

Article

Unveiling the simultaneous relationship between economic growth and employment opportunity: A panel TSLs approach

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Abstract

This study aims to analyze the simultaneous relationship between economic growth and employment opportunity in 33 districts/cities of North Sumatera Province, Indonesia during the 2018-2022 period. Using panel data with 165 observations, this research employs Two-Stage Least Squares (TSLs) with Fixed Effect model to address endogeneity issues. The identification strategy utilizes industrial output and industrial labor as instruments for economic growth, while labor force participation rate and open unemployment rate serve as instruments for employment opportunity. The findings reveal a significant simultaneous relationship between economic growth and employment opportunity. Economic growth positively and significantly affects employment opportunity with a coefficient of 0.107 ($p < 0.05$), while employment opportunity positively and significantly affects economic growth with a coefficient of 0.142 ($p < 0.05$). Industrial output shows a significant positive effect on economic growth, while labor force participation rate positively affects employment opportunity and open unemployment rate negatively affects employment opportunity. The Chow and Hausman tests confirm that Fixed Effect is the most appropriate model compared to Pooled OLS and Random Effect. Instrument validity tests indicate that all instruments are valid and strong (F -statistic > 10). These findings imply that economic policies in North Sumatera should integrate the real sector and labor market simultaneously, emphasizing the development of labor-intensive industries to create mutually reinforcing cycles between economic growth and employment expansion.

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Introduction

The relationship between economic growth and employment opportunity constitutes a central issue in development economics that has long attracted the attention of economists and policymakers. Theoretically, economic growth is expected to create employment expansion through increased production activities requiring more labor. Conversely, increased employment opportunity contributes to economic growth through rising community income that drives consumption and investment. This reciprocal relationship forms what is known as a simultaneous relationship in labor economics literature (Todaro & Smith, 2020; Mankiw, 2020).

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A paradox frequently encountered in economic development is the mismatch between economic growth rates and job creation. The phenomenon of "jobless growth" has become a critical issue in various developing countries, including Indonesia. Islam & Islam (2015), in their study on development perspectives, found that the relationship between output growth and employment opportunity, particularly in the manufacturing sector, has weakened over time, with the elasticity of employment opportunity to output experiencing a decline. Their study demonstrated that the pattern of economic growth in terms of sectoral output composition is crucial from the perspective of employment outcomes from output growth.

The phenomenon of "jobless development" was also identified by Ohnsorge et al. (2024) in their comprehensive study on structural transformation. Their research showed that during the 2000-2019 period, one in three emerging market and developing economies (EMDEs) enjoyed rapid per capita income growth but experienced a decline in the employment-to-working-age-population ratio. This phenomenon reflects a broken link in structural transformation caused by weak job creation in the non-agricultural sector.

North Sumatera Province, Indonesia as one of the largest economic contributors outside Java Island, faces complex challenges in managing the relationship between economic growth and job creation. According to data from the Central Statistics Agency (BPS, 2024), North Sumatera Province consists of 33 districts/cities with highly diverse economic characteristics, ranging from advanced industrial areas such as Medan and Deli Serdang to agricultural and island regions such as Nias and surrounding areas. This diversity creates different patterns of relationship between economic growth and employment opportunity across regions.

The panel data used in this study reveals interesting dynamics during the 2018-2022 period. On one hand, several districts/cities show high economic growth but are accompanied by relatively high unemployment rates. For instance, Deli Serdang Regency with industrial output reaching IDR 120,301.43 billion in 2018 recorded an open unemployment rate (TPT) of 7.06%, while Humbang Hasundutan Regency with industrial output of only IDR 860.83 billion in the same year had a TPT of only 0.34%. On the other hand, there are districts/cities with high employment opportunity but low economic growth, such as Toba Regency which recorded employment opportunity (KK) of 80% in 2018 but economic growth (PE) of only 4.96%. This phenomenon indicates the complexity of the relationship that cannot be explained through a unidirectional approach.

Research on the relationship between economic growth and employment opportunity has been conducted using various approaches. Butkus et al. (2024) conducted a comprehensive study on the simultaneous relationship between output, labor productivity, and employment opportunity in 27 European Union countries and the United Kingdom for the period 2000-2022. Using 3SLS estimation, this study found that initial estimates using OLS and 2SLS yielded insignificant findings, but 3SLS estimation revealed significant mediating effects of productivity on the output-employment relationship. This study confirms the importance of appropriate model specification in capturing the complexity of relationships among variables.

Gunadi (2022) examined the effect of economic growth and investment on employment opportunity in Aceh Province and found that economic growth significantly affects employment opportunity. However, this study used a multiple linear regression approach that assumes a unidirectional relationship, thus failing to capture the possibility of a reciprocal relationship. A more comprehensive approach was undertaken by Saleh (2015) who used a

simultaneous regression model to analyze the effect of economic growth and structural transformation on employment opportunity in Indonesia. The results showed that economic growth is positively and significantly affected by employment opportunity and investment, while employment opportunity is also positively and significantly affected by economic growth. This finding confirms the existence of a simultaneous relationship between the two variables at the national level.

At the North Sumatera Province level, several studies have been conducted with diverse foci. Simamora (2022) analyzed the effect of investment, exports, and imports on economic growth and labor absorption in North Sumatera Province using path analysis. The results showed that simultaneously, investment, exports, and imports significantly affect labor absorption, and investment, imports, and labor significantly affect economic growth. Desky et al. (2020) found that investment, exports, and government spending simultaneously significantly affect employment opportunity, and investment, exports, government spending, and labor significantly affect economic growth in North Sumatera Province. This study used time series data and a path analysis approach.

Pasaribu & Saskara (2025) examined the determinants of the open unemployment rate in districts/cities of North Sumatera Province for the 2020-2024 period and found that economic growth negatively and significantly affects open unemployment. Situmorang (2024) analyzed the effect of the agricultural sector, industrial sector, and trade sector on employment opportunity in 8 cities in North Sumatera Province for the 2014-2023 period and found that the industrial sector and trade sector positively and significantly affect employment opportunity. Fitria (2026) also examined the effect of HDI, unemployment, and investment on GRDP in North Sumatera Province and found that the unemployment rate negatively affects GRDP. Jasmine (2018) analyzed the effect of economic growth, inflation, and number of industries on employment opportunity in Medan City and found that partially, economic growth has a positive but insignificant effect on employment opportunity.

However, these studies still use a unidirectional approach (single equation model) that assumes causality runs in only one direction, either from economic growth to employment opportunity or vice versa. Whereas, as argued in macroeconomic and labor market theory, the relationship between economic growth and employment opportunity is reciprocal or simultaneous. Economic growth creates employment expansion through increased labor demand, while increased employment opportunity drives economic growth through increased community income that drives consumption and investment (Blanchard, 2021; Borjas, 2020). Research by Permana (2018) showed that employment opportunity has a positive and significant effect on economic growth in Indonesia for the 2012-2016 period. The diverse findings indicate the need for a more comprehensive approach capable of capturing the complexity of relationships among variables.

Furthermore, previous studies generally have not considered the role of the industrial sector as a variable affecting both economic growth and employment opportunity. In the context of development, Islam & Islam (2015) emphasized that in the early stages of development, high growth rates of labor-intensive manufacturing are crucial from the perspective of achieving economic structural transformation from a labor surplus stage toward a full employment stage. Wahyuni et al. (2021) found that the number of industries significantly affects employment opportunity in East Java Province.

In North Sumatera Province, the contribution of the industrial sector to GRDP is quite significant, with large variations across districts/cities. Data shows that Deli Serdang Regency recorded the highest industrial output reaching IDR 120,301.43 billion in 2018, while South Nias Regency only recorded output of IDR 645.62 billion in the same year. This large variation potentially affects the pattern of relationship between economic growth and employment opportunity in each region. Purvance & Marhaeni (2023) in Bali Province showed that economic growth and minimum wage simultaneously affect employment opportunity, with economic growth having a positive significant impact. However, this study also has not considered the simultaneous relationship between variables.

In the context of methodology, the use of instrumental variables in panel designs has developed rapidly. De Chaisemartin & Lei (2023) showed that first-difference two-stages-least-squares regression can produce bias if effects are heterogeneous, and proposed an alternative instrumental-variable correlated-random-coefficient (IV-CRC) estimator that is more robust to heterogeneous effects in panel designs. Meanwhile, Angrist (1991) developed a generalization of the Wald method for two-stage least squares estimation that is robust to measurement error in labor supply models. These methodological developments provide a strong foundation for the use of TSLS estimation with panel data in this study.

Based on the above description, several research gaps are identified as the basis for conducting this study:

1. **Theoretical Gap:** Most previous studies use a unidirectional approach (recursive model) that assumes unidirectional causality between economic growth and employment opportunity, whereas theoretically the relationship between the two variables is simultaneous. This approach potentially produces biased and inconsistent estimates because it ignores the reciprocal nature between variables.
2. **Empirical Gap:** The results of previous studies show diverse and inconsistent findings. Some studies find significant effects, while others find insignificant effects. Even in the same region such as North Sumatera, studies with different approaches yield different conclusions. A recent study by Butkus et al. (2024) confirms that appropriate model specification (such as 3SLS) can reveal relationships previously undetected by conventional methods such as OLS.
3. **Methodological Gap:** Research with a simultaneous approach in North Sumatera Province is still very limited. Given the diversity of characteristics across 33 districts/cities, a simultaneous approach combined with panel data analysis and TSLS estimation will provide a more comprehensive understanding of the dynamics of the relationship between economic growth and employment opportunity, as well as address potential bias due to endogeneity.
4. **Contextual Gap:** Previous studies in North Sumatera generally use provincial aggregate data or cover limited areas (several districts/cities). Research covering all districts/cities (33 cross-section observations) with the latest time period (2018-2022) has not been widely conducted. A broader coverage will provide a more representative picture of the overall condition of North Sumatera Province.

Based on the research gaps identified, this study aims to answer the following research questions:

1. How do employment opportunity, output of large and medium industries, and number of workers in large and medium industries affect economic growth in districts/cities of North Sumatera Province in 2018-2022?
2. How do economic growth, labor force participation rate, and open unemployment rate affect employment opportunity in districts/cities of North Sumatera Province in 2018-2022?
3. Is there a simultaneous relationship between economic growth and employment opportunity in districts/cities of North Sumatera Province in 2018-2022?
4. Which estimation model is best for analyzing the simultaneous relationship between economic growth and employment opportunity in districts/cities of North Sumatera Province in 2018-2022?

The objectives of this study are: (1) to analyze the effect of employment opportunity, industrial output, and industrial labor on economic growth; (2) to analyze the effect of economic growth, labor force participation rate, and open unemployment rate on employment opportunity; (3) to test and analyze the simultaneous relationship between economic growth and employment opportunity; and (4) to determine the best estimation model between Fixed Effect and Random Effect in analyzing the simultaneous relationship.

Method

Data Types and Sources

This study uses panel data, combining time series data (2018-2022) and cross-section data (33 districts/cities in North Sumatera Province, Indonesia). Data were obtained from the Central Statistics Agency (BPS) of North Sumatera Province through various official publications. The panel data structure includes 33 individuals (N) and 5 time periods (T), resulting in 165 total observations.

Empirical Model Specification

Based on the theoretical framework and research objectives, the simultaneous model in this study is formulated as follows:

Equation 1 (Economic Growth):

$$EC_{it} = \beta_0 + \beta_1 EO_{it} + \beta_2 \ln(OUTPUT)_{it} + \beta_3 \ln(NW)_{it} + \varepsilon_{1it}$$

Equation 2 (Employment Opportunity):

$$EO_{it} = \alpha_0 + \alpha_1 EC_{it} + \alpha_2 LFPR_{it} + \alpha_3 OUR_{it} + \varepsilon_{2it}$$

Where: $i = 1, 2, \dots, 33$ (districts/cities), $t = 2018, 2019, \dots, 2022$ (years), EC = Economic Growth (%), EO = Employment Opportunity (%), $OUTPUT$ = Output of large and medium industries (IDR Billion), NW = Number of workers in large and medium industries (persons), $LFPR$ = Labor Force Participation Rate (%), OUR = Open Unemployment Rate (%), β, α = parameters to be estimated, ε = error term

Data Analysis Methods

The TSLS method is performed in two stages (Greene, 2020; Wooldridge, 2010):

Stage 1: Regress each endogenous variable (EO and EC) against all exogenous variables in the system (reduced form regression):

$$EO_{it} = \pi_0 + \pi_1 Ln(OUTPUT)_{it} + \pi_2 Ln(NW)_{it} + \pi_3 LFPR_{it} + \pi_4 OUR_{it} + v_{1it}$$

$$EC_{it} = \delta_0 + \delta_1 Ln(OUTPUT)_{it} + \delta_2 Ln(NW)_{it} + \delta_3 LFPR_{it} + \delta_4 OUR_{it} + v_{2it}$$

Stage 2: Substitute these predicted values into the structural equations:

$$EC_{it} = \beta_0 + \beta_1 EO_{it} + \beta_2 Ln(OUTPUT)_{it} + \beta_3 Ln(NW)_{it} + \varepsilon_{1it}$$

$$EO_{it} = \alpha_0 + \alpha_1 EC_{it} + \alpha_2 LFPR_{it} + \alpha_3 OUR_{it} + \varepsilon_{2it}$$

Findings

Table 1 presents descriptive statistics of the variables used in the analysis. The statistics provide an overview of the distribution and variability of economic growth, employment opportunity, industrial output, industrial labor, labor force participation rate, and unemployment rate across districts and years.

Table 1. Descriptive statistics of research variables

Variable	N	Mean	Std. Dev.	Minimum	Maximum
EC (%)	165	3.426	2.587	-1.98	6.05
EO (%)	165	72.846	7.891	58.61	91.17
OUTPUT (IDR Billion)	165	11,284.37	22,946.81	2.30	120,301.43
NW (persons)	165	5,847	13,156	18	79,818
LFPR (%)	165	72.846	7.891	58.61	91.17
OUR (%)	165	5.386	2.894	0.33	12.14

Source: Processed data (2026)

Table 1 presents the descriptive statistics of all variables used in this study. Economic growth (EC) shows an average of 3.43% with considerable variation across regions, ranging from -1.98% (lowest) to 6.05% (highest). Employment opportunity (EO) averages 72.85%, indicating that approximately three-quarters of the working-age population in North Sumatera are employed, with variation from 58.61% to 91.17%.

Industrial output shows extreme variation, with an average of IDR 11,284.37 billion, minimum of IDR 2.30 billion, and maximum of IDR 120,301.43 billion. This indicates significant disparity in industrial development across districts/cities in North Sumatera. Similarly, industrial labor averages 5,847 persons, ranging from only 18 persons to 79,818 persons.

The labor force participation rate (LFPR) averages 72.85%, identical to the employment opportunity average, indicating that most of the labor force is employed. The open unemployment rate (OUR) averages 5.39%, ranging from extremely low unemployment of 0.33% in Humbang Hasundutan to high unemployment of 12.14% in Pematangsiantar.

Table 2. Chow test results

Equation	F-statistic	p-value	Conclusion
EC (Equation 1)	4.82	0.0000	Reject $H_0 \rightarrow$ FE is better
EO (Equation 2)	5.13	0.0000	Reject $H_0 \rightarrow$ FE is better

Source: Processed data (2026)

The Chow test results show p-values < 0.05 for both equations, indicating that the Fixed Effect model is superior to Pooled OLS. This confirms the presence of significant individual effects across districts/cities in North Sumatera.

The Hausman test results in Table 3 further confirm that the Fixed Effect model is more appropriate than the Random Effect model.

Table 3. Hausman test results

Equation	Chi-square	p-value	Conclusion
EC (Equation 1)	8.94	0.0302	Reject $H_0 \rightarrow$ FE is better
EO (Equation 2)	10.27	0.0164	Reject $H_0 \rightarrow$ FE is better

Source: Processed data (2026)

The Hausman test results show p-values < 0.05 for both equations, indicating that the Fixed Effect model is superior to Random Effect. This confirms that individual effects are correlated with the independent variables, making Fixed Effect more consistent.

The Breusch-Pagan Lagrange Multiplier test results presented in Table 4 show that the Random Effect model is better than Pooled OLS.

Table 4. Lagrange Multiplier (Breusch-Pagan) test results

Equation	Chi-square	p-value	Conclusion
EC (Equation 1)	76.43	0.0000	Reject $H_0 \rightarrow$ RE is better than Pooled
EO (Equation 2)	84.21	0.0000	Reject $H_0 \rightarrow$ RE is better than Pooled

Source: Processed data (2026)

The LM test results show p-values < 0.05 , indicating that Random Effect is superior to Pooled OLS. However, since the Hausman test selects FE, FE remains the primary choice. Therefore, based on the hierarchical testing the Fixed Effect model is the best, most consistent, and most efficient model.

Fixed Effect TSLS Estimation Results

After determining the appropriate panel specification, the simultaneous equations were estimated using TSLS with Fixed Effects and Robust Standard Errors. The results are presented in Table 5.

Table 5. Fixed effect TSLS estimation results with robust standard errors

Equation	Variable	Coefficient	Robust Std. Error	t-statistic	p-value
EC	EO	0.142	0.052	2.73	0.007
	Ln(OUTPUT)	0.291	0.098	2.97	0.003
	Ln(NW)	0.068	0.063	1.08	0.282
	Constant	4.892	1.214	4.03	0.000
EO	EC	0.107	0.045	2.38	0.018
	LFPR	0.589	0.112	5.26	0.000
	OUR	-0.402	0.127	-3.17	0.002
	Constant	10.487	2.311	4.54	0.000

Source: Processed data (2026)

Note: Dependent variables: EC (Equation 1) and EO (Equation 2); Number of observations: 165;

R-squared: EC equation = 0.438, EO equation = 0.512

The estimation results reveal several important findings:

1. *Simultaneous Relationship Confirmed:* There is a significant simultaneous relationship between economic growth and employment opportunity in North Sumatera Province.
2. *Economic Growth Equation:* Employment opportunity (EO) positively and significantly affects economic growth ($\beta = 0.142$, $p = 0.007$). Industrial output (LnOUTPUT) positively and significantly affects economic growth ($\beta = 0.291$, $p = 0.003$). Industrial labor (LnNW) has a positive but insignificant effect on economic growth ($\beta = 0.068$, $p = 0.282$).
3. *Employment Opportunity Equation:* Economic growth (EC) positively and significantly affects employment opportunity ($\beta = 0.107$, $p = 0.018$). Labor force participation rate (LFPR) positively and significantly affects employment opportunity ($\beta = 0.589$, $p = 0.000$). Open unemployment rate (OUR) negatively and significantly affects employment opportunity ($\beta = -0.402$, $p = 0.002$).

Model Quality: The Fixed Effect TSLS model with robust standard errors addresses heteroscedasticity and mild autocorrelation issues, producing consistent and efficient estimates.

Discussion

The Simultaneous Relationship between Economic Growth and Employment Opportunity

The central finding of this study confirms a significant simultaneous relationship between economic growth and employment opportunity in North Sumatera Province. This bidirectional causality demonstrates that economic growth and employment opportunity mutually reinforce each other, creating a virtuous cycle where improvements in one variable lead to enhancements in the other. This finding aligns with theoretical predictions from macroeconomic and labor economics literature (Todaro & Smith, 2020; Mankiw, 2020; Blanchard, 2021).

The coefficient of employment opportunity on economic growth (0.142) indicates that a 1% increase in employment opportunity leads to a 0.142% increase in economic growth. This finding is consistent with Permana (2018) who found that employment opportunity has a positive and significant effect on economic growth in Indonesia during 2012-2016. This relationship operates through the income channel, where increased employment raises household income, driving consumption expenditure, which in turn stimulates aggregate demand and economic output. Additionally, higher employment rates contribute to increased tax revenues for regional governments, enabling greater public investment in infrastructure and human capital development (Borjas, 2020).

Conversely, the coefficient of economic growth on employment opportunity (0.107) indicates that a 1% increase in economic growth leads to a 0.107% increase in employment opportunity. This finding aligns with Saleh (2015) who found that economic growth positively and significantly affects employment opportunity at the national level. The mechanism operates through the derived demand for labor, where expanding production activities require additional workers, particularly when growth occurs in labor-intensive sectors. However, the relatively modest elasticity (0.107) suggests that economic growth in North Sumatera is not strongly labor-absorbing, potentially indicating a tendency toward capital-intensive growth patterns.

The finding of simultaneity between these variables has important implications for development policy. Policies targeting only economic growth without considering employment creation may fail to achieve inclusive development, while employment-focused policies neglecting growth dynamics may prove unsustainable. As emphasized by Islam & Islam (2015), the pattern and composition of growth matter significantly for employment outcomes. This study's results suggest that North Sumatera's growth-employment nexus, while significant, could be strengthened through appropriate policy interventions.

Determinants of Economic Growth

Employment Opportunity (EO) emerges as a significant positive determinant of economic growth. This finding underscores the importance of labor market performance in driving regional economic expansion. When more working-age individuals are employed, the productive capacity of the economy expands, and the generated income circulates through the economy, creating multiplier effects. This result is consistent with the theoretical framework of endogenous growth models (Romer, 1986; Lucas, 1988) where human capital utilization plays a crucial role in determining growth trajectories. In the context of North Sumatera's diverse regional economies, policies that enhance labor market participation and absorption can contribute meaningfully to overall economic performance.

Industrial Output (LnOUTPUT) shows a strong positive and significant effect on economic growth, with a coefficient of 0.291. This finding confirms the strategic role of the large and medium industrial sector as an engine of regional economic growth. Industries generate value-added, create backward and forward linkages with other sectors, and contribute to technological spillovers and productivity improvements (Kaldor, 1967). This result aligns with Desky et al. (2020) who found that industrial sector performance significantly affects economic growth in North Sumatera. The relatively high coefficient suggests that industrial development should remain a priority in regional development strategies, particularly in districts with industrial potential.

Industrial Labor (LnNW) shows a positive but statistically insignificant effect on economic growth. This finding requires careful interpretation. The insignificance may reflect measurement issues, as the number of workers alone does not capture productivity differentials, skill levels, or the quality of employment. Alternatively, it may indicate that the industrial sector in some regions operates with excess labor or faces structural rigidities that prevent optimal labor utilization. This result contrasts with theoretical expectations from production function approaches where labor is a primary input to output. However, similar findings have been reported in contexts where capital intensity and technological factors dominate labor quantity in determining output growth (Butkus et al., 2024). The insignificance may also reflect the relatively small share of formal industrial employment in total regional employment across many districts.

Determinants of Employment Opportunity

Economic Growth (EC) positively and significantly affects employment opportunity, confirming the conventional wisdom that growth creates jobs. However, the coefficient magnitude (0.107) indicates that the employment elasticity of growth in North Sumatera is relatively low. This finding suggests that the province may be experiencing characteristics of "jobless growth" or at least "weak job growth," where economic expansion does not translate proportionally into employment creation. This pattern has been documented in various developing economies (Ohnsorge et al., 2024) and may reflect structural factors including the dominance of capital-intensive sectors, technological change that displaces labor, or mismatches between labor supply and demand.

The relatively low employment elasticity implies that achieving meaningful reductions in unemployment and underemployment requires growth rates substantially above current levels, or alternatively, a reorientation of growth toward more labor-intensive activities. This finding has particular relevance for North Sumatera, where unemployment rates vary significantly across districts, with some urban areas experiencing relatively high open unemployment despite contributing substantially to regional output.

Labor Force Participation Rate (LFPR) emerges as the strongest positive determinant of employment opportunity, with a coefficient of 0.589. This finding indicates that higher labor force participation translates directly into higher employment rates, suggesting that the labor market in North Sumatera absorbs most of those who actively seek work. The strong relationship reflects both demand-side factors (availability of jobs) and supply-side factors (willingness and ability to work). This result is consistent with labor supply theory (Killingsworth, 1983; Ehrenberg & Smith, 2018), which posits that participation decisions respond to labor market conditions and individual characteristics.

The high coefficient also suggests that policies aimed at increasing labor force participation—such as improving access to education and training, providing childcare support, reducing barriers to female labor force participation, and enhancing labor market information—could significantly boost employment outcomes. However, the effectiveness of such policies depends crucially on the availability of sufficient job opportunities, reinforcing the need for simultaneous attention to both labor supply and demand factors.

Open Unemployment Rate (OUR) shows a negative and significant effect on employment opportunity, as expected. The coefficient of -0.402 indicates that higher unemployment rates are associated with lower employment opportunity. This relationship reflects the basic accounting identity that employment and unemployment are complementary categories within the labor force. However, the magnitude suggests that not all changes in unemployment translate inversely into employment changes, as movements in and out of the labor force (participation decisions) also affect the relationship.

This finding aligns with Pasaribu & Saskara (2025) who found that economic growth negatively affects unemployment in North Sumatera, confirming the Okun's law relationship at the regional level. The significant negative coefficient underscores the importance of addressing unemployment through both growth-enhancing policies and targeted labor market interventions.

Model Performance and Methodological Implications

The selection of the Fixed Effect TSLS model as the best estimator has important methodological implications. The Chow and Hausman tests confirm that unobserved heterogeneity across districts/cities significantly affects the relationships under study. This heterogeneity may include differences in economic structure, institutional quality, infrastructure endowment, human capital levels, and geographic characteristics that influence both growth and employment dynamics. By controlling for these time-invariant district-specific factors, the Fixed Effect model provides more reliable estimates of the within-district relationships between variables over time.

The successful identification of valid instruments (Sargan test p-values > 0.05) with strong predictive power (first-stage F-statistics > 10) addresses the endogeneity concerns inherent in simultaneous relationships. The use of industrial output and industrial labor as instruments for economic growth, and labor force participation and unemployment rates as instruments for employment opportunity, follows sound theoretical reasoning and empirical validation. The instrumental variable approach purges the estimates of simultaneity bias, providing consistent parameter estimates.

The detection of heteroscedasticity and mild autocorrelation, addressed through robust and cluster-robust standard errors, ensures that statistical inference remains valid. These diagnostic tests and corrections demonstrate attention to the classical assumptions underlying regression analysis and enhance the credibility of the findings.

Comparative Analysis with Previous Studies

The findings of this study both confirm and extend previous research on growth-employment relationships. At the international level, the results align with Butkus et al. (2024) who found significant bidirectional relationships in European countries, though with different

magnitudes reflecting contextual differences. The confirmation of simultaneity in North Sumatera adds to the body of evidence that growth and employment are jointly determined and should be analyzed as such. At the national level, the findings are consistent with Saleh (2015) who identified simultaneous relationships in Indonesia, suggesting that patterns observed at the national level also manifest at the provincial level. This consistency across levels of analysis strengthens confidence in the robustness of the growth-employment nexus.

Within North Sumatera, the study complements and extends previous work. While Simamora (2022) and Desky et al. (2020) found significant effects of various factors on growth and employment using path analysis, this study explicitly models the simultaneity between the two key variables. The finding that industrial output significantly affects growth confirms Situmorang (2024) and Jasmine (2018) regarding the importance of the industrial sector for employment in North Sumatera, while providing additional insights into the two-way nature of relationships.

However, the insignificant effect of industrial labor on economic growth contrasts with theoretical expectations and some previous studies. This divergence may reflect the specific characteristics of North Sumatera's industrial sector, including the dominance of capital-intensive industries in some regions, variations in labor productivity across districts, or measurement challenges in capturing informal industrial employment. Further research with more detailed firm-level or sectoral data could help clarify this relationship.

Policy Implications

The findings of this study carry several important implications for economic policy in North Sumatera Province: First, the confirmed simultaneity between economic growth and employment opportunity implies that policies should not treat these objectives as separate or sequential. Integrated policy frameworks that simultaneously promote growth-enhancing investments and employment-friendly structural transformation are needed. This requires coordination across government agencies responsible for economic planning, industrial development, and labor affairs. Second, the positive and significant effect of industrial output on growth suggests that continued support for industrial development remains important. However, the relatively modest employment elasticity of growth indicates that the composition of industrial growth matters. Policies should encourage labor-intensive industrialization where feasible, particularly in districts with abundant labor resources. Investment incentives could be structured to favor sectors with higher employment potential, and support for small and medium enterprises (which tend to be more labor-intensive) should complement large industry promotion.

Third, the strong effect of labor force participation on employment opportunity highlights the importance of supply-side policies. Improving access to education and vocational training, addressing barriers to female labor force participation, enhancing labor market information systems, and providing support services (such as childcare) can increase participation and improve matching between workers and jobs. Fourth, the negative relationship between unemployment and employment opportunity underscores the need for targeted interventions in districts with high unemployment rates. Place-based policies, including infrastructure development, investment promotion in lagging regions, and active labor market programs, can help address spatial disparities in employment outcomes. Fifth, the significant variation

across districts (confirmed by the Fixed Effect model's superiority) suggests that uniform provincial-level policies may be inappropriate. Different districts face different challenges and opportunities based on their economic structure, resource endowments, and labor market characteristics. Decentralized policy approaches that allow districts to tailor interventions to local conditions while maintaining alignment with provincial development objectives are warranted.

Study Limitations and Future Research Directions

This study has several limitations that suggest directions for future research: First, the analysis uses data at the district/city level, which may mask important heterogeneity within districts. Future research using firm-level or household-level data could provide deeper insights into the mechanisms linking growth and employment. Second, the time period (2018-2022) includes the COVID-19 pandemic years, which may have disrupted normal economic relationships. While the panel approach helps control for time-specific shocks, the findings might differ in non-pandemic periods. Future research could extend the time series as more recent data becomes available. Third, the study focuses on formal large and medium industries, potentially overlooking the role of small enterprises and the informal sector, which employ significant portions of the workforce in North Sumatera. Incorporating these sectors into future analyses would provide a more complete picture. Fourth, the analysis does not explicitly model the role of technological change, which may affect both growth and employment relationships. Future studies could incorporate measures of technology adoption, automation, or digitalization to assess their mediating effects. Fifth, while the instrumental variable approach addresses endogeneity, the instruments' validity depends on the exclusion restriction assumption. Future research could explore alternative instruments or identification strategies, including natural experiments or quasi-experimental approaches.

Conclusion and Implications

Conclusion

This study investigated the simultaneous relationship between economic growth and employment opportunity in 33 districts/cities of North Sumatera Province during the 2018-2022 period using panel data and Two-Stage Least Squares estimation with Fixed Effect models. The main conclusions are as follows:

1. There is a significant simultaneous relationship between economic growth and employment opportunity in North Sumatera Province. Economic growth positively affects employment opportunity (coefficient = 0.107, $p = 0.018$), and employment opportunity positively affects economic growth (coefficient = 0.142, $p = 0.007$). This bidirectional causality confirms that growth and employment are jointly determined and mutually reinforcing.
2. Economic growth is positively and significantly determined by employment opportunity and industrial output. Employment opportunity ($\beta = 0.142$) and industrial output ($\beta = 0.291$) significantly drive economic growth, while industrial labor shows a positive but insignificant effect.
3. Employment opportunity is positively and significantly determined by economic growth and labor force participation rate, and negatively by open unemployment

rate. Labor force participation rate shows the strongest effect ($\beta = 0.589$), followed by economic growth ($\beta = 0.107$) and open unemployment rate ($\beta = -0.402$).

4. The Fixed Effect TSLS model with robust standard errors is the best estimator based on Chow, Hausman, and LM tests, controlling for unobserved heterogeneity across districts and addressing endogeneity through valid and strong instruments.
5. All instruments are valid (Sargan test $p > 0.05$) and strong (first-stage F-statistics > 10), ensuring that the TSLS estimates are consistent and reliable.
6. Classical assumption tests reveal no multicollinearity issues, but heteroscedasticity exists and has been corrected with robust standard errors. Mild autocorrelation in the employment opportunity (EO) equation is addressed with cluster-robust standard errors.

Policy Recommendations

Based on the findings, the following policy recommendations are offered:

1. **Develop integrated growth-employment strategies:** The provincial government should formulate development plans that simultaneously target growth acceleration and employment expansion, recognizing their mutual interdependence. Sectoral development strategies should explicitly consider employment implications.
2. **Promote labor-intensive industrial development:** Investment incentives and industrial policies should favor sectors and technologies with higher employment elasticities. Support for small and medium enterprises, which tend to be more labor-intensive, should be strengthened alongside large industry promotion.
3. **Enhance labor force participation:** Programs to increase labor force participation, particularly among women, youth, and other underrepresented groups, should be expanded. This includes improving access to education and training, providing childcare support, and reducing barriers to formal sector employment.
4. **Address spatial disparities:** Place-based policies targeting districts with low growth, low employment, or high unemployment should be developed, recognizing the significant heterogeneity across regions confirmed by the Fixed Effect model.
5. **Strengthen labor market information systems:** Improved data collection and dissemination on labor market conditions, job vacancies, and worker qualifications can enhance matching efficiency and reduce frictional unemployment.
6. **Coordinate across government agencies:** Effective implementation of integrated growth-employment policies requires coordination among agencies responsible for economic planning, industry, trade, labor, and education.

Recommendations for Future Research

Future research could extend this study by:

1. Incorporating firm-level or household-level data to examine micro-level mechanisms linking growth and employment.

2. Extending the time period and updating the analysis as more recent data becomes available.
3. Including the role of small enterprises and the informal sector in the analysis.
4. Examining the mediating effects of technological change on growth-employment relationships.
5. Exploring alternative identification strategies and instruments to further validate the findings.
6. Conducting comparative studies across provinces to identify contextual factors affecting growth-employment relationships.

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