangan ketimpangan regional, meskipun proses konvergensi berlangsung moderat.

Keywords: Konvergensi- β ; Konvergensi- σ ; Indeks Williamson; Kesenjangan Regional; Indonesia

INTRODUCTION

Since the implementation of fiscal decentralization in 2001, Indonesia has entered a new phase of governance and economic management. This policy, often referred to as *big bang decentralization*, granted extensive authority to local governments in managing finance and development (Bank, 2003). Decentralization in Indonesia encompasses fiscal decentralization through central-to-local fund transfers, political decentralization through regional elections, and administrative decentralization through local autonomy (Lewis, 2014). The expectation was to reduce interregional development disparities and improve the quality of public services. However, two decades after implementation, the results remain debatable as inequality among provinces persist.

In addition to decentralization, Indonesia has undergone significant regional expansion. This regional proliferation aimed to shorten administrative reach, bring public services closer to communities, and accelerate local development. The number of provinces increased from 26 in 1999 to 34 in 2014 (Firman, 2009) and by 2022 the figure rose to 38. Several new provinces emerged during this period, including Banten (2000), Bangka Belitung Islands (2000), Gorontalo (2000), North Maluku (1999/2000), West Papua (2003), and North Kalimantan (2012). The year 2022 marked another wave of expansion with the creation of Central Papua, Highland Papua, South Papua, and Southwest Papua. Although intended to improve administrative efficiency and equity, some studies suggest that regional expansion has often generated new fiscal burdens and has not automatically enhanced local economic performance (Fitriani et al., 2005).

From an institutional perspective, regional development in Indonesia is closely linked to the country's fiscal decentralization framework. Since the early 2000s, fiscal decentralization has been implemented primarily through intergovernmental fiscal transfers from the central government to subnational governments. General Allocation Funds (DAU), Special Allocation Funds (DAK), and Special Autonomy Funds constitute (Republic of Indonesia, 2004) the main channels through which provincial governments finance public services and development programs. Differences in the scale and composition of these transfers reflect variations in fiscal capacity and policy priorities across provinces, and may therefore influence regional growth and convergence dynamics.

Regional economic growth in Indonesia demonstrates considerable heterogeneity across provinces. One of the key indicators used to describe regional economic performance is the Gross Regional Domestic Product (GRDP). While Indonesia's national GDP has exhibited a generally positive long-term growth trend, its growth trajectory has not been uniform over time and has experienced periods of stagnation and slowdown, particularly during episodes of economic shocks. Despite national-level growth, regional disparities in economic performance across provinces remain substantial. According to Statistics Indonesia (BPS, 2022) in 2021, Java Island contributed over 57% to national GDP, whereas the eastern regions (Papua, Maluku, and Nusa Tenggara) contributed only around 15%. In terms of per capita GRDP, the inequality is even more pronounced: provinces in Java and Bali record per capita incomes nearly twice the national average, while Papua, Maluku, and East Nusa Tenggara remain far below.

As illustrated in Figure 1, which presents the average provincial GRDP over the period 2000–2022 grouped by island, clear regional disparities are observed. Provinces in Java, particularly DKI Jakarta, West Java, and East Java, exhibit much higher GRDP values compared to those in

eastern Indonesia. This finding aligns with Kuncoro (2013) who emphasized that Indonesia's economic growth tends to be concentrated in Java due to industrial agglomeration and superior infrastructure. Meanwhile, Figure 2 shows that the Java island group records the highest average provincial population, reflecting a strong concentration of population relative to other regions. This pattern is consistent with Firdaus & Hakim (2019) that large populations often hinder increases in per capita welfare.

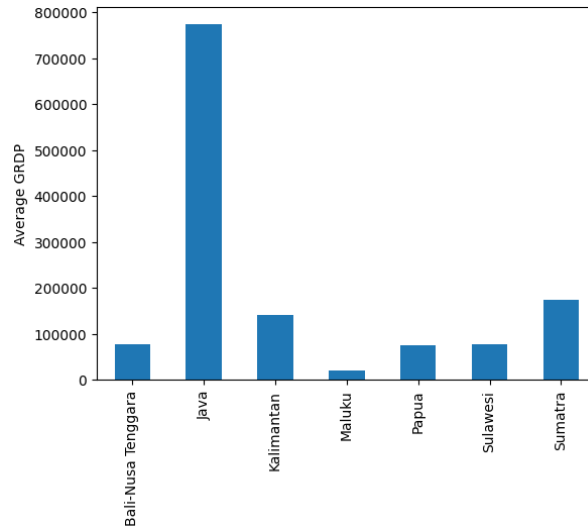


Figure 1.
Average provincial GRDP 2000–2022 (billion rupiah) by island group
 Source: BPS 2025, Processed

When combining GRDP and population into per capita GRDP, as illustrated in Figure 3, regional disparities become even more pronounced. Island groups characterized by strong economic bases and relatively lower population pressure, such as Kalimantan and Papua, record substantially higher average provincial GRDP per capita. In contrast, island groups with high population concentration, particularly Java, exhibit more moderate per capita GRDP despite their large economic scale.

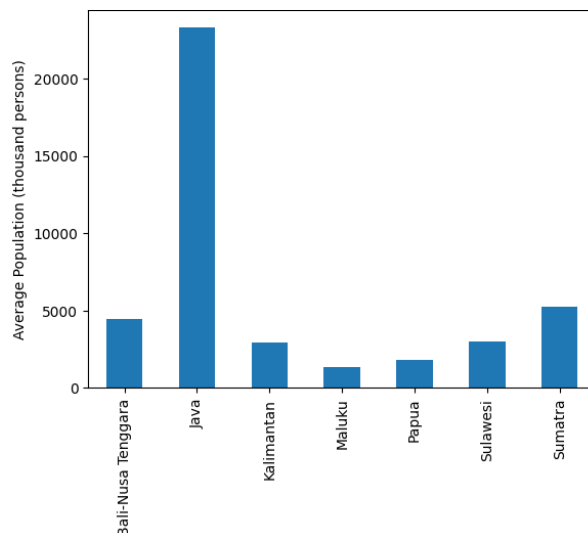


Figure 2.
Average population 2000-2022 (thousand people) by island group
 Source: BPS 2025, Processed

Recent empirical evidence confirms this persistent heterogeneity in per capita GRDP across Indonesian provinces, which significantly influences interprovincial inequality (Maichal et al., 2024). For example, panel data studies find that GRDP per capita remains a significant determinant of regional inequality, and its uneven distribution amplifies divergence between wealthy and lagging provinces (Kumara & Utomo, 2024). Similarly, heterogeneous growth patterns within Indonesia's major islands further reflect how economic structure, population distribution, and institutional factors shape gross and per capita output differences. Together, these patterns confirm that both GRDP and per capita GRDP disparities remain significant, providing a strong motivation to test the hypothesis of income convergence across Indonesian provinces.

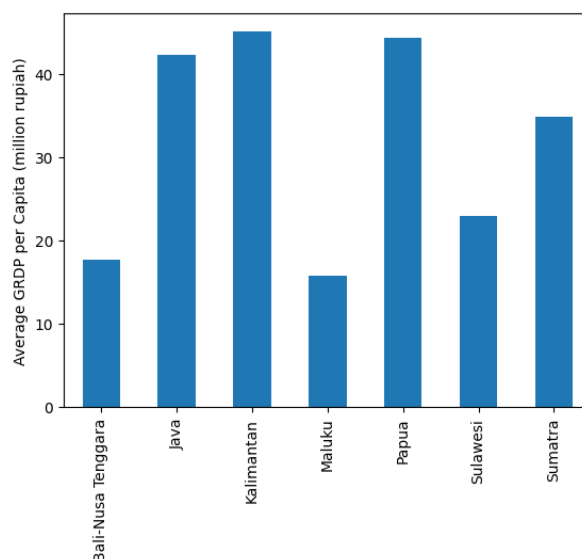


Figure 3.
Average GRDP 2000-2022 per capita (million rupiah) by island group

Source: BPS 2025, Processed

Theoretically, the analysis of economic convergence is rooted in the Solow–Swan neoclassical growth model (Solow, 1956). Swan (1956) explains the dynamics of economic growth through capital accumulation, labor force and technological progress, represented by the following fundamental equation:

$$Y(t) = AK(t)^\alpha L(t)^{1-\alpha}, 0 < \alpha < 1$$

where $Y(t)$ denotes total output, $K(t)$ represents physical capital, $L(t)$ is labor, indicates the level of technology. When expressed per effective unit of labor, the equation becomes

$$y(t) = Ak(t)^\alpha$$

where y represents output per effective worker, and k denotes capital per effective worker.

This model implies the presence of diminishing returns to capital, meaning that in the long run the economy approaches a steady-state level of output whose growth is determined solely by exogenous technological progress. The model predicts that countries or regions with lower capital per worker will grow faster than those with higher capital levels, leading to a process of economic convergence over time. This concept was further developed by Barro and Sala-i-Martin in 1992 through the notion of β -convergence, which occurs when regions with lower initial income experience higher growth rates than richer regions. In contrast, σ -convergence is used to

measure whether income dispersion among regions decreases over time, indicating reduced inequality in regional income levels (Kremer et al., 2021).

Empirical evidence on economic convergence suggests that convergence dynamics vary substantially across regions and development contexts. In the Indonesian case, Kharisma and Saleh (2013) document the presence of β -convergence among provinces over the period 1984–2008, with an estimated convergence speed of approximately 2 percent per year, indicating a gradual tendency for poorer provinces to catch up with richer ones. However, their findings also suggest that the convergence process is relatively slow, reflecting structural heterogeneity across regions (Kharisma & Saleh, 2013).

At a broader comparative level, Young, Higgins, and Levy (2013) demonstrate that convergence outcomes depend critically on the underlying economic structure and growth drivers. Their analysis shows that regions experiencing sustained industrialization and productivity growth tend to converge more rapidly, while areas with weaker structural transformation display slower convergence (Young et al., 2013). Complementing these academic findings, recent policy-oriented analysis by the ASEAN+3 Macroeconomic Research Office highlights that income convergence in emerging and developing economies is highly conditional on institutional quality, fiscal capacity, and regional policy effectiveness. In the Indonesian context, AMRO emphasizes that decentralization, uneven infrastructure provision, and disparities in human capital accumulation remain key constraints to faster regional convergence (ASEAN+3 Macroeconomic Research Office (AMRO), 2022). Taken together, these studies indicate that while convergence is observable, its pace and consistency are shaped by structural and institutional factors rather than occurring automatically.

Despite the extensive literature on regional economic convergence in Indonesia, several important gaps remain. Most previous studies focus on earlier periods, typically ending before the full impact of fiscal decentralization and recent regional expansion can be observed. In addition, many analyses rely on a single convergence approach: either β -convergence or σ -convergence without integrating population-weighted inequality measures such as the Williamson Index. Furthermore, the creation of new provinces, particularly in Eastern Indonesia, has altered regional economic structures, yet remains underexplored due to data limitations.

To address these gaps, this study provides a comprehensive analysis of provincial economic convergence in Indonesia over the period 2000–2022 by simultaneously applying β -convergence, σ -convergence, and the Williamson Index within a panel data framework. By incorporating updated GRDP base-year adjustments, population projections, and post-decentralization regional dynamics, this research offers a more complete and up-to-date assessment of whether fiscal decentralization and regional expansion have effectively reduced interprovincial economic disparities.

Accordingly, this study aims to examine both β -convergence and σ -convergence among Indonesian provinces during the 2000–2022 period, taking into account the dynamics of post-decentralization and regional expansion. The analysis focuses on 35 provinces in Indonesia, covering data from 2000 to 2022. Provinces created during the study period were included only if consistent post-establishment GRDP data were available and could be harmonized with the panel structure. As a result, North Maluku and North Kalimantan were included, while newly

created provinces in Papua were excluded due to the absence of consistent historical series. Nevertheless, inequality patterns can still be observed through comparisons of GRDP, population size, and GRDP across provinces providing a robust empirical basis to assess whether decentralization and regional expansion have promoted convergence or reinforced regional disparities.

A key contribution of this study lies in its use of longitudinal panel data, the harmonization of GRDP base years (2000 and 2010), and the integration of population projection data to compute per capita GRDP. By combining multiple convergence measures within a unified empirical framework, this research contributes new evidence to the literature on regional convergence in Indonesia and offers policy-relevant insights for achieving more balanced development in the era of local autonomy.

METHODOLOGY

This research is an empirical quantitative study that aims to test the hypothesis of economic growth convergence among Indonesian provinces over the period 2000–2022. The model employed is based on the concept of β -convergence derived from the Solow neoclassical growth theory, which is empirically tested using panel data estimation with EViews 12. The primary goal is to identify whether regions with lower per capita income levels grow faster than wealthier regions—an indication of absolute convergence.

The unit of analysis covers all provinces in Indonesia during the observation period of 2000–2022. Due to regional expansion, the number of provinces changed from 26 in 2000 to 34 after the formation of new provinces such as North Kalimantan in 2012. Consequently, the data used are unbalanced panel data. Nonetheless, all available provincial data were included so that the analysis represents Indonesia's overall regional dynamics. The main variable used in this study is real Gross Regional Domestic Product (GRDP) per capita at constant prices (ADHK), obtained from Statistics Indonesia (BPS, n.d.). For the period 2000–2009, GRDP data with the 2000 base year were used (BPS, 2010), while for 2010–2022, data with the 2010 base year were employed (BPS, 2014, 2025). To ensure consistency in a single time series, the 2000-based GRDP values were converted to 2010-based values using conversion ratios derived from overlapping 2010 data.

Population data were used to calculate per capita GRDP. Since some annual population data were unavailable—especially in the early 2000s—interpolation and projections were made based on census trends and official BPS data (BPS, 2018). These projections were primarily applied for the years 2011–2014, when no official data were recorded.

Three convergence approaches were applied:

1. β -convergence analysis

The β -convergence test regresses the growth rate of per capita GRDP against the initial level of per capita GRDP. The model is estimated using both Fixed Effects (FEM) and Random Effects (REM) panel regressions, with the best model selected through the Hausman test. A negative and statistically significant coefficient for the initial income variable indicates that lower-income provinces grow faster, suggesting convergence.

The empirical model estimated can be expressed as:

$$g_{it} = \alpha + \beta \ln y_{i,t-1} + \mu_i + \lambda_t + \varepsilon_{it}$$

where:

g_{it} growth rate of real per capita GRDP for province i at time t ,

y_{it} is GRDP per capita of province i at time t ,

$\ln y_{i,t-1}$ is natural log per capita GRDP of province i in the previous period,

μ_i province-specific effect (fixed or random),

λ_t time effect

ε_{it} error term.

2. σ -convergence analysis

σ -convergence is analyzed by observing the dispersion of per capita income among provinces over time. The standard deviation of the logarithm of per capita GRDP is used as the measure. A decreasing standard deviation over time indicates narrowing income disparities, implying convergence.

The σ -convergence formula can be expressed as:

$$\sigma_t = \sqrt{\frac{1}{N} \sum_{i=1}^N (\ln y_{it} - \ln \bar{y}_t)^2}$$

where y_{it} is GRDP per capita of province i in year t , and \bar{y}_t is the national average. A declining σ value implies income convergence, while an increasing σ suggests divergence.

3. Williamson Index analysis

The Williamson Index is used as a population-weighted measure of regional inequality. It captures the weighted deviation between each province's per capita GRDP and the national average, using population share as the weight. A declining index value over time indicates a reduction in regional inequality.

The Williamson Index (Williamson, 1965) provides another measure of regional inequality, calculated as

$$W = \frac{\sqrt{\sum_{i=1}^n f_i (y_i - \bar{y})^2}}{\bar{y}}$$

where y_{it} is GRDP per capita of province i , f_i population proportion, and \bar{y} is the national average per capita GRDP. Lower values of W indicate more equal income distribution across provinces.

Data processing was performed using Microsoft Excel for basic calculations and EViews 12 for panel estimations. This methodology thus enables convergence testing from three complementary perspectives: β -convergence, to measure *catching-up* speed; σ -convergence, to observe long-term income dispersion; and Williamson Index, to assess population-weighted regional inequality.

DISCUSSION AND FINDINGS

Before testing the convergence hypothesis, a descriptive analysis of provincial real per capita GRDP data in Indonesia was conducted. As shown in Figure 4, the real per capita GRDP for the

period 2000–2022 exhibits an overall upward trend across all provinces, although with substantial variation in levels. The national average per capita GRDP increased from approximately Rp 9.8 million per person in 2000 to over Rp 55 million per person in 2022. Nevertheless, large disparities between provinces persist.

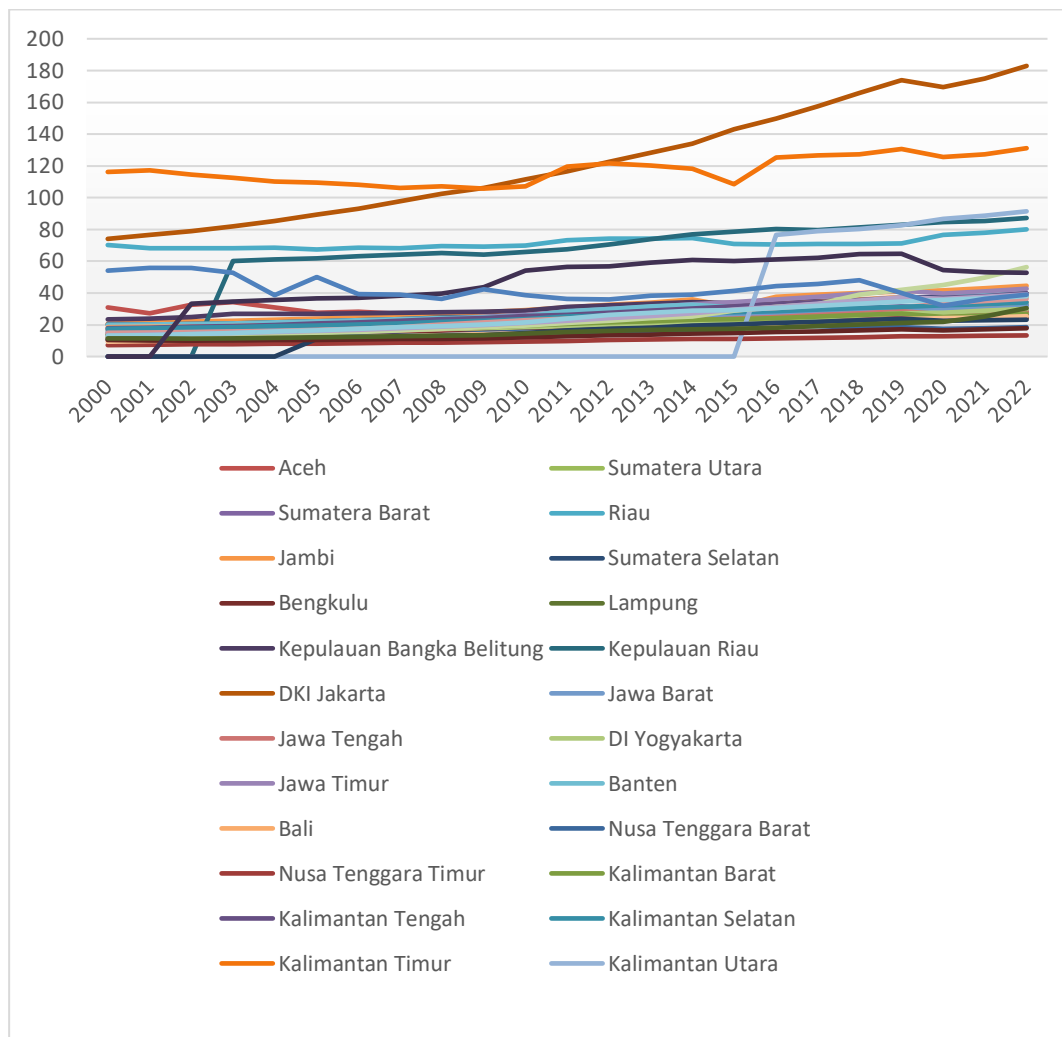


Figure 4.
Dynamics of GRDP per province in Indonesia 2000-2022 (million rupiah)
 Source: BPS 2025, Processed

Provinces consistently recording the highest per capita GRDP include DKI Jakarta, East Kalimantan, Riau Islands, and North Kalimantan, each averaging over Rp 100 million per person per year. Conversely, provinces such as East Nusa Tenggara (NTT), Maluku, and Gorontalo record only about Rp 15–20 million per person per year. These differences reflect fundamentally distinct regional economic structures—resource-rich or industrialized provinces tend to exhibit higher output per capita compared to agrarian-based economies. This descriptive evidence indicates persistent regional inequality, which is further examined through the β -convergence, σ -convergence, and Williamson Index approaches.

β -Convergence Results

The panel regression results—using per capita GRDP growth as the dependent variable and the logarithm of the previous year’s per capita GRDP as the independent variable—are presented in

Table 1. The estimated coefficient β is negative and statistically significant, supporting the hypothesis of β -convergence: provinces with lower initial income levels grow faster than wealthier ones. Hence, there is evidence of absolute β -convergence among Indonesian provinces during the post-decentralization period (2000–2022), consistent with predictions from the neoclassical growth model.

Table 1.
Panel Data Regression Results (FEM and REM)

Model	α	β	Std. Error	t-Stat	Prob.	R^2
Fixed Effect (FEM)	7,121074	-1,224906	0,58803	-2,083066	0,0376	0,159061
Random Effect (REM)	6,798258	-1,122261	0,360521	-3,112886	0,0019	0,013308

Source: Output Eviews 12

Model selection based on the Hausman test (Table 2) indicates that the Random Effects Model (REM) is more appropriate (p-value = 0.8251 > 0.05). This suggests that convergence occurs generally across provinces rather than being driven by province-specific characteristics.

Table 2.
Hausman Test Results

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0	1	0,8251

Source: Output Eviews 12

This convergence implies that although disparities remain, there is a tendency toward income equalization over time. However, the pace is moderate, suggesting that achieving substantial equality would require long-term consistency in fiscal policy, institutional capacity, and regional development coordination.

These findings align with Kharisma and Saleh, who also detected β -convergence among provinces for 1984–2008, though with a narrower time frame. Extending the analysis to 2022, this study incorporates data from newly formed provinces and includes intergovernmental fiscal transfers, namely General Allocation Funds (DAU), Special Allocation Funds (DAK), and Special Autonomy Funds as institutional and fiscal controls reflecting decentralization mechanisms. Despite convergence, progress remains slow, particularly outside Java and Kalimantan, due to limited infrastructure, lower human capital, and dependency on primary commodities. For instance, DKI Jakarta and East Kalimantan maintain per capita GRDP levels far above Maluku, NTT, and West Papua. Thus, while convergence exists, full income equalization has yet to be achieved.

σ -Convergence Result

σ -convergence was assessed by examining the dispersion of per capita income across provinces over time, measured using the standard deviation of the logarithm of provincial GRDP per capita. The results, as illustrated in Figure 5, indicate that the dispersion of income levels among Indonesian provinces declined steadily from 2000 to 2022, albeit with some fluctuations during specific years.

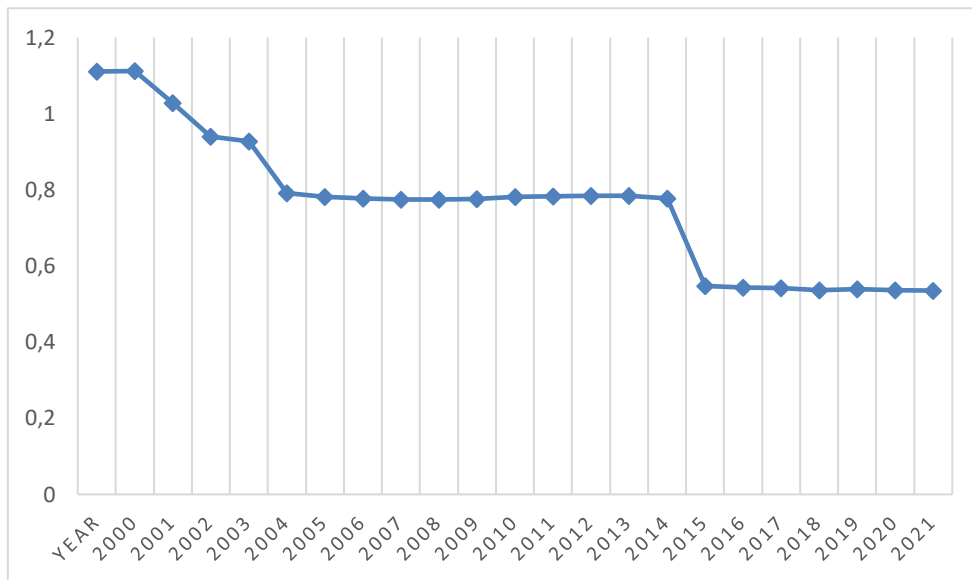


Figure 5.
Results of Indonesia's σ -convergence 2000-2022

Source: Output, Data Processed

The decreasing variation in per capita income implies that provinces with relatively low income levels have gradually caught up with richer provinces. Provinces outside Java—particularly in Sulawesi and Kalimantan—experienced faster growth, driven by the expansion of the mining, plantation, and infrastructure sectors. Meanwhile, provinces on Java, though still more developed, recorded slower growth due to already high economic bases. This pattern confirms the presence of σ -convergence, consistent with the earlier finding of β -convergence. In other words, poorer provinces have shown tangible progress in narrowing the income gap relative to wealthier ones over the past two decades.

Williamson Index Results

The results of the Williamson Index are shown in Figure 6. The index reflects a similar trend to the σ -convergence analysis: relatively high inequality in the early 2000s, followed by a gradual and consistent decline until 2022. A Williamson Index value approaching zero signifies more equal income distribution, while values closer to one indicate widening inequality. The downward trend in the Williamson Index demonstrates that interprovincial inequality has diminished in tandem with national economic growth. This finding highlights the positive role of fiscal decentralization and infrastructure investment in promoting regional equity. Programs such as the Special Autonomy Fund (Dana Otsus) in Papua and regional infrastructure acceleration initiatives in Eastern Indonesia have contributed to reducing spatial inequality, even though the overall speed of convergence remains modest. Overall, the findings from the β -convergence, σ -convergence, and Williamson Index analyses provide consistent evidence of economic convergence across Indonesian provinces. However, the process has been gradual rather than rapid, indicating that long-term structural disparities persist.

These results align with international evidence such as Barro and Sala-i-Martin for the United States and Europe, where convergence occurs but at a slow pace over extended periods. In Indonesia's context, structural constraints—such as uneven fiscal capacity, dependence on natural resources, and institutional variations across regions—remain significant determinants of

convergence speed.

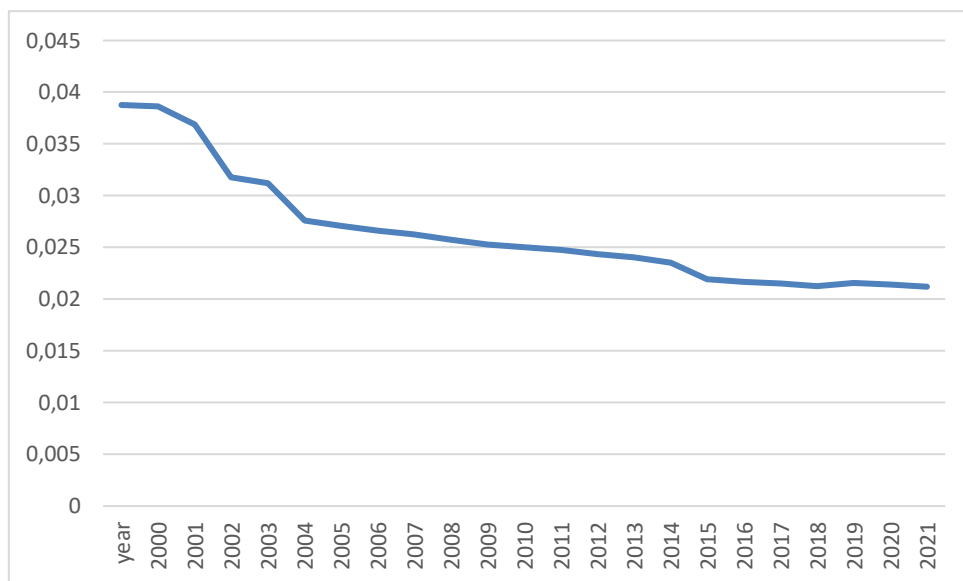


Figure 6.
Williamson Index Trends for Indonesia (2000–2022)

Source: Output, Data Processed

CONCLUSION

This study examines regional income convergence across Indonesian provinces using three complementary empirical approaches. The results consistently indicate the presence of β -convergence, suggesting that provinces with lower initial levels of GRDP per capita tend to grow faster than richer provinces. However, evidence from σ -convergence shows that income dispersion across provinces has declined only marginally over time, implying that the catching-up process remains slow and incomplete. The combined results highlight that convergence exists in a statistical sense, but has not been sufficient to substantially reduce long-standing regional disparities. Structural challenges persist in achieving inclusive and balanced regional development.

The findings further reveal that convergence dynamics are highly heterogeneous across regions. Provinces endowed with abundant natural resources continue to exhibit exceptionally high levels of per capita GRDP, while many provinces outside Java and Kalimantan lag behind due to structural constraints. Differences in infrastructure provision, human capital accumulation, and economic diversification appear to play an important role in shaping regional growth trajectories. Moreover, the inclusion of intergovernmental fiscal transfers as institutional controls suggests that fiscal capacity and decentralization mechanisms are relevant in explaining variations in regional performance, although they do not automatically guarantee faster convergence.

These results provide a clear rationale for the proposed policy implications. Given that convergence is present but proceeds slowly and unevenly, policies aimed at reducing regional disparities should go beyond aggregate growth promotion. Strengthening infrastructure development, improving human capital, and enhancing the effectiveness of intergovernmental fiscal transfers are essential to address the structural and institutional constraints identified in the

empirical analysis. In this context, fiscal decentralization policies need to be complemented by capacity-building measures to ensure that transferred resources translate into productive investment and sustainable regional growth. Without such complementary policies, regional convergence is likely to remain partial and protracted.

Limitation

Several limitations should be acknowledged in this study. First, the analysis is constrained by data availability from 2000 to 2022 and the adjustment between different GRDP base years (2000 and 2010), which may introduce potential inconsistencies in measurement. Second, population data prior to 2010 were not fully available, requiring interpolation and projection methods that may affect the accuracy of per capita calculations. Third, the study focuses solely on β - and σ -convergence and the Williamson Index, without incorporating structural determinants such as education, investment, or institutional quality, which could provide deeper insights into the drivers of regional convergence.

Suggestion

Future research should expand the analysis to conditional convergence, incorporating structural and policy-related variables such as human capital, fiscal transfers, and infrastructure investment to capture regional growth disparities more comprehensively. Moreover, applying club convergence and spatial econometric approaches could reveal whether provinces form distinct convergence clusters and how spatial spillover effects influence regional dynamics. From a policy perspective, the results suggest that regional convergence in Indonesia is occurring but remains gradual and uneven. The persistence of income gaps, particularly between resource-rich and less-developed provinces, implies that reliance on natural resource endowments alone is insufficient to sustain long-term convergence, highlighting the importance of promoting economic diversification. Moreover, the role of fiscal variables in the empirical model indicates that intergovernmental transfers matter for regional performance, but their effectiveness depends on how well they are allocated and utilized, providing a rationale for strengthening performance-based fiscal transfers. Finally, the slower convergence observed in eastern Indonesia is consistent with structural constraints related to infrastructure and connectivity, suggesting that targeted infrastructure investment remains a key complementary policy to support more balanced regional growth.

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