

The Influence of Inflation, Unemployment, and Economic Growth on Poverty Rate in the Toba Caldera Geopark Region

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Abstract

This study examines the influence of inflation, unemployment, and economic growth on the poverty rate in the Toba Caldera Geopark Region of North Sumatra, Indonesia, covering seven regencies — Toba, Samosir, Simalungun, Karo, Dairi, Humbang Hasundutan, and Tapanuli Utara — over the period 2010–2024. The region gained recognition as a UNESCO Global Geopark in 2020, yet persistent socioeconomic disparities continue to hinder equitable development. Using panel data regression with the Fixed Effect Model (FEM) — selected through Chow and Hausman tests — the study finds that unemployment exerts a positive and statistically significant effect on poverty, while inflation has a positive but insignificant effect, and economic growth has a negative yet insignificant effect. The adjusted R-squared of 0.8317 indicates that the three independent variables explain approximately 83% of the variation in poverty rates across the region. Cross-section fixed effects further reveal notable inter-regency heterogeneity, with Humbang Hasundutan recording the highest poverty coefficient and Simalungun the lowest. These findings underscore the critical importance of employment expansion and inclusive economic growth strategies for poverty alleviation in the Toba Caldera Geopark Region.

Keywords: Poverty Rate; Inflation; Unemployment; Economic Growth; Panel Data; Fixed Effect Model.

1. Introduction

Poverty is a complex and multidimensional development problem, encompassing not only low income but also limited access to education, healthcare, employment, and other economic opportunities. In developing countries, including Indonesia, poverty remains a central challenge requiring serious attention from governments and stakeholders alike. Poverty reduction efforts cannot be separated from macroeconomic dynamics such as inflation, unemployment, and economic growth, which interact to shape the welfare of communities (Mardiatillah et al., 2021; Lusiana et al., 2024).

The Toba Caldera Geopark Region is a strategically significant area in terms of geology, environment, and sociocultural heritage. Formed by ancient volcanic activity that created a massive caldera and Lake Toba — one of the largest volcanic lakes in the world — the region holds exceptional geological value and was officially recognized as a UNESCO Global Geopark in 2020 (Hidayat & Nasution, 2019; Simatupang & Ismanto, 2021). This recognition marked a critical milestone in directing the region toward the integration of geological conservation, environmental protection, and sustainable community economic development.

Administratively, the Toba Caldera Geopark Region encompasses seven regencies: Toba, Samosir, Simalungun, Karo, Dairi, Humbang Hasundutan, and Tapanuli Utara. Each regency has distinct geographic conditions, economic structures, and social characteristics, with communities primarily engaged in agriculture, tourism, trade, and services. Although the development of the geopark is expected to drive regional economic growth through tourism activity and employment creation, poverty and limited employment opportunity remain persistent challenges across several sub-regions.

In the macroeconomic context, poverty levels are significantly influenced by key economic indicators – inflation, unemployment, and economic growth. Inflation, characterized by a sustained general rise in the prices of goods and services, reduces the real purchasing power of households, disproportionately burdening low-income groups who allocate most of their income to basic necessities (Aprilia et al., 2025). Unemployment reflects an imbalance between the labor force and available employment opportunities; higher unemployment rates indicate that a significant portion of the workforce lacks stable income, directly increasing poverty risk (Anggraini et al., 2023). Economic growth, while often regarded as the primary mechanism for reducing poverty by expanding output, employment, and income, does not always guarantee poverty reduction if its benefits are unevenly distributed across society (Adinda & Asmara, 2024).

Despite the growing body of literature on poverty determinants in Indonesia, research specifically examining the combined influence of inflation, unemployment, and economic growth on poverty in the Toba Caldera Geopark Region remains limited. This study aims to fill this gap by employing panel data regression analysis across seven regencies over the period 2010–2024, thereby contributing both theoretical insights into regional poverty dynamics and practical policy recommendations for sustainable development in the Toba Caldera Geopark Region.

Table 1. Poverty Rate (%) in the Toba Caldera Geopark Region, 2010–2024

Year	Toba (%)	Samosir (%)	Simalungun (%)	Karo (%)	Dairi (%)	Humbahas (%)	Taput (%)
2010	12.45	15.62	11.21	10.54	11.76	14.87	13.94
2011	11.98	15.11	10.87	10.13	11.28	14.35	13.42
2012	11.42	14.56	10.41	10.41	10.84	13.92	12.95
2013	10.96	13.98	9.94	9.94	10.36	13.37	12.41
2014	10.43	13.45	9.48	9.48	9.94	12.88	11.97
2015	11.85	11.85	13.20	9.85	12.10	11.40	10.95
2016	11.42	11.42	12.78	9.55	11.70	11.05	10.60
2017	10.98	10.98	12.35	9.25	11.30	10.70	10.25
2018	10.55	10.55	11.90	8.95	10.90	10.32	9.90
2019	10.12	10.12	11.45	8.60	10.50	9.95	9.55
2020	8.71	8.71	12.50	8.70	8.70	9.36	9.37
2021	8.99	8.99	12.70	8.79	8.79	9.65	9.72
2022	8.89	8.89	11.80	8.17	8.17	8.86	8.93
2023	8.04	8.04	11.66	7.98	7.98	8.69	8.54
2024	8.07	8.07	11.63	7.37	7.37	8.44	8.21

Source: BPS Sumatera Utara Dalam Angka (various editions)

Table 1 shows a general declining trend in poverty rates across all seven regencies from 2010 to 2024. Samosir and Humbang Hasundutan recorded the highest poverty rates throughout the observation period, while Karo and Simalungun showed relatively lower levels. A temporary uptick is observed around 2015 and 2020–2021, corresponding to economic shocks and the impact of the COVID-19 pandemic. The overall downward trend suggests gradual socioeconomic improvement, though significant inter-regency disparities persist.

The hypotheses of this study are formulated as follows:

H1: Inflation has a significant effect on the poverty rate in the Toba Caldera Geopark Region.

H2: Unemployment has a significant effect on the poverty rate in the Toba Caldera Geopark Region.

H3: Economic growth has a significant effect on the poverty rate in the Toba Caldera Geopark Region.

2. Literature Review

Poverty

Poverty is understood as a condition in which individuals or households are unable to meet basic needs — food, clothing, shelter, education, and health — as measured by a nationally or regionally established poverty line. The Central Statistics Agency (BPS) of Indonesia defines poverty as the economic inability to fulfill basic food and non-food requirements, assessed through per capita expenditure. Those whose average monthly per capita expenditure falls below the poverty line are categorized as poor (BPS, 2017). Poverty is also understood as a multidimensional phenomenon, encompassing social, political, and structural dimensions beyond mere income deficiency (Basri, 2002; Astuti & Lestari, 2018).

From the perspective of development economics, poverty arises from multiple interconnected causes: inequitable distribution of productive resources at the micro level, low quality of human capital leading to low productivity and wages, limited access to capital reinforcing the vicious cycle of poverty, and structural constraints in economic systems that prevent upward mobility (Kuncoro, 2004; Primandari, 2018).

Inflation

Inflation is defined as a sustained and general increase in the prices of goods and services within an economy, reflecting an imbalance between the flow of money and goods (Muttaqin & Anwar, 2023). When inflation rises while wages remain stagnant, the purchasing power of households declines, and low-income groups — who spend most of their earnings on basic commodities — are most severely affected. Economically, inflation can be classified by severity (mild, moderate, severe, hyperinflation), by cause (demand-pull and cost-push), and by origin (domestic and imported inflation). Theoretically, the Quantity Theory of Money, Keynesian Theory, and Structuralist Theory provide distinct explanations for inflationary dynamics and their consequences for poverty (Ningsih & Andiny, 2018; Batubara et al., 2023).

Unemployment

Unemployment refers to the condition of individuals within the labor force who are actively seeking employment at a prevailing wage rate but have not yet secured a suitable job. It reflects an imbalance between labor supply and the availability of productive employment opportunities (Mahendra, 2016; Novianto, 2018). Types of unemployment include frictional, cyclical, structural, and technological unemployment, each arising from distinct economic mechanisms. High unemployment rates signal that a significant share of the workforce lacks stable income, directly reducing household welfare and increasing poverty risk (Budhijana, 2019; Anggraini et al., 2023).

Economic Growth

Economic growth reflects the expansion of a region's productive capacity over time, typically measured by the growth rate of Gross Domestic Regional Product (GDRP). It is theoretically expected to generate employment, raise household incomes, and improve overall welfare, thereby reducing poverty

(Adinda & Asmara, 2024). Classical growth theories (Adam Smith), neoclassical models (Solow), and endogenous growth theory each offer different explanations of the growth process and its distributional effects. However, the poverty-reducing effect of economic growth is contingent upon the equitable distribution of growth benefits across income groups; growth that primarily benefits higher-income segments may leave poverty levels largely unchanged (Syahputra, 2017).

Conceptual Framework

This study is grounded in the theoretical understanding that poverty is shaped by macroeconomic conditions operating at both the aggregate and regional levels. Inflation erodes real incomes and purchasing power, particularly among low-income households. Unemployment reduces stable income sources for a portion of the labor force, thereby increasing vulnerability to poverty. Economic growth, while expected to reduce poverty through employment creation and income improvements, may have limited impact if growth benefits are unevenly distributed. The conceptual framework therefore proposes three direct relationships: inflation $\rightarrow$ poverty rate (H1), unemployment $\rightarrow$ poverty rate (H2), and economic growth $\rightarrow$ poverty rate (H3), examined simultaneously through panel data regression across seven regencies of the Toba Caldera Geopark Region.

3. Research Methods

This study employs a quantitative approach using panel data regression analysis to examine the influence of inflation (X1), unemployment (X2), and economic growth (X3) on the poverty rate (Y) across seven regencies of the Toba Caldera Geopark Region over the period 2010–2024, yielding a total of 105 observations. The seven regencies — Toba, Samosir, Simalungun, Karo, Dairi, Humbang Hasundutan, and Tapanuli Utara — were selected as they constitute the official administrative area of the Toba Caldera Geopark.

Data were obtained from secondary sources, specifically from the BPS (Central Statistics Agency) of North Sumatra Province through its annual publication Sumatera Utara Dalam Angka (North Sumatra in Figures), covering various editions from 2010 to 2024. All variables are measured in percentage terms: poverty rate (percentage of population below the poverty line), inflation rate, open unemployment rate, and GDRP growth rate.

Three panel data regression models were estimated: the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). Model selection was determined through the Chow Test (CEM vs. FEM) and the Hausman Test (FEM vs. REM). The best-fitting model was subsequently used for hypothesis testing through the t-test (partial effect), F-test (simultaneous effect), and coefficient of determination (R^2). Classical assumption tests — normality (Jarque-Bera), multicollinearity (correlation matrix), and heteroscedasticity (Harvey test) — were conducted to validate the regression assumptions. All data processing was performed using EViews 12.

4. Results

Descriptive Statistics

Table 2. Descriptive Statistics

Variable	Mean	Max	Min	Std. Dev.
Poverty Rate (Y)	10.71	15.62	7.37	1.87
Inflation (X1)	4.33	8.45	1.70	1.71
Unemployment (X2)	3.11	6.35	0.30	1.85
Economic Growth (X3)	4.66	6.54	-1.00	1.57

Source: BPS Sumatera Utara Dalam Angka (various editions), processed

Table 2 presents descriptive statistics for all variables across 105 panel observations. The mean poverty rate across the seven regencies over the study period is 10.71%, with a minimum of 7.37% (Karo, 2024) and a maximum of 15.62% (Samosir, 2010), indicating considerable inter-regency disparity. The average inflation rate is 4.33%, unemployment averages 3.11%, and economic growth averages 4.66% per year.

Model Selection

Table 3. Model Selection Results (Chow Test and Hausman Test)

Test	Statistic	Prob.	Decision
Chow Test	14.7423	0.0000	FEM > CEM
Hausman Test	12.9856	0.0048	FEM > REM

Source: EViews 12 output (processed)

The Chow Test yields an F-statistic probability of 0.0000 (< 0.05), indicating that the Fixed Effect Model is superior to the Common Effect Model. The Hausman Test produces a chi-squared probability of 0.0048 (< 0.05), confirming that the Fixed Effect Model is preferred over the Random Effect Model. Therefore, the Fixed Effect Model (FEM) is adopted as the main model for this study.

Classical Assumption Tests

Table 4. Classical Assumption Test Results

Test	Result	Conclusion
Normality (Jarque-Bera)	Prob. = 0.3814 > 0.05	Normally Distributed
Multicollinearity	Max r = 0.588 < 0.90	No Multicollinearity
Heteroscedasticity (Harvey)	Prob. F = 0.2163 > 0.05	Homoscedastic

Source: EViews 12 output (processed)

All classical assumption tests confirm the validity of the regression model. The Jarque-Bera normality test yields a probability of 0.3814, exceeding the 5% significance threshold, indicating that residuals are normally distributed. The multicollinearity correlation matrix shows a maximum inter-variable correlation of 0.588 (between X1 and X2), well below the critical threshold of 0.90, confirming the absence of multicollinearity. The Harvey heteroscedasticity test produces an F-probability of 0.2163, indicating homoscedastic residuals and confirming the appropriateness of the model.

Fixed Effect Model Regression Results

Table 5. Fixed Effect Model (FEM) Regression Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C (Constant)	4.6575	2.3524	1.9799	0.0511
Inflation (X1)	0.7065	0.4302	1.6424	0.1044
Unemployment (X2)	1.0658	0.1121	9.5050	0.0000
Economic Growth (X3)	-0.0986	0.2508	-0.3930	0.6953
R-squared	0.8635		F-stat	22.27
Adj. R-squared	0.8317		Prob(F)	0.0000

Source: EViews 12 output (processed)

Based on the Fixed Effect Model estimation, the panel regression equation is as follows:

$$Y_{it} = 4.6575 + 0.7065 X1_{it} + 1.0658 X2_{it} - 0.0986 X3_{it}$$

The constant value of 4.6575 indicates that when all independent variables equal zero, the baseline poverty rate is 4.66 percentage points. The coefficient of inflation (X1) is 0.7065 with a probability of 0.1044, indicating a positive but statistically insignificant effect on poverty. The coefficient of unemployment (X2) is 1.0658 with a probability of 0.0000, revealing a positive and highly significant effect. The coefficient of economic growth (X3) is -0.0986 with a probability of 0.6953, showing a negative but insignificant relationship.

The R-squared value of 0.8635 indicates that 86.35% of the variation in poverty rates is explained by the three independent variables and the individual fixed effects. The adjusted R-squared is 0.8317. The F-statistic probability of 0.0000 confirms that the three independent variables simultaneously exert a significant effect on poverty rates across the Toba Caldera Geopark Region.

Cross-Section Fixed Effects

Table 6. Cross-Section Fixed Effect Coefficients

Regency	Fixed Effect Coefficient
Toba	-0.1787
Samosir	1.1483
Simalungun	-1.3800
Karo	-1.1362
Dairi	0.0474
Humbang Hasundutan	1.3784
Tapanuli Utara	0.1209

Source: EVIEWS 12 output (processed)

Table 6 presents the individual fixed effect coefficients for each of the seven regencies, capturing unobserved regency-specific factors not included in the model. Regencies with negative coefficients (Toba, Simalungun, Karo) have poverty rates below the average after controlling for the independent variables, reflecting more diversified economic structures and better absorption of labor. Regencies with positive coefficients (Samosir, Dairi, Humbang Hasundutan, Tapanuli Utara) exhibit higher poverty rates relative to the average, influenced by more limited employment opportunities and greater dependence on traditional agricultural sectors.

Discussion

The Effect of Inflation (X1) on Poverty Rate (Y)

The t-test result shows that inflation has a positive but statistically insignificant effect on the poverty rate ($t = 1.6424$; prob. = $0.1044 > 0.05$), leading to the rejection of H1. Although theoretically inflation erodes household purchasing power and is expected to increase poverty — particularly for low-income groups whose expenditure is concentrated on basic necessities — the finding suggests that inflation levels in the Toba Caldera Geopark Region during 2010–2024 remained within a mild and relatively controlled range. This moderate inflation did not cause a severe enough reduction in real incomes to translate into statistically measurable poverty increases.

Additionally, a significant share of households in the region depend on agriculture, trade, and tourism-related activities, which provide income sources that partially buffer the impact of price increases. The expansion of tourism activity following UNESCO Global Geopark recognition in 2020 also contributed to maintaining household incomes despite inflationary pressures. These findings align with Amalia and Rachmawati (2020), who similarly found a positive but insignificant effect of inflation on poverty, while

contrasting with Novianto and Primandari (2022), who found a significant effect in a different regional context.

The Effect of Unemployment (X2) on Poverty Rate (Y)

Unemployment exerts a positive and highly significant effect on poverty rates ($t = 9.5050$; $\text{prob.} = 0.0000 < 0.05$), confirming H2 and making it the most influential variable in this study. The regression coefficient of 1.0658 implies that a one-percentage-point increase in unemployment is associated with approximately a 1.07-percentage-point increase in the poverty rate, all else equal. This finding strongly aligns with theoretical expectations: unemployment eliminates stable household income, reduces the capacity to meet basic needs, and drives households below the poverty line.

Although the Toba Caldera Geopark Region possesses considerable economic potential in tourism, agriculture, trade, and services, the available employment has not been sufficient to absorb the entire labor force. Structural unemployment and underemployment persist in several regencies, contributing to sustained poverty. The results are consistent with findings by Novianto and Primandari (2022), Budhijana (2019), and Lubis (2023), all of whom reported a positive and significant effect of unemployment on poverty in Indonesian regional contexts. Expanding employment opportunities — particularly by developing the tourism value chain and supporting small-scale enterprises — is therefore critical for poverty reduction in this region.

The Effect of Economic Growth (X3) on Poverty Rate (Y)

Economic growth shows a negative but statistically insignificant effect on the poverty rate ($t = -0.3930$; $\text{prob.} = 0.6953 > 0.05$), leading to the rejection of H3. While the negative direction is consistent with the theoretical proposition that growth reduces poverty through employment creation and income improvement, the lack of statistical significance indicates that economic growth in the Toba Caldera Geopark Region has not been sufficiently inclusive to generate measurable poverty reduction. Growth benefits appear concentrated in sectors with limited distributional reach, such as tourism and formal trade, leaving large segments of the population — particularly those in subsistence agriculture — relatively unaffected.

The COVID-19 pandemic further disrupted economic activity during 2020–2021, particularly in tourism — one of the key sectors of the region — temporarily reversing growth gains. Post-pandemic recovery, while underway, requires time before translating into broad-based poverty improvements. These findings differ from Amalia and Rachmawati (2020), Budhijana (2019), and Lubis (2023), who documented a significant negative effect of economic growth on poverty. The divergence suggests that poverty alleviation in the Toba Caldera Geopark Region requires not only aggregate growth but also deliberate inclusive growth policies targeting income distribution and access to economic opportunities for low-income communities.

5. Conclusion

This study examined the influence of inflation, unemployment, and economic growth on the poverty rate in the Toba Caldera Geopark Region across seven regencies over the period 2010–2024, using panel data regression with the Fixed Effect Model. The main findings can be summarized as follows.

Inflation has a positive but statistically insignificant effect on the poverty rate. Although inflationary pressures theoretically reduce purchasing power and increase poverty vulnerability, the controlled and mild inflation levels in the region, combined with diverse income sources, have prevented a statistically significant poverty response. Unemployment has a positive and highly significant effect on poverty, confirming that employment expansion is the most critical lever for poverty alleviation in the Toba Caldera Geopark Region. Economic growth has a negative but insignificant effect on poverty, reflecting the non-

inclusive nature of regional growth that has yet to deliver broad welfare improvements to low-income communities.

Based on these findings, regional governments are recommended to prioritize labor absorption strategies through the development of tourism value chains, agribusiness, and small-to-medium enterprises; to maintain price stability through improved distribution and market monitoring; and to pursue inclusive economic growth policies that ensure the benefits of development reach all income groups, particularly in rural and peripheral areas. Future research should consider incorporating additional variables such as the Human Development Index, education levels, government expenditure, and regional investment to provide a more comprehensive understanding of poverty determinants in this strategically important region.

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