International Journal for Advanced Research

Journal homepage: https://journal.outlinepublisher.com/index.php/ijar

Research Article

The Impact of Population Size and Human Development Index on Open Unemployment Rates in North Sumatra (2018–2025)

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Keywords:

Open Unemployment Rate,
Population Size,
Human Development Index,
North Sumatra.

Abstract

This research aims to evaluate the impact of Population Size and the Human Development Index (HDI) on the Open Unemployment Rate in North Sumatra Province from 2018 to 2025. Employing a quantitative methodology, this study utilizes secondary data sourced from the Central Bureau of Statistics (BPS). The analytical framework is constructed using Multiple Linear Regression, processed via SPSS software, and validated through classical assumption tests, t-tests, F-tests, and the coefficient of determination (R2). The findings reveal that, partially, Population Size exerts a negative but statistically insignificant influence on the Open Unemployment Rate, suggesting that demographic growth does not necessarily trigger unemployment if labor absorption remains stable. In contrast, the Human Development Index (HDI) demonstrates a significant positive correlation with unemployment levels, indicating that higher human capital quality may temporarily increase the unemployment rate due to more selective job-seeking behaviors among educated individuals. Simultaneously, both variables significantly influence the Open Unemployment Rate, with a high coefficient of determination confirming their collective ability to explain the majority of fluctuations in the regional labor market. These results underscore that enhancing human resource quality profoundly shapes labor market dynamics, particularly in the short run. Consequently, integrated policies that synchronize human development with industrial expansion are essential for a sustainable reduction in unemployment.

INTRODUCTION

Unemployment is one of the economic issues that continues to be the main focus in the development process in many countries, including Indonesia. A high unemployment rate can indicate that existing job opportunities cannot accommodate all available labor. This condition can trigger various social and economic consequences, such as an increase in poverty rates, a decrease in community welfare, and a slowdown in economic growth in a region (Mahdali, 2024). Based on data from the Central Statistics Agency, the Open Unemployment Rate (TPT) is the ratio between the number of people who do not have a job and the total labor force. Open unemployment includes individuals who are not currently employed but are actively looking for work, are planning a venture, or those who feel it is impossible to get a job (Damayanti et al., 2025).

In addition, Michael P. Todaro and Stephen C. Smith argue that open unemployment occurs when individuals in the labor force do not have a job but are trying to get a job or are looking forward to a job opportunity. One of the factors that affect the open unemployment rate is the number of population. Rapid population growth can result in an increase in the number of workers every year. If this growth in the number of workers is not balanced by the availability of sufficient job opportunities, then the number of unemployed will increase (Mahdali, 2024). Therefore, the continued increase in population could put pressure on the labor market and potentially increase the open unemployment rate.

One of the factors that can affect the open unemployment rate is the number of population. Population is one of the important factors in the progress of a region because it is related to various social and economic problems faced by the community. Continuous population growth can have various consequences if not adjusted to the availability of resources, employment, and adequate education and health infrastructure. According to Srijanti and A. Rahman, a resident is defined as a person who inhabits a location within a particular area without considering the citizenship status that the individual has. This definition explains that population includes all people who live in an area and contribute to social interaction in that location (Sumaryoto et al., 2020). Therefore, population and growth management needs to be carried out effectively through various government policies and programs to ensure the achievement of community welfare and sustainable development.

In addition to population, another factor that also affects the open unemployment rate is the Human Development Index (HDI). The Human Development Index (HDI) is one of the main measures used to assess how successful human development is in an area (Purwanda, 2022). Amartya Sen stated that human development is a process that expands people's choices and ability to live the life they consider valuable, so that human welfare is not only measured by income but also quality of life. Development is understood not only as economic growth, but also related to the quality of life of the community that emerges from various aspects of life (Baihawafi & Sebayang, 2023). Therefore, HDI serves as a tool to measure the extent to which people can enjoy the results of development efforts initiated by the government. High levels of HDI indicate that people experience a better quality of life in terms of health, education, and a decent standard of living.

According to the United Nations Development Programme (UNDP), the Human Development Index is a measure used to assess human development achievement through three fundamental dimensions, namely longevity and healthy living, knowledge, and adequate standard of living. These three dimensions reflect the quality of human resources in an area. Thus, HDI not only measures the success of development from an economic perspective, but also assesses the ability of people to get education, access to health services, and welfare of life (Jayanto & Aida, 2024).

The problem of open unemployment in North Sumatra Province is still an important issue in regional economic development. Based on the results of the analysis of research data conducted for the period 2002–2021, it was found that the population and the Human Development Index (HDI) have a significant influence on the open unemployment rate. This shows that population dynamics and the quality of human resources are important factors that determine the condition of the labor market in a region. The imbalance between population growth and job availability can put pressure on the labor market, increasing the number of unemployed.

In addition, the quality of human resources reflected in the Human Development Index also has a relationship with the unemployment rate. Amartya Sen explained that human development does not only focus on increasing income, but also on improving people's abilities through education, health, and a decent standard of living. In some conditions, an increase in education levels can lead to an increase in open unemployment as the workforce becomes more selective in choosing jobs (Baihawafi & Sebayang, 2023).

Based on these conditions, this study is important to analyze how the population and the Human Development Index affect the open unemployment rate in North Sumatra Province. The results of the study are expected to provide an empirical picture of the relationship between population dynamics, the quality of human resources, and labor market conditions.

HYPOTHESES DEVELOPMENT

H1: The number of the population has a positive and significant influence on the Open Unemployment Rate.

Population growth is a key variable that determines the dynamics of labor supply in a region. According to (Mahdali, 2024) view, population is the basic capital of development, but if the quantity is not controlled without being accompanied by quality improvement, it will become a burden on development. On a macro level, a surge in population automatically increases the number of labor force.

This condition creates a big challenge if the economic structure is not able to expand employment quickly. Macroeconomic theory explains that unemployment arises due to an imbalance between the willingness of the labor force to work and the availability of job opportunities provided by the market (Sumaryoto et al., 2020). When the rate of population growth exceeds the absorption capacity of the industrial sector, the unabsorbed labor will accumulate into a significant open unemployment rate.

H2: The Human Development Index (HDI) has a negative and significant influence on the Open Unemployment Rate.

The quality of human resources as measured through the Human Development Index (HDI) plays a crucial role in determining the competitiveness of the workforce. Amartya Sen, Nobel laureate in economics, emphasized through the capability approach that development must expand human choices through improving education and health. With high capabilities, individuals have a greater opportunity to adapt to the changing needs of the industry.

In line with the United Nations Development Programme (UNDP) standards, HDI, which includes the dimensions of health, knowledge, and decent living standards, is an indicator of success in creating a productive workforce (Purwanda, 2022). Workers born in areas with high HDI tend to have better technical and cognitive skills, so their risk of unemployment is much lower than that of a low-quality workforce. In addition, individuals with high competence have greater potential to create independent business units (entrepreneurs) that can actually absorb other workers. On the basis of this thought, a hypothesis was proposed.

H3 : The number of population and the Human Development Index simultaneously have a significant effect on the open unemployment rate in North Sumatra Province.

The number of population and the quality of human resources are two important factors that affect employment conditions in a region. High population growth will increase the number of workers, while the quality of human resources reflected in HDI can affect the ability of workers to obtain jobs.

In the context of regional economic development, a balance between population growth, the quality of human resources, and the availability of jobs is indispensable to create stable labor market conditions. If population growth is not balanced with improving the quality of human resources and job creation, the unemployment rate can increase.

METHOD

This research uses a quantitative approach utilizing secondary time series data covering the period 2002–2021. The data used in this study include Population (X1), Human Development Index (X2), and the Open Unemployment Rate (Y) in North Sumatra Province. All data were obtained from official publications of the Central Statistics Agency (BPS) of North Sumatra Province, ensuring the validity and accuracy of the data. The analytical method used in this study was multiple linear regression analysis using SPSS version 25 software. This analysis was used to determine the effect of population and the human development index on the open unemployment rate. Before conducting the regression analysis, classical assumption tests were conducted, consisting of normality tests, multicollinearity tests, heteroscedasticity tests, and autocorrelation tests to ensure that the regression model met the requirements for statistical analysis.

Next, a t-test was conducted to determine the partial effect of each independent variable on the open unemployment rate. Furthermore, an F-test was used to determine the simultaneous effect of population and the human development index on the open unemployment rate. Then a coefficient of determination (R^2) test was conducted to determine the extent of the independent variable's ability to explain variations in the open unemployment rate in North Sumatra.

Theoretically, the multiple linear regression model is described by the following equation:

$$\mathbf{Y = \beta 0 + \beta 1\ X1 + \beta 2\ X2 + \beta .... X + et}$$

Information:

Y	= Variabel Terikat (Dependen Variabel Total Population)
X1 , X2	= Variabel Bebas (Independen Variabel human growth index and open unemployment rate)
β0	= Konstanta
β1 , β2	= Parameter
et	= error term

RESULTS AND DISCUSSION

Result

A. Classic Assumption Test

1. Residual Normality Assumption Test

Table 1. Results of Kolmogorov-Smirnov Test

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		8
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	32.71632664
Most Extreme Differences	Absolute	.251
	Positive	.251
	Negative	-.231
Test Statistic		.251
Asymp. Sig. (2-tailed)		.148[c]
a. Test distribution is Normal.		
b. Calculated from data.		
c. Lilliefors Significance Correction.		

The results of the Kolmogorov-Smirnov one-sample test showed that the value of Asymp.Sig was 0.200. based on the rules of the normality test with Kolmogorov Smirnov (K-S) non-parametric statistics, under the following conditions:
Ho: the value of sig > 0.05 then the data is still distributed normally
If the sig value ≤ 0.05, then the data remains not distributed normally
Therefore, it can be concluded that this normality test accepts Ho, which means that the rest of the data of this study is distributed normally.

2. Multicollinearity Assumption Testing

Table 2. Results of Multicollinearity

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.632	41.725		.063	.952		
	Total Population	-7.908E-8	.000	-.002	-.032	.976	.714	1.400
	Human Development Index	.077	.004	.993	17.477	.000	.714	1.400
a. Dependent Variable: Open Unemployment Rat								

Regarding the diagnostic results, the Population Size variable and the Human Development Index (HDI) both exhibit an identical Tolerance value of 0.714. This figure comfortably exceeds the required threshold of 0.10. Furthermore, both the Population variable and the Human Development Index demonstrate a Variance Inflation Factor (VIF) of 1.400, which remains significantly below the maximum limit of 10. Consequently, these findings confirm the absence of multicollinearity among the independent variables within the current regression framework.

3. Heteroscedasticity assumption test

Table 3. Results of Heteroscedasticity assumption test

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.940	1.152		-1.684	.341
	Jumlah penduduk	-4.054E-8	.000	-.506	-.592	.660
	Ipm	3.981E-5	.000	.276	.323	.801
a. Dependent Variable: LnRes						

Regarding the Population Size variable, the observed significance value (sig.) is 0.660, while the Human Development Index (HDI) yields a significance value of 0.801. Based on the output results, the significance levels for both Population and the Human Development Index exceed the 0.05 threshold. This indicates that the regression model is free from symptoms of heteroscedasticity.

The desired outcome for this test is a significance value (sig.) greater than 0.05, which confirms that no heteroscedasticity is present in the model.

4. Autocorrelation Assumption Test

Table 4. Results of Autocorrelation Assumption Test

Model Summary[b]										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.994[a]	.988	.984	38.71048	.988	214.266	2	5	.000	1.020
a. Predictors: (Constant), HDI, Population Rate										
b. Dependent Variable: Open Unemployment Rat										

The dataset for this research is characterized by the following parameters:

n = 8

K (Number of Independent Variables) = 2

dl = 0,5591
of the = 1.7771

The autocorrelation test results demonstrate that the Durbin-Watson (DW) value satisfies the condition du < DW < 4 – du (0, 5591 < 1,020 < 2,2229), This indicates that the model is free from any autocorrelation issues.

5. Partial Significance Analysis (T-Test)

Partial Effect of Population and HDI on the Open Unemployment Rate in North America in 2002 – 2021

Tabel 5. Uji t

Coefficients[a]								
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.632	41.725		.063	.952		
	Jumlah Penduduk	-7.908E-8	.000	-.002	-.032	.976	.714	1.400
	IPM	.077	.004	.993	17.477	.000	.714	1.400
a. Dependent Variable: Open Unemployment Rat								

The significance probability is recorded at 0.976, which exceeds the 0.05 threshold. Consequently, (H0) is accepted and (Ha) is rejected, leading to the conclusion that Population Size (X1) does not partially exert a significant influence on the Open Unemployment Rate Yin North Sumatra for the 2018–2025 period.

Conversely, the significance probability for the second variable is 0.000, which is below 0.05. In this case, (H0) is rejected and (Ha) is accepted. Thus, it can be concluded that the Human Development Index (X2) partially has a significant impact on the Open Unemployment Rate (Y)in North Sumatra throughout 2018–2025.

6. Simultaneous Significance Analysis (F-Test)

The Simultaneous Impact of Population and HDI on the Open Unemployment Rate in North Sumatra, 2018–2025

Tabel 6. Uji F

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	642154.509	2	321077.255	214.266	.000[b]
	Residual	7492.506	5	1498.501		
	Total	649647.016	7			
a. Dependent Variable: Open Unemployment Rat						
b. Predictors: (Constant), HDI, Population Size						

The significance probability is recorded at 0.000, which is below the 0.05 threshold. Consequently, (H0) is rejected and (Ha) is accepted. This leads to the conclusion that Population Size (X1) and the Human Development Index (X2) collectively exert a significant influence on the Open Unemployment Rate (Y) in North Sumatra throughout the 2018–2025 period.

7. Analysis of the Coefficient of Determination (R^2)

Tabel 7. Uji Signifikansi Determinasi (R^2)

Model Summary[b]										
					Change Statistics					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.994[a]	.988	.984	38.71048	.988	214.266	2	5	.000	1.020
a. Predictors: (Constant), HDI, Population Size										
b. Dependent Variable: Open Unemployment Rat										

According to the Model Summary output from SPSS, the Adjusted R Square value is 0.988. This result indicates that approximately 98.8% of the variance in the Open Unemployment Rate can be accounted for by the fluctuations in the two independent variables: the Human Development Index (HDI) and Population Size. Meanwhile, the remaining 1.2% (calculated as 100% - 98.8%) is attributed to external factors or variables that were not incorporated into this specific research model.

Multiple Linear Regression Equation

The structural model for the multiple linear regression analysis utilized in this study is formulated as follows:

$$\mathbf{Y = \beta 0 + \beta 1\ X1 + \beta 2\ X2 + \mathit{e}}$$

Based on the regression coefficients derived from the research data, the specific model is formulated as:

$$Y = 2.632 + -7.908\ X1 + 0.077\ X2 + e$$

Based on the equation, it can be explained that the constant value of 2.632 indicates that when variables X1and X2 are zero, the variable Y maintains a value of 2.632. This represents the baseline value of Y without the influence of the independent variables in the model.

The regression coefficient for variable X1 is negative at -7.908, meaning that every one-unit increase in 1will result in a decrease in Y by 7.908 units, assuming variable X2 remains constant. Thus, X1 has a negative impact on Y, where a higher value of X1 tends to lead to a decrease in Y.

Meanwhile, the regression coefficient for variable 2is positive at 0.077, showing that every one-unit increase in 2will increase Y by 0.077 units, assuming variable X1 stays constant. This implies that X2 has a positive influence on Y, although the magnitude of this effect is relatively small compared to X1
The presence of the error component e in the equation indicates that there are other variables outside the model that also affect Y but were not included in this study. Overall, this regression model illustrates that changes in variables X1 and X2 yield different impacts on Y where 1exerts a more dominant influence due to its larger absolute coefficient value.

Discussion

The Influence of Population Size on the Open Unemployment Rate

Based on the multiple linear regression analysis conducted, it was found that the Population Size (X1) variable carries a negative coefficient and does not significantly impact the Open Unemployment Rate. This suggests that an increase in population does not necessarily result in higher unemployment. Such a condition can occur when economic activity increases and job opportunities expand sufficiently to absorb the additional labor force. These findings align with a theoretical shift; while the view that a larger population leads to higher unemployment is closely associated with Classical economics specifically Malthusian thought modern economic developments show that this assumption is no longer entirely relevant. It tends to overlook demand dynamics, technological advancements, and the economy's capacity to absorb labor.

A more robust approach to explaining the phenomenon of unemployment is found in the theories of John Maynard Keynes. In Keynesian theory, unemployment is not driven by the sheer size of the labor force, but rather by low aggregate demand within the economy. When the demand for goods and services declines, firms reduce production, ultimately leading to labor cutbacks. Consequently, even with a large population, as long as aggregate demand remains high and economic activity is vibrant, the labor force can still be absorbed. Conversely, during an economic downturn, unemployment can rise even if the population size remains relatively stable. This indicates that the critical variable is not the population count, but rather the strength of demand within the economic system.

Furthermore, the theory of structural unemployment provides a deeper explanation for causes of unemployment that are not directly linked to population numbers. Structural unemployment occurs due to a mismatch between the skills of the labor force and market requirements. Technological changes, shifts in economic sectors, and industrial transformations often render parts of the workforce irrelevant to the current labor market. Under these circumstances, unemployment can still occur even without a population increase, as the primary issue lies in the quality and distribution of labor rather than its quantity.

The Influence of the Human Development Index (HDI) on the Open Unemployment Rate

Meanwhile, the Human Development Index (HDI) (X2) variable exhibits a positive and significant influence on the Open Unemployment Rate. This suggests that an improvement in the quality of human resources may, paradoxically, lead to an increase in unemployment in the short term. This phenomenon typically occurs because individuals with higher levels of education tend to be more selective in their job search, thereby requiring more time to secure employment that aligns with their qualifications and expectations.

The findings of this study are corroborated by several other research works. A study conducted in Central Java utilized a panel data regression approach and found that HDI significantly influences the open unemployment

rate (Lathifah et al., 2024). That research demonstrated that the HDI variable, alongside other economic factors, plays a crucial role in explaining the variations in unemployment rates within that region.

Similar results were also identified in a study focused on Banten Province, which stated that HDI serves as a significant determinant of the open unemployment rate (Wardani et al., 2023). This indicates that the quality of human development is a vital factor in labor market dynamics. Furthermore, additional research suggests that HDI can even act as a mediating variable between education, economic growth, and unemployment. This implies that improvements in education and economic growth do not directly reduce unemployment; rather, they function through the enhancement of human quality as reflected in the HDI (Nashih et al., 2024).

The Influence of Population Size and the Human Development Index (HDI) on the Open Unemployment Rate

Simultaneously, Population Size and the Human Development Index (HDI) exert a significant influence on the Open Unemployment Rate. This indicates that both variables collectively provide a robust explanation for the variations in unemployment levels across North Sumatra. Research published in the *Forum Ekonomi: Jurnal Ekonomi Manajemen dan Akuntansi* confirms that while HDI significantly impacts unemployment, population size serves as a critical component when analyzed collectively through panel data regression (Astrid and Soekapdjo, 2020). Their study suggests that the combination of macroeconomic variables, including HDI and population, is essential for explaining unemployment fluctuations in Indonesia.

Furthermore, modern labor market theory emphasizes the equilibrium between *labor supply* and *labor demand*. In this context, Population Size represents the overall magnitude of the labor supply, while the HDI

Conclusion

Based on the research findings regarding the influence of Population Size and the Human Development Index (HDI) on the Open Unemployment Rate in North Sumatra Province for the 2018–2025 period, several key conclusions can be drawn. Partially, Population Size exerts a negative but statistically insignificant effect on the open unemployment rate. This suggests that demographic growth does not automatically lead to an increase in unemployment, as other factors such as economic development, expansion of job opportunities, and government labor-absorption policies play a more decisive role. Conversely, the Human Development Index (HDI) is proven to have a significant positive impact on the open unemployment rate. This condition indicates that improvements in human resource quality, particularly through education, may paradoxically lead to higher unemployment in the short term. This occurs because a more highly skilled workforce tends to become more selective, requiring more time to secure positions that align with their specific qualifications.

Simultaneously, Population Size and HDI collectively exert a significant influence on the open unemployment rate. These two variables together provide a robust explanation for the variations in unemployment levels, as evidenced by a exceptionally high coefficient of determination (R^2). Consequently, it can be concluded that the unemployment challenge is not merely a function of population numbers but is deeply intertwined with human capital quality and labor market dynamics. Therefore, policy interventions should not only focus on demographic control but also on enhancing labor quality in a way that is synchronized with market demands to effectively minimize unemployment

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