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Spatial Analysis of the Effect of Economic Growth and Unemployment on Poverty in Papua Province and Its New Autonomous Regions

Iis Pebriyanti[1*], Hasan Basri Umar[2], Yundy Hafizrianda[3]
Universitas Cenderawasih, Papua, Indonesia[1,2,3]
iispebriyanti0221@gmail.com[1*],

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Corresponding author:
Iis Pebriyanti
Universitas Cenderawasih, Papua, Indonesia
E-mail: iispebriyanti0221@gmail.com

ABSTRACT

Purpose: Poverty in Papua Province and its three New Autonomous Regions remains the most critical development challenge in Indonesia, given its persistently high ranking relative to the national average. This study analyzes the effect of economic growth and the open unemployment rate on poverty while accounting for spatial heterogeneity across districts and cities.
Methodology: Panel data from 29 districts and cities in Papua, South Papua, Central Papua, and Highland Papua for 2020 to 2024, yielding 145 observations, were analyzed using Geographically Weighted Regression Panel with an adaptive bisquare kernel function, following a Breusch-Pagan test for spatial heterogeneity and a global Ordinary Least Squares benchmark.
Results: The Breusch-Pagan test confirmed significant spatial heterogeneity. The Geographically Weighted Regression Panel model substantially outperformed the global model, raising R squared from 35.78% to 73.23% and lowering the corrected Akaike Information Criterion from 965.00 to 881.87. Locally, economic growth and unemployment negatively affect poverty with varying sensitivity across regions, and unemployment proved a more dominant and spatially stable determinant than growth.
Conclusions: Poverty reduction strategies following regional expansion must be spatially differentiated rather than uniform.
Limitations: The study covers only five years, three predictors, and one geographic cluster of provinces.
Contributions: The study offers one of the first district-level spatial panel analyses of poverty determinants across Papua's newly expanded provinces.

Keywords: *Economic Growth, GWR-Panel, New Autonomous Region, Poverty, Unemployment*

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1. Introduction

Poverty is a multidimensional phenomenon encompassing income limitations, social disintegration, and the failure to meet basic human capabilities. Todaro and Smith (2015) argue that ideal economic development is not simply about pursuing macro output growth but must be accompanied by declining poverty, more equitable income distribution, and adequate job creation. Empirical reality in Indonesia, however, reveals a persistent pattern of spatial inequality, particularly in the eastern part of the country. Papua Province and its three New Autonomous Regions, namely South Papua Province, Central Papua Province, and Highland Papua Province, consistently record the highest poverty rates in Indonesia, far exceeding the national average.

As of 2024, data from the Central Statistics Agency show a sharply contrasting poverty burden across regions (Badan Pusat Statistik, 2024). The poor population is extremely concentrated in the highland areas, reaching 363.43 thousand people in Highland Papua Province and 308.48 thousand people in Central Papua Province. Spatial disparities are also substantial between urban and rural areas. In Central Papua Province, for instance, urban poverty stands at only 4.32%, while rural poverty surges to 37.98%. This gap indicates that two decades of massive fiscal intervention through the Special Autonomy fund have not been able to unravel the structural and geographic barriers confining the interior population. The way poverty itself is measured also shapes how this gap is interpreted, since recent revisions to the international extreme poverty line carry direct implications for how regional fiscal policy should be evaluated (Pentury, 2023a). Earlier spatial work on Papua's poverty landscape using Geographically Weighted Regression already identified the coastal-highland divide that this study revisits with an expanded four-province panel. Comparable evidence from other special economic zones in Indonesia shows that capital-intensive, enclave-style development can widen local inequality even as aggregate regional output continues to rise, a pattern that closely parallels the disconnect observed in Papua's mining-dependent districts (Hornok & Raeskyesa, 2023). At the same time, cross-provincial evidence indicates that the quality, not merely the volume, of regional government spending is what ultimately determines whether fiscal capacity translates into lower poverty and a higher human development index (Masduki et al., 2022).

Theoretically, economic growth through a trickle-down mechanism is believed to reduce poverty, while unemployment is regarded as the main channel that widens the poverty trap. However, this causal relationship frequently shows anomalies in regions with a high dependence on extractive sectors such as Papua. High economic growth in such regions is often capital-intensive, so it does not translate linearly into local employment absorption. Recent evidence on resource-dependent regions of Indonesia similarly shows that mining revenue windfalls do not automatically reduce poverty, and in some cases even correlate with rising poverty rates when fiscal transmission and governance quality are weak (Hajad et al., 2023). In addition, unemployment in Papua carries a unique character. The low open unemployment rate recorded in interior districts such as Nduga and Lanny Jaya, close to zero percent, does not reflect an efficient labor market but rather a heavy bias toward informal subsistence agriculture, commonly described as disguised unemployment, characterized by very low productivity and wages.

The formation of the three New Autonomous Regions in 2022 under Law Number 14, 15, and 16 was intended to shorten the bureaucratic span of control and accelerate the equitable distribution of public services. Nevertheless, these newly expanded regions inherited an extreme degree of spatial heterogeneity. The use of classical linear econometrics based on global Ordinary Least Squares assumes that the relationship among variables is stationary across geographic space. This assumption becomes misleading when applied to a region with variability as high as Papua, because it disregards the fact that the impact of economic growth in integrated coastal areas such as Jayapura City or Merauke differs markedly from that in isolated mountainous areas such as Intan Jaya or Deiyai.

This study therefore fills this literature gap by applying a local spatial econometric approach, namely Geographically Weighted Regression Panel. This method produces parameter estimates that

are local to each district and city across years. Recent applications of Geographically Weighted Regression to poverty modeling in Papua confirm that spatially varying coefficients capture determinants of deprivation far more accurately than pooled national or provincial models (Lumbantoruan et al., 2023). By mapping the heterogeneous effect of economic growth and unemployment on poverty across 29 districts and cities in Papua Province and its New Autonomous Regions for the period 2020 to 2024, this study aims to provide an empirical foundation for formulating spatially based poverty alleviation policy.

2. Literature Review and Hypothesis/es Development

2.1 Trickle-Down Growth and the Poverty Trap

The trickle-down hypothesis holds that aggregate economic growth eventually diffuses benefits to the poorest segments of society through expanded employment, higher wages, and increased tax revenue available for redistribution. Nurkse (1953) laid an early theoretical foundation for this view by describing how a vicious circle of poverty in underdeveloped economies, characterized by low income, low savings, and low investment, can be broken once a critical mass of capital formation and growth is achieved. Under this framework, a rise in regional output is expected to reduce poverty by expanding the resource base available to households.

Yet decades of empirical scrutiny show that this diffusion mechanism is far from automatic. Where growth is concentrated in capital-intensive extractive sectors, the benefits of rising output tend to accrue disproportionately to capital owners and a narrow set of skilled workers, leaving the poverty-reducing effect of growth muted or even reversed. National evidence from Indonesia reinforces this pattern, showing that working poverty, that is, employment that still leaves a household below the poverty line, is closely tied to the informality and low productivity of the sectors in which the poor are absorbed rather than to the unemployment rate itself (Endrawati, 2022). Regional industrial agglomeration studies similarly suggest that the competitiveness of a district's flagship industries, not merely the presence of growth, shapes how far economic gains diffuse into the surrounding labor market. Evidence from resource-rich provinces in Indonesia illustrates this dynamic clearly, showing that natural resource abundance does not automatically translate into improved welfare when revenue flows are not channeled into economic diversification or productive public spending (Hajad et al., 2023). Similar evidence from the nickel-producing districts of Sulawesi shows that mining revenue sharing intended to mitigate negative externalities and reduce poverty has failed to produce a statistically significant poverty-reducing effect, and in some subsamples even coincides with rising poverty (Shynta et al., 2025). Complementary national and provincial evidence from Indonesia likewise shows that natural resource abundance alone does not guarantee improved regional welfare unless resource revenue is channeled into diversification and productive spending (Wahyudi & Palupi, 2023). Pardede (2019) extends this argument specifically to eastern Indonesia, noting that multidimensional poverty in this region reflects not merely an income deficit but a deeper failure of capability expansion that growth alone cannot resolve. Based on this reasoning, the first hypothesis is proposed:

> *H_1:* Economic growth has a negative and spatially varying effect on poverty across districts and cities in Papua and its New Autonomous Regions

2.2 Unemployment, Disguised Unemployment, and Structural Poverty

Unemployment theory conventionally treats a high open unemployment rate as a direct channel toward poverty, since the absence of formal employment removes households from a stable income stream. In competitive urban labor markets, this relationship holds relatively cleanly, as documented in studies of open unemployment determinants across Indonesian provinces, where variables such as human capital, wage levels, and the structure of local industry consistently predict unemployment outcomes (Efendi & Yulianto, 2023; Wicaksono, 2024). A related cross-country perspective similarly finds a coherent negative relationship between economic growth and unemployment once labor market rigidities are accounted for, underscoring that the growth-unemployment-poverty chain is not universal but depends on structural labor market conditions. Recent panel evidence directly from Papua Province corroborates this asymmetry, finding that Gross Regional Domestic Product growth together with government expenditure explains a

substantial share of poverty variation while unemployment retains an independent and at times counterintuitive relationship with welfare outcomes depending on model specification (Indrasari & Yulianto, 2025). A parallel study covering Papua Province from 2017 to 2021 finds that the Gini index, construction cost index, and open unemployment rate each raise poverty, while average years of schooling reduces it, underscoring that unemployment operates alongside inequality and cost-of-living factors rather than in isolation (Loka & Purwanti, 2022). Comparable panel evidence from neighboring West Papua Province similarly finds that unemployment exerts a positive and significant effect on poverty, while human development and average years of schooling exert a negative effect, reinforcing the view that labor market structure and human capital jointly, rather than singly, determine poverty outcomes in this part of Indonesia. A more recent panel application in West Papua covering 2018 to 2022 further confirms that economic growth and human development jointly explain most of the variation in provincial poverty, with a goodness of fit exceeding 0.7 once individual district effects are accounted for (Malawat et al., 2024). Broader evidence from South Africa similarly finds that the growth-unemployment-poverty relationship is non-linear, with the poverty-reducing effect of growth weakening once unemployment exceeds a structural threshold, a pattern conceptually close to the disguised unemployment dynamic observed in Papua's interior districts (Ngubane et al., 2023).

In agrarian and geographically isolated economies, however, unemployment statistics can be structurally misleading. A near-zero open unemployment rate may simply reflect the near-total absence of a formal labor market rather than full employment, since the statistical convention of counting subsistence farmers, hunters, and gatherers as employed obscures extremely low productivity and income among this group. This phenomenon, commonly termed disguised unemployment, has long been recognized in development economics as a condition in which large segments of the rural labor force contribute negligible marginal product, so that conventional unemployment indicators lose their power to explain poverty outcomes in such areas. Recent modeling work using Geographically and Temporally Weighted Regression in Indonesia confirms that unemployment's marginal effect on poverty varies substantially by location and time, undermining any assumption of a single national or provincial coefficient (Nisa et al., 2022). Based on this reasoning, the second hypothesis is proposed:

> H_2: The open unemployment rate has a negative and spatially varying effect on poverty, with a magnitude and significance pattern that differs from that of economic growth

2.3 Spatial Heterogeneity and the Limits of Global Regression

Classical econometric models estimated through global Ordinary Least Squares implicitly assume that the relationship between predictors and an outcome is stationary across the entire geographic extent of a study area. This assumption is often violated in regions marked by strong geographic, economic, and cultural diversity. Fotheringham, Brunsdon, and Charlton (2002) pioneered Geographically Weighted Regression precisely to relax this stationarity assumption, allowing regression coefficients to vary continuously across space according to a spatial weighting kernel centered on each observation's geographic coordinates. Applications of a locally weighted spatial kernel outside the poverty literature, such as modeling air pollution determinants across Chinese cities, similarly confirm that a spatially varying coefficient specification consistently outperforms a fixed global coefficient whenever the underlying process is geographically non-uniform (Gu et al., 2021).

Applications of this framework to poverty modeling in Indonesia have proliferated in recent years, consistently demonstrating that a local model captures substantially more variation than its global counterpart. A study modeling poverty in Papua directly using Geographically Weighted Regression found that coefficients for key socioeconomic predictors varied markedly between coastal and highland districts, a pattern the authors argued reflects deep infrastructural and cultural discontinuities within the province (Lumbantoruan et al., 2023). Complementary studies applying Geographically Weighted Regression to human development, mortality, and unemployment outcomes across other Indonesian provinces likewise report substantial gains in explanatory power once spatial heterogeneity is accommodated (Nisa et al., 2022). Analogous evidence from Eastern

Indonesia more broadly shows that inequality and poverty intensity interact with geography in ways that a single pooled coefficient cannot represent (Rusdiana et al., 2023), a conclusion reinforced by panel evidence across Indonesian provinces showing that regional inequality, human capital, and unemployment jointly shape growth outcomes in ways that vary by region (Setiawan & Kurniawan, 2023). The formal diagnostic test for this condition, the Breusch-Pagan test, evaluates whether regression residual variance is homogeneous across the sample, with rejection of the null hypothesis signaling that a spatially varying model is methodologically required rather than merely preferable. Based on this reasoning, the third hypothesis is proposed:

> *H_3:* A Geographically Weighted Regression Panel model provides a significantly better fit than a global Ordinary Least Squares model due to the presence of genuine spatial heterogeneity in the relationship between economic growth, unemployment, and poverty

2.4 Regional Expansion and Post-Pemekaran Development Disparities

The 2022 formation of South Papua, Central Papua, and Highland Papua as new autonomous provinces was intended to shorten administrative spans of control and accelerate equitable public service delivery. Earlier assessments of regional expansion, or pemekaran, elsewhere in Papua found mixed effects on per capita income, poverty, and interregional inequality, with newly formed regions sometimes experiencing a temporary widening of disparities before administrative capacity matures. More recent policy analyses of the Papua expansion caution that a new autonomous region is not by itself sufficient to resolve entrenched development gaps unless accompanied by capacity building and context-specific investment (Fauzi et al., 2023). Complementary evidence suggests that special autonomy and fiscal decentralization can reduce regional inequality in Papua only when institutional quality and resource allocation are strong enough to convert transferred funds into productive local capacity, otherwise the intended equalizing effect fails to materialize (Riani & Pudjihardjo, 2023). Evaluations of the Special Autonomy Fund itself likewise show uneven effects on human development across Papua and West Papua, with some districts registering meaningful gains while others show little improvement despite comparable levels of transfer (Dewantara, 2024; Ginting, 2023). Similar caution is warranted based on evidence from Aceh Province, another region governed under a special autonomy arrangement, where special autonomy funds have not consistently translated into stronger economic performance across all sectors (Hayati et al., 2022). Fiscal decentralization has nonetheless been found to alleviate poverty in Papua Province when economic growth operates as a mediating channel, although the strength of this mediation varies across districts and time periods (Vitara Agatha & Uliansyah, 2021). Analysis of special autonomy fund allocation in Papua and West Papua similarly finds an uneven impact on the human development index across districts, echoing the district-level asymmetry this study documents for poverty (Muhtarulloh, 2021). This body of work underscores why a spatially disaggregated empirical approach, rather than an aggregate assessment of the whole region, is necessary to understand how growth and unemployment interact with poverty in the newly expanded Papuan provinces. District-level evidence on targeted government spending in Papua similarly finds that fiscal allocation alone, without attention to local institutional capacity, has produced only modest and uneven gains in human development across districts (Dwiputrianti et al., 2025), a pattern consistent with cross-country evidence that sectoral government spending does not automatically translate into human development outcomes unless allocation is well targeted (Onabote et al., 2023). Spatial modeling of the human development index in Papua using a geographically weighted ridge regression approach further confirms that socioeconomic outcomes in this region are highly non-stationary across districts, reinforcing the case for a local rather than a global modeling strategy (Saputro et al., 2021). Post-pandemic assessments of local government service capacity in Papua also point to persistently limited institutional readiness to translate planning and budget allocation into measurable welfare improvement (Prasetyo et al., 2022).

3. Methodology

3.1 Data Sources and Variables

This study uses secondary data in the form of a macro panel with an analytical unit of 29 districts and cities spread across four provinces in the Papua region. The observation period spans five years,

from 2020 to 2024, yielding a total of 145 observations, calculated as 29 units multiplied by 5 years. Data were obtained from official publications of the Central Statistics Agency, including the National Socioeconomic Survey and the National Labor Force Survey.

The variables analyzed are defined as follows. The dependent variable, poverty, is measured through the percentage of poor people, defined as those whose average monthly per capita expenditure falls below the poverty line in each district and city. The first independent variable, economic growth, is measured based on the percentage change in real Gross Regional Domestic Product at constant prices from the previous year. The second independent variable, the open unemployment rate, is measured through the percentage of unemployed people relative to the total labor force.

3.2 GWR-Panel Model Specification

The global pooled Ordinary Least Squares linear regression model assumes a constant parameter across regions, expressed as follows.

$$Yit = \beta 0 + \beta 1 X1it + \beta 2 X2it + \varepsilon it \quad (1)$$

Formula 1 show in this equation, Yit denotes the poverty rate of district or city i in year t, X1it denotes economic growth, X2it denotes the open unemployment rate, β0 through β2 denote global regression coefficients, and εit denotes the error term.

To accommodate spatial heterogeneity, this model is developed into a Geographically Weighted Regression Panel model, in which the regression coefficients depend on the geographic position, expressed through latitude and longitude coordinates, of each observation unit. Ensuring that the underlying panel specification satisfies standard classical regression assumptions, including the absence of severe multicollinearity, remains an essential precondition before any spatial extension is applied (Nisa et al., 2022). The equation is expressed as follows.

$$Yit = \beta 0(ui, vi) + \beta 1(ui, vi) X1it + \beta 2(ui, vi) X2it + \varepsilon it \quad (2)$$

Formula 2 show in this equation, (ui, vi) denotes the geographic coordinates, that is, the centroid, of district or city i. Local parameter estimation in the Geographically Weighted Regression Panel model is conducted by applying a spatial weight matrix W(ui, vi) based on Euclidean distance between regions. The weighting kernel function applied in this study is the Adaptive Bisquare Kernel function, with the optimal bandwidth criterion determined using the smallest Corrected Akaike Information Criterion.

3.3 Testing Stages

The analysis proceeds through several stages. The first stage, temporal descriptive analysis, identifies the general characteristics and trends of the macro variables during the analysis period. The second stage, the spatial heterogeneity test, applies the Breusch-Pagan test to test the null hypothesis of whether residual variance is spatially homogeneous. If the null hypothesis is rejected at a p-value below 0.05, genuine spatial heterogeneity is present, making local modeling through Geographically Weighted Regression a methodological necessity. The third stage, local model estimation and clustering, estimates the local parameters β0, β1, and β2 for the 29 regions and groups them according to the statistical significance status of the partial t-test, using a threshold of absolute t exceeding 1.96 at a 5% significance level.

4. Results and Discussion

4.1 Descriptive Characteristics of Macroeconomic Data

Based on a summary of the panel data over the period 2020 to 2024, comprising 145 observations, the average poverty rate across the study area stood at a troubling level of 28.48% with a standard deviation of 9.09%.

Table 1. Descriptive statistics of research variables in 2020-2024

Statistic	Poverty (%)	Economic Growth (%)	Unemployment Rate (%)
Minimum	10.01	-5.06	0.00
First Quartile (Q1)	23.90	1.26	0.90
Median	30.03	2.57	2.39
Mean	28.48	2.73	2.87
Third Quartile (Q3)	36.41	3.81	4.11
Maximum	42.03	36.85	10.38
Standard Deviation	9.09	3.84	2.38

Table 1 reports the distribution of the three research variables across the 145 panel observations. Extreme variability is clearly visible in the gap between a minimum poverty rate of 10.01 percent recorded in Merauke Regency in 2023 and a maximum rate reaching 42.03% in Intan Jaya Regency in 2022. Average economic growth stood at 2.73% with a considerably larger standard deviation of 3.84%, indicating high spatial instability. The main driver of this variability is the anomalous growth of Mimika Regency, which reached 36.85% in 2021 due to fluctuations in large-scale copper and gold production, while non-mining regions moved slowly or even contracted, reaching negative 5.06% in Biak Numfor as a result of the COVID-19 pandemic in 2020. Over time, a marginal welfare improvement trend is evident. The average regional poverty rate declined gradually from 28.82% in 2020 to 27.58% by the end of 2024. This slow decline suggests an inefficient transmission of macroeconomic output into local pockets of poverty.

4.2 Verification of Spatial Heterogeneity

Before applying local modeling, a comparison was first conducted through global pooled Ordinary Least Squares regression estimation to detect violations of the spatial stationarity assumption.

Table 2. Global pooled OLS model estimation results

Variables	Coefficient	Std. Error	t-Statistic	p-value
Constant	35.9693	1.1450	31.41	0.0000
Economic Growth (X_1)	-0.5155	0.1601	-3.22	0.0017
Unemployment Rate (X_2)	-2.1195	0.2994	-7.08	0.0000

Table 2 presents the global regression results, which show that at the aggregate macro level, economic growth and unemployment have a negative and statistically significant effect on poverty. However, the global coefficient of determination is quite low at 0.3578, meaning this classical linear regression model can only explain 35.78% of poverty variability in Papua, while the remaining 64.22% of variation is left unexplained because the model cannot capture the spatial element. To verify this weakness of the global model, a Breusch-Pagan test for spatial heterogeneity was conducted.

Table 3. Breusch-pagan spatial heterogeneity test results

Description	Statistic Value	Critical Chi-Square (alpha = 5%, df = 2)	Decision
BP Statistic	9.5594	5.9915	Reject H_0
p-value	0.0084	not applicable	Significant ($p < 0.05$)

Table 3 shows that the Breusch-Pagan statistic of 9.5594 substantially exceeds the critical chi-square threshold of 5.9915, reinforced by a p-value of 0.0084, below the conventional 0.05 threshold. This empirical result decisively rejects the null hypothesis of homogeneous residual variance. Regression parameters are shown to undergo significant non-stationarity across geospatial coordinates in Papua Province and its New Autonomous Regions, making the use of a local Geographically Weighted Regression Panel model a methodological necessity rather than a mere preference. This finding is consistent with prior Geographically Weighted Regression applications to poverty in Papua, which similarly report strong evidence against a single global coefficient structure (Lumbantoruan et al., 2023).

4.3 GWR-Panel Model Estimation Results and Model Superiority

Through optimization of the Corrected Akaike Information Criterion using an adaptive bisquare kernel function, the Geographically Weighted Regression Panel model achieved a far more precise performance than the global Ordinary Least Squares model.

Table 4. Comparison of OLS and GWR-panel model Fit

Performance Indicator	Global OLS Regression	Spatial GWR-Panel Regression	Change / Efficiency
Coefficient of Determination (R squared)	0.3578	0.7323	Increase of 37.45 points
Adjusted R squared	0.3492	0.6910	Improved
Corrected Akaike Information Criterion (AICc)	965.00	881.87	Decrease of 83.13 points

Table 4 presents a direct comparison of model fit statistics between the global and local specifications, demonstrating the clear superiority of the Geographically Weighted Regression Panel model. The R squared value rose sharply to 0.7323, indicating that the model's ability to explain poverty variation increased by 37.45 percentage points once geographic weighting was incorporated. Model adequacy is further confirmed by the sharp decline in the corrected Akaike Information Criterion from 965.00 to 881.87. A decline in this information criterion exceeding the conventional critical threshold of three points constitutes valid empirical evidence that the Geographically Weighted Regression Panel model is structurally far more accurate and less prone to specification bias in modeling the dynamics of poverty in Papua.

4.4 Local Parameter Variability and Regional Clustering

The Geographically Weighted Regression Panel model produces location-specific coefficients for each district and city observation unit. A summary of the distribution of these local coefficients is presented in Table 5.

Table 5. Summary of GWR-panel local parameters in all observations

Statistic	Intercept	Beta 1 (Economic Growth)	Beta 2 (Unemployment)
Minimum	26.7127	-1.2595	-5.0680
First Quartile (Q1)	35.7121	-0.6531	-2.6912
Median	37.0920	-0.5036	-2.0515
Mean	36.6262	-0.5485	-2.1594
Third Quartile (Q3)	39.2740	-0.3803	-1.4013
Maximum	40.7050	-0.1118	-0.6749
Significant locations	145 of 145, 100 percent	60 of 145, 41.4 percent	106 of 145, 73.1 percent

Table 5 shows the full distribution of local parameter estimates across all 145 panel observations, together with the proportion of locations at which each coefficient is statistically significant. Overall, the direction of all local coefficients is consistent with development theory, in which economic growth, β1, and unemployment, β2, are negatively associated with poverty at every location. However, the strength of the impact and its level of significance vary considerably across space. The unemployment coefficient, β2, proves statistically significant at 73.1% of total observations, a reach far broader and more stable than the economic growth coefficient, β1, which is significant at only 41.4% of locations. Depicts the spatial distribution of the four significance-based clusters across the 29 districts and cities of Papua Province and its New Autonomous Regions, distinguishing coastal and urban centers from the isolated central highland districts described in the clustering discussion below. Based on the similarity of the local partial t-test significance pattern, the study area is grouped into four spatial clusters reflecting distinct structural characteristics

Cluster one, in which both economic growth, β1, and unemployment, β2, are significant, comprises twelve districts. This cluster covers regions with ongoing economic transformation dynamics, including Nduga, Mimika, Asmat, Mappi, Merauke, Boven Digoel, Dogiyai, Deiyai, Nabire, Paniai, Intan Jaya, and Puncak. In these regions, changes in macroeconomic indicators and fluctuations in the formal labor market directly affect household welfare. Mimika and Merauke, for instance, are growth centers with substantial extractive mining and large-scale agribusiness sectors connected to formal labor supply chains. Meanwhile, interior districts such as Intan Jaya and Puncak fall into this cluster because of their very low economic starting point, so that even a modest change in accessibility and employment absorption produces a substantial shock effect on local poverty reduction.

Cluster two, in which only the unemployment variable, β2, is significant, comprises ten districts and cities. This cluster covers established urban and northern coastal regions, including Jayapura City, Jayapura Regency, Keerom, Sarmi, Mamberamo Raya, Mamberamo Tengah, Tolikara, Pegunungan Bintang, Puncak Jaya, and Supiori. In urban areas such as Jayapura City, the labor market is already formal and competitive, so the primary determinant of rising or falling poverty is employment availability, that is, a reduction in the unemployment rate. By contrast, aggregate Gross Regional Domestic Product growth does not significantly affect poverty because such growth is dominated by services, trade, and government administration sectors that have reached saturation, so it is no longer elastic with respect to expanding welfare among marginal groups. In lagging regions such as Mamberamo Raya or Tolikara, the insignificance of economic growth is attributable to geographic isolation, in which money circulating from Gross Regional Domestic Product growth flows back out of the region, a form of capital flight, due to dependence on goods supplied from parent regions, so that a local multiplier effect fails to form. This pattern mirrors broader evidence that regional development strategies confined to headline growth targets, without parallel attention to local institutional and industrial capacity, tend to leave lagging districts persistently behind (Husnah & Adam, 2022), and that poverty alleviation policy transplanted from other contexts without adaptation to local labor market structure, as observed in comparative policy reviews from Malaysia and Nigeria, rarely produces the intended welfare gains (Zain et al., 2021).

Cluster three, in which only the economic growth variable, β1, is significant, contains no districts or cities. Not a single district or city fell into this category throughout the 2020 to 2024 period. This confirms the empirical truth that in Papua, output growth in isolation, without accompanying employment absorption or improvement in labor market structure, amounts to jobless growth that can never alleviate poverty on its own, a conclusion consistent with broader evidence that unemployment and poverty jointly constrain both economic growth and human development outcomes when treated as isolated policy targets rather than an integrated system (Priambodo, 2021).

Cluster four, in which neither variable, β1 nor β2, is significant, groups seven core districts in the isolated central highlands, comprising Jayawijaya, Lanny Jaya, Yalimo, Yahukimo, Kepulauan Yapen, Biak Numfor, and Waropen. Interior highland districts such as Lanny Jaya, Yalimo, and

Yahukimo record an anomaly in which economic growth fluctuates while the unemployment rate approaches zero percent. This low open unemployment rate in the interior highlands is not good news, but rather an indicator that a formal labor market has failed to form, with the majority of residents trapped in traditional informal subsistence agriculture, hunting, and gathering purely for survival. Statistically, they are categorized as employed rather than openly unemployed, yet their marginal productivity and income fall below the poverty line. As a result, conventional macroeconomic indicators, X1 and X2, lose their relevance and become dysfunctional in explaining the structural and cultural poverty that confines the local population.

5. Conclusions

5.1 Conclusion

Genuine and significant spatial heterogeneity exists in the pattern of poverty distribution and its determinants across Papua Province and its New Autonomous Regions during the period 2020 to 2024, so that the local spatial Geographically Weighted Regression Panel model proved far more accurate, superior, and representative, with an R squared of 73.23%, than the conventional global Ordinary Least Squares model, with an R squared of 35.78%.

The effect of economic growth and unemployment on poverty is asymmetric and location specific. The unemployment rate acts as a far more stable and dominant determinant of poverty, significant in 73.1% of regions, than economic growth, which remains vulnerable to distortion from a capital-intensive extractive sector bias.

The clustering pattern shows that the isolated central highland districts experience a dysfunction of macroeconomic indicators, in which low economic growth and low unemployment do not correlate with declining poverty, owing to the dominance of informal subsistence agriculture, or disguised unemployment, and extreme geographic isolation.

5.2 Research Limitations

This study is limited by its five-year observation window, which restricts the ability to capture longer structural cycles of development following regional expansion. The analysis is also confined to only two macroeconomic predictors, economic growth and the open unemployment rate, so that other plausible determinants of poverty, such as human capital, infrastructure access, and fiscal transfer composition, were not incorporated into the model. In addition, the study covers only the Papua region and its New Autonomous Regions, which limits the generalizability of the findings to other parts of Indonesia with different geographic and economic structures.

5.3 Suggestions and Directions for Future Research

Regional and national policymakers across the four Papuan provinces are encouraged to move away from a uniform, one-size-fits-all approach to poverty alleviation. Interventions should instead be tailored to the characteristics of each district cluster identified through the Geographically Weighted Regression Panel estimation. For urban and economically transitioning districts corresponding to clusters one and two, local government should prioritize non-mining economic diversification and the creation of formal, labor-intensive employment to maximize the poverty-reducing elasticity achieved through unemployment reduction. For the isolated central highland districts corresponding to cluster four, where macroeconomic indicators are dysfunctional, regional finance, including Special Autonomy funds allocated to the New Autonomous Regions, should not be directed toward symbolic infrastructure projects but instead toward structural interventions, including the opening of logistics connectivity to break the chain of price disparity, strengthening basic human capability through vocational education and free healthcare, and the gradual transformation of subsistence agriculture into economically productive farming. Future research is encouraged to extend the observation period, incorporate additional structural and institutional variables, and apply comparable spatial panel methods to other newly expanded regions in eastern Indonesia to test the generalizability of these findings.

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