

ANALYSIS OF DETERMINANTS OF UNEMPLOYMENT RATES IN REGENCIES/CITIES IN WEST JAVA PROVINCE

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Abstract

Unemployment serves as a key indicator of labor market conditions and regional economic performance. This research assesses variations in unemployment rates across the pre-pandemic, pandemic, and post-pandemic periods while comparing unemployment patterns in rural and urban settings. It further examines how education level, technology utilization, health level, and investment influence unemployment, with particular emphasis on whether education level moderates the relationship between investment and unemployment. The analysis uses panel data comprising 216 observations and applies the Fixed Effect Model, complemented by ANOVA, independent-samples t-tests, F-tests, t-tests, and Moderated Regression Analysis (MRA). The analysis reveals that unemployment rates differed significantly across the pre-pandemic, pandemic, and post-pandemic periods, with additional disparities observed across rural and urban areas. Furthermore, the explanatory variables jointly exert a statistically significant influence on unemployment. Partially, education level has a negative and significant effect on unemployment, whereas technology utilization has a positive but insignificant effect. Health level and investment both exhibit negative but insignificant effects. Moreover, education level does not significantly moderate the effect of investment on unemployment. These results suggest that although education contributes to reducing unemployment, it has not been statistically proven to strengthen the impact of investment in reducing unemployment.

Keywords: Education, Technology, Health, Investment, Unemployment.

INTRODUCTION

The unemployment rate is a crucial indicator of labor market performance and regional economic development, as it reflects the imbalance between labor supply and demand (Chakravorty et al., 2023; Borjas, 2024). Over the past decade, global labor markets have undergone substantial changes due to rapid digitalization, automation, structural shifts in production, and increasing capital mobility. The transition toward technology-based employment has altered labor demand and the skills required by employers, creating new challenges in providing decent employment opportunities (Wahyuni & Hidayati, 2025). These changes intensified during the COVID-19 pandemic as digital work arrangements expanded, while sectors requiring direct physical interaction

experienced significant employment losses (Battisti et al., 2022). Similarly, Dang et al., (2023) found that the pandemic increased unemployment, reduced job quality, and weakened wages due to disruptions in economic activity and production. Consequently, developing countries, including Indonesia, continue to face challenges in expanding employment opportunities and improving labor absorption (Davis et al., 2026).

In the post-pandemic period, Indonesia's labor market recovery has progressed more slowly than the broader economic recovery due to weakened labor absorption and changing employment structures and skill requirements (Handayani, 2024; Sugiharti et al., 2025). Unemployment therefore represents not only a labor market issue but also a constraint on economic development through its effects on productivity, household income, and social welfare Todaro & Smith (2015).

From the perspective of classical economic theory, unemployment is considered a temporary phenomenon because market mechanisms are expected to restore equilibrium through the interaction of labor supply and demand with limited government intervention. Wage flexibility enables labor markets to adjust, as declining wages can encourage firms to increase labor demand and eventually move the economy toward full employment (Smith, 1776). Labor market flexibility can therefore support employment creation through adjustments in wages and firms' production decisions (Anderson, 2024). In contrast, Keynes (1936) argued that unemployment is primarily attributable to inadequate aggregate demand rather than labor market rigidities. Weak aggregate demand limits firms' incentives to expand production and recruit workers, allowing unemployment to persist even when wages remain flexible.

Accordingly, unemployment should be viewed as a structural phenomenon shaped by multiple factors, including human capital quality, investment, technological advancement, and population health. These factors influence workers' productivity, employability, and ability to adapt to changing labor market conditions, while economic development is inherently multidimensional and may affect labor absorption across sectors (Guerrero et al., 2023).

West Java Province was selected as the study area because it has consistently experienced a relatively high unemployment rate while also having the largest labor force in Indonesia. Statistics Indonesia (2025) reported an Open Unemployment Rate (OUR) of 6.77% for the province, exceeding the national average of 4.85%. With approximately 39.24 million people aged 15 years and over in 2025, this high unemployment rate represents a substantial socioeconomic challenge. Although West Java is recognized as one of Indonesia's major manufacturing and industrial centers, the expansion of industrial activities has not been accompanied by a proportional increase in labor absorption (Ramadhani & Ananda, 2024). Unemployment disparities also persist across the province's regencies and municipalities, with highly industrialized and urbanized areas such as Bekasi, Bogor, Karawang, and Bandung City generally recording higher rates than predominantly agrarian areas in eastern West Java (Gessan & Tusianti, 2020). Urban areas also tend to record higher unemployment than rural areas, reflecting differences in labor market

structures, urbanization, and employment competition (Utomo & Prajanti, 2022). Figure 1 presents the administrative boundaries of the 27 regencies and municipalities that constitute the units of analysis.



Figure 1. Study Area of West Java Province, Indonesia

Source: Statistics Indonesia, 2020

Unemployment dynamics in West Java have become increasingly complex across the periods preceding, during, and following the COVID-19 pandemic. Before the pandemic, the industrial, trade, and service sectors accounted for a substantial proportion of labor absorption. However, pandemic-related restrictions disrupted production, reduced demand for goods and services, and constrained employment opportunities across various sectors. Following the pandemic, economic activity gradually recovered, but labor absorption increased more slowly than economic output, indicating changes in employment structures and labor absorption patterns (Qotrunnida et al., 2024; Herawaty et al., 2025).

Human Capital Theory, developed by Becker (1975), views education as an investment that increases workers' productivity, skills, adaptability, and competitiveness, thereby reducing the risk of unemployment. Education also develops knowledge, work experience, and individual capabilities that improve labor market outcomes (Oya & Schaefer, 2023). Health is also an important component of human capital, as individuals with better health conditions tend to be more productive and have greater opportunities to participate in employment (Clark, 1899; Brown et al., 2023).

From a labor market perspective, Labor Demand and Supply Theory explains unemployment as a consequence of an imbalance between the supply of labor and the demand for workers (Marshall, 1890). Technological development affects labor market dynamics through improvements in production efficiency and productivity, while digital skills support workers' adaptation to changing labor market requirements and the growing digital economy (Jambadu et al., 2024; Luz et al., 2023; Gomez-gonzalez et al., 2023). Endogenous Growth Theory suggests that technological progress promotes

productivity and economic growth but may also create skill mismatches when workers cannot adapt to technological change (Romer, 2018). Meanwhile, Investment Theory suggests that increased investment expands production capacity, stimulates economic growth, and creates employment opportunities, while investment allocates productive resources to generate future economic returns (Phillips, 2000; Waroux & Kronenburg, 2025).

Previous studies have consistently identified education, technology, health, and investment as key determinants of unemployment. Higher educational attainment improves labor quality and employment opportunities (Hanafi & Wenagama, 2024), while technological advancement influences unemployment through productivity and changing labor skill requirements (Romer, 2018). Better health conditions can promote labor force participation and employment opportunities (Herdiwiguna & Fadli, 2025). Investment also contributes to reducing unemployment through job creation, expanded employment opportunities, and improved productivity (Maluleke, 2024; Wang et al., 2024; Mawuli & Amedanou, 2026).

Existing research has explored the relationship between unemployment and factors such as education, technology, health, and investment. Nevertheless, most studies have focused on these determinants individually rather than examining them within an integrated framework. Studies simultaneously comparing unemployment across the pre-, during-, and post-pandemic periods, examining rural–urban differences, and assessing the moderating role of education in the investment–unemployment relationship remain limited. Research integrating these temporal, spatial, and socioeconomic dimensions at the regency and municipality levels in West Java Province is also scarce. These limitations indicate a substantial research gap and emphasize the need for a more comprehensive examination of unemployment dynamics.

Based on these research limitations, the present study extends the literature by combining temporal, spatial, and socioeconomic perspectives in one analytical framework using panel observations from regencies and municipalities in West Java Province. Specifically, it examines the simultaneous and partial effects of education level, technology utilization, health status, and investment on unemployment, as well as the moderating role of education in the investment–unemployment relationship. Accordingly, this study aims to compare unemployment trends across the pre-pandemic, pandemic, and post-pandemic periods; assess disparities in unemployment across rural and urban settings; examine the joint and individual effects of education level, technology utilization, health status, and investment on unemployment; and determine whether education level moderates the relationship between investment and unemployment.

METHOD

A quantitative research approach was adopted, incorporating both associative and comparative designs to investigate the determinants of unemployment and differences in unemployment conditions across periods and geographical areas in West Java Province (Sugiyono, 2019). The unemployment rate was the dependent variable, education level,

technology utilization, health status, and investment were the independent variables, and education level was also examined as a moderating variable.

West Java Province, consisting of 27 regencies and municipalities, was selected as the study area because it has the largest population in Indonesia and continues to experience one of the highest unemployment rates nationwide. In 2025, the province's population reached approximately 50.75 million, making it an appropriate setting for investigating the factors associated with regional unemployment. The analysis relied on secondary panel data covering the 2018–2025 period. These data were compiled from Statistics Indonesia (BPS) for West Java Province, the West Java Open Data Portal, the Department of Manpower and Transmigration (DISNAKERTRANS), the Regional Information and Documentation Management Office (PPID), and the Department of Investment and One-Stop Integrated Services (DPMPTSP). Yuliarmi & Marhaeni (2019), secondary data are appropriate for quantitative research because they provide reliable information that has been systematically collected and documented.

Data were collected through non-participant observation and documentation. According to Creswell (2012), non-participant observation allows researchers to examine research phenomena without directly participating in the activities of the subjects under investigation. The quantitative data comprised unemployment rates, education levels, technology utilization, health status, and investment across the 27 regencies and municipalities. Meanwhile, qualitative information obtained from books, scientific journals, and other academic publications was used to reinforce the theoretical foundation and support the interpretation of the research findings (Sugiyono, 2022).

The analysis began with descriptive statistical procedures to summarize the study variables (Sugiyono, 2023). Inferential statistical techniques were subsequently applied to examine the relationships among the variables and evaluate the proposed hypotheses (Gujarati & Porter, 2009). Differences in unemployment rates across time periods and regional classifications were evaluated using comparative analysis. The simultaneous and individual effects of the explanatory variables were then estimated through panel data regression. Finally, moderation analysis was performed to determine whether education level altered the relationship between investment and unemployment.

RESULTS AND DISCUSSION

Research result

1) Analysis of Differences in Unemployment Rates Before, During, and After the COVID-19 Pandemic Using One-Way Analysis of Variance (ANOVA)

Table 1. Results of the ANOVA Test (Test of Between-Subjects Effects)

	<i>Sum of Squares</i>	<i>df</i>	<i>Mean Square</i>	<i>F</i>	<i>Sig.</i>
<i>Between Groups</i>	173.248	2	86.624	18.888	.000
<i>Within Groups</i>	976.873	213	4.586		

Source: Data attached to the author's thesis

Table 1 reports an F-statistic of 18.888, accompanied by a significance value of 0.000 for the between-group effect. Since this probability is lower than 0.05, the observed differences are statistically significant. Accordingly, the null hypothesis is rejected in favor of the alternative hypothesis, confirming that unemployment rates differ significantly across the three periods in the regencies and municipalities in West Java Province.

2) Analysis of Differences in Unemployment Rates Between Rural and Urban Areas Using the Independent Samples t-Test

Table 2. Independent Samples Test Results

	Sig.	t	df	Sig. (2-tailed)
<i>Equal variances assumed</i>	.884	2.667	14	.018
<i>Equal variances not assumed</i>		2.667	13.696	.019

Source: Data attached to the author's thesis

As reported in Table 2, the *Independent Samples t-test* produced a two-tailed *p*-value of 0.018 under the *equal variances assumed* assumption. Because this value is lower than the 0.05 threshold, the null hypothesis was rejected, indicating that the average Open Unemployment Rate (OUR) differed significantly across urban and rural areas.

3) Analysis of the Simultaneous Effects of Education Level, Technology Utilization, Health Status, and Investment on the Unemployment Rate Using the Overall Regression Significance Test (F-Test)

Table 3. Panel Data Regression Results Using the Fixed Effects Model

<i>Variable</i>	<i>Coefficient</i>	<i>Std. Error</i>	<i>t-Statistic</i>	<i>Probability</i>
C	24.77015	8.575142	2.888599	0.0043
Education Level (X1)	-2.281760	0.938904	-2.430237	0.0160
Technology Use (X2)	0.047087	0.039401	1.195082	0.2336
			-	
Health Level (X3)	-0.001920	0.023526	0.081606	0.9350
			-	
LN_Investment (X4)	-0.624301	0.656815	0.950497	0.3431
X4_X1	0.057030	0.087832	0.649315	0.5169
		S.D. dependent		
R-Square	0.760413	var	2.312877	
Adjusted R-square	0.720047	Sum squared resid	275.5546	
		Durbin-Watson		
F-statistic	18.83829	stat	1.170493	
Prob(F-statistic)	0.000000			

Source: Data attached to the author's thesis

Table 3 presents the estimated panel data regression model, which can be written as follows:

$$Y_{it} = 24,770 - 2,281X_{1it} + 0,047X_{2it} - 0,001X_{3it} - 0,624\ln X_{4it} + 0,057(\ln X_{4it} \times X_{1it}) + e$$

Table 3 indicates that the F-statistic produced a probability value of 0.000, which is lower than the 0.05 significance threshold. This result demonstrates that education level, technology utilization, health status, and investment jointly exert a statistically significant influence on unemployment across the regencies and municipalities of West Java Province. Hence, these explanatory variables collectively account for a significant proportion of the variation in regional unemployment rates.

4) Analysis of the Partial Effects of Education Level, Technology Utilization, Health Status, and Investment on the Unemployment Rate Using the Partial Regression Coefficient Significance Test (t-Test)

The estimated coefficients obtained from the partial (t-test) are summarized in Table 3. The results for each explanatory variable are interpreted as follows.

a) Effect of Education Level on Unemployment

Education level exhibited a negative coefficient (−2.282) with a *p*-value of 0.016, indicating a statistically significant inverse relationship with unemployment.

b) Effect of Technology Utilization on Unemployment

Technology utilization produced a positive coefficient of 0.047. However, the corresponding *p*-value (0.234) exceeded the 0.05 significance threshold, suggesting that its effect on unemployment was not statistically significant.

c) Effect of Health Level on Unemployment

The estimated coefficient for health level was −0.002, implying a negative association with unemployment. Nevertheless, the probability value of 0.935 indicates that this relationship was not statistically significant.

d) Effect of Investment on Unemployment

Investment was estimated to have a coefficient of −0.624. Despite the negative coefficient, the *p*-value of 0.343 indicates that investment did not exert a statistically significant influence on unemployment.

5) Moderating Effect of Education Level on the Relationship Between Investment and Unemployment

The Moderated Regression Analysis (MRA) showed that the interaction term between investment (X_4) and education level (X_1) generated a coefficient of 0.057 with a *p*-value of 0.516. Because this probability value exceeded the 0.05 significance level, the interaction effect was not statistically significant. These results indicate that education level did not significantly moderate the relationship between investment and unemployment in the regencies and municipalities of West Java Province.

Discussion

Differences in Unemployment Rates Before, During, and After the COVID-19 Pandemic in the Regencies and Cities of West Java Province

Table 1 shows that the ANOVA produced a probability value of 0.000, which is lower than the 0.05 significance threshold. This result indicates a statistically significant difference in unemployment rates across the periods before, during, and after the COVID-19 pandemic in the regencies and municipalities of West Java Province. The findings suggest that the pandemic influenced labor market dynamics, as evidenced by variations in unemployment rates across the three periods. These differences reflect changes in labor market conditions resulting from disruptions to economic activity during the pandemic and the subsequent process of economic recovery.

Differences in Unemployment Rates Between Rural and Urban Areas in West Java Province

The *Independent Samples t*-test yielded a *p*-value of 0.018 under the *equal variances assumed* condition, indicating statistical significance at the 5% level. Accordingly, the statistical evidence supported rejection of the null hypothesis, demonstrating that unemployment rates differed significantly across rural and urban areas in West Java Province. The descriptive analysis further indicates that urban areas recorded higher unemployment rates than rural areas. This pattern suggests that labor market conditions vary across these settings, as urban areas generally accommodate larger populations and labor forces, resulting in more intense competition for available jobs.

Simultaneous Effects of Education Level, Technology Use, Health Level, and Investment on Unemployment Rates in the Regencies and Cities of West Java Province

The simultaneous test yielded an F-statistic probability of 0.000, indicating statistical significance at the 5% level. Moreover, the calculated F-value (18.838) exceeded the critical F-value (2.41), providing sufficient evidence to reject the null hypothesis. These results indicate that education level, technology utilization, health status, and investment jointly exert a statistically significant influence on unemployment across the regencies and municipalities of West Java Province. The findings further suggest that regional unemployment is shaped by the combined effects of multiple economic and social factors rather than by any single determinant.

Partial Effects of Education Level, Technology Use, Health Level, and Investment on Unemployment Rates in the Regencies and Cities of West Java Province

The estimation results indicate that education is inversely related to unemployment and that this relationship is statistically significant ($\beta = -2.281$; $p = 0.016$). The negative coefficient suggests that greater educational attainment is associated with stronger human capital, improved workforce capabilities, and better access to

employment opportunities. The finding suggests that improved educational attainment enables workers to meet the qualifications demanded by an increasingly competitive labor market. Therefore, enhancing the quality and attainment of education can be considered an important strategy for reducing unemployment in West Java Province. This result is consistent with Human Capital Theory (Becker, 1975), which views education as an investment that increases workers' productivity, knowledge, and skills. It is also in line with Dhewanata & Saskara (2022), who found that higher educational attainment improves labor quality and contributes to lower unemployment rates.

The results in Table 3 further show that technology utilization had a positive but statistically insignificant effect on the unemployment rate ($\beta = 0.047$; $p = 0.233 > 0.05$). This finding suggests that the expansion of internet use has not been sufficiently supported by improvements in digital literacy and workforce competencies, thereby limiting its potential contribution to unemployment reduction. Access to technology alone may therefore be insufficient without the capacity to utilize digital tools effectively and productively within the labor market. This finding is consistent with Labor Demand Theory (Marshall, 1890), which explains that technological advancement can alter labor demand depending on workers' ability to adapt to changing labor market requirements. Thus, technological progress may either increase or decrease labor demand depending on workers' skills and adaptability. The finding is also consistent with (Rismawati et al., 2025; Davani & Sulistyaningrum, 2022), who reported that technology utilization had not significantly reduced unemployment due to limited digital competencies among workers.

According to Table 3, health level had a negative but statistically insignificant effect on the unemployment rate ($\beta = -0.001$; $p = 0.935 > 0.05$). This result indicates that health conditions do not have a direct influence on unemployment, as individuals may remain employed despite experiencing mild or moderate health problems. Employment decisions are also shaped by other considerations, including economic needs, labor market opportunities, and household financial conditions. This finding is consistent with Marginal Productivity Theory (Clark, 1899), which suggests that improved health can enhance worker productivity but does not necessarily determine employment status directly. Accordingly, health may contribute more substantially to improving labor productivity than to increasing employment opportunities. This result is also consistent with (Muhaimin et al. 2023; Sihombing et al. 2025), who found that health status does not have a statistically significant effect on unemployment.

The estimation reveals an inverse relationship between investment and unemployment, although the effect does not reach statistical significance ($\beta = -0.624$; $p = 0.343$). This suggests that higher investment levels have not necessarily translated into substantial employment creation in the study area. Although increased investment tends to be associated with lower unemployment, the effect was not statistically significant. This finding suggests that investment in West Java Province has not yet translated fully into employment creation, partly because a considerable share of

investment is concentrated in capital-intensive industries that require fewer workers than labor-intensive sectors. This result is consistent with the Accelerator Theory of Investment (Phillips, 2000), which states that investment decisions are primarily influenced by changes in output demand rather than by the direct need to increase employment. Consequently, greater investment does not necessarily generate more employment when firms prioritize machinery, automation, and production technology over workforce expansion. This finding is also consistent with (Fitrahwaty et al., 2024; Arizal et al., 2025; Simamora, 2025) who reported that investment does not have a statistically significant effect on reducing unemployment.

The Moderating Effect of Education Level on the Investment–Unemployment Relationship in the Regencies and Municipalities of West Java Province

Table 3 shows that the interaction between education level and investment generated a coefficient of 0.057 with a *p*-value of 0.516. Since the probability value exceeded the 5% significance criterion, the interaction effect was not statistically significant. These findings suggest that differences in educational attainment did not meaningfully influence the impact of investment on unemployment across the regencies and municipalities of West Java Province. Although the estimated interaction coefficient was positive, the absence of statistical significance indicates that this tendency cannot be interpreted as evidence of a moderating effect. Consequently, the hypothesis proposing that education level moderates the influence of investment on unemployment was not empirically supported.

CONCLUSION

1. There were differences in unemployment rates across the pre-pandemic, pandemic, and post-pandemic COVID-19 periods in the regencies and cities of West Java Province.
2. The analysis revealed significant spatial disparities in unemployment rates across West Java Province, where urban areas consistently exhibited higher unemployment rates than rural areas.
3. The findings indicate that education level, technology utilization, health level, and investment collectively exert a statistically significant influence on unemployment rates across the regencies and municipalities of West Java Province.
4. Individually, education level demonstrates a significant negative relationship with unemployment. In contrast, technology utilization shows a positive but statistically insignificant association, whereas health level and investment exhibit negative relationships that are not statistically significant.
5. The estimated interaction between education level and investment was not statistically significant, suggesting that education level did not change the effect of investment on unemployment in the regencies and municipalities of West Java Province.

SUGGESTIONS

Strengthening human capital development should become a policy priority for the government to address unemployment more effectively. Expanding access to quality education and improving educational outcomes can enhance workforce skills and competitiveness, which in turn may contribute to lower unemployment rates across the region.

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