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Original Article

Analysis of the Impact of Unemployment Rates on Economic Growth in Java: The ARDL Panel Approach in Current Economic Dynamics

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Abstract

Economic growth plays an important role in the development of a country and the welfare of its people. One indicator that influences economic growth is the unemployment rate, which can reduce productivity and cause social problems. This research aims to analyze the long-term and short-term effects of unemployment rate, investment, inflation, and Human Development Index (HDI) on economic growth in the provinces of Java Island, as well as to assess the long-term adjustment mechanism (Error Correction Term) in each region. This research uses secondary data analysis with a correlational quantitative approach. The research results show that in the long term, unemployment rate, investment, inflation, and HDI have a significant influence on economic growth. In the short term, the influence between variables differs across provinces: East Java shows significant influence from all variables, Central Java is influenced by unemployment rate, inflation, and HDI, while DKI Jakarta is influenced by unemployment rate and investment. Banten, West Java, and DIY do not show significant influence in the short term. The long-term adjustment mechanism (Error Correction Term) is significant in East Java, but not significant in other provinces. Based on these findings, it can be concluded that macroeconomic variables have different influences across regions in Java Island, with East Java as the province that is most consistent in achieving long-term economic growth stability. The results of this research provide important implications for the formulation of region-based economic policies that consider the differences in characteristics and economic responses across provinces.

Keywords: ARDL Panel, Economic Growth, Unemployment Rate.

1. Introduction

Economic growth is very important for the state and society in terms of the successful economic development of the regions in each province. Economic growth also has an important policy in encouraging sustainable economic growth so that there is no increase in unemployment. In this case, the level of community prosperity can be seen from economic growth (Zahari & Prabowo, 2022). This shows the extent to which economic activity can increase income or community welfare for a given year. Recent global economic challenges, including post-pandemic recovery and increasing economic uncertainty, have heightened the urgency to understand how macroeconomic fundamentals shape regional economic growth (Umeaduma, 2022). This is particularly relevant in developing countries where structural transformation and regional disparities remain significant issues. The level of community prosperity can be seen from economic growth (Zahari & Prabowo, 2022). This shows the extent to which economic activity can increase income or community welfare for a given year (Neumann, 2021; Ugochukwu & Oruta, 2021).

One indicator that plays an important role in economic growth is the unemployment rate. Unemployment can have an impact in the form of reduced productivity, which can lead to social problems (Jeray et al., 2023). High unemployment rates can also undermine public confidence and cause various social problems. As a result, unemployment has a negative impact on the current global economic situation (Irawan et al., 2023).

In addition to unemployment, other macro indicators that affect economic growth are investment (Ucok, 2023). Investment is the mobilization of resources to create or increase future production capacity or income. The main purpose of investment is to replace existing capital. Investment in a region, whether foreign or domestic, will lead to employment and productive manufacturing processes. Furthermore, investment is one of the important or vital variables in the economic activities of every country. In order to create added value through production activities that generate goods and services for domestic marketing and export, investment is needed as an initial sacrifice in economic development planning (Ucok, 2023).

Besides unemployment, another macroeconomic indicator that affects economic growth is inflation. Inflation is an economic condition characterized by a general and continuous increase in the prices of goods and services in an economy over a certain period of time (Maulana & Maulana, 2024). One of the main causes of inflation is high demand compared to the availability of goods and services. When many consumers are willing to pay more to obtain a product or service, producers will usually raise prices in order to obtain greater profits (Maulana & Maulana, 2024).

In addition to disruption, investment, and inflation, other indicators that can affect economic growth are the human development index. The Human Development Index (HDI) is an indicator that describes the level of development based on access expansion, equity, and fairness in the aspects of health, education, and community welfare (Ulyati et al., 2024). HDI plays an important role in the modern economy because better human development enables optimal increases in production capacity. Individuals with good qualities are capable of creating innovations and developing various available factors of production. In addition, high-quality human development also has an impact on population growth, which drives increased consumption, ultimately contributing to economic growth (Efendi et al., 2024). Java was chosen as the focus of this research because it is the economic center of Indonesia, contributing the largest share to the national GDP, yet at the same time faces problems of unemployment, uneven investment distribution, and inflationary pressures. This combination makes Java an ideal case for analyzing how macroeconomic indicators interact to influence regional growth.

The correlation between unemployment rates and economic growth is reinforced by previous studies such as (Arifin, 2021). The effect of HDI and unemployment rate on economic growth in East Java Province The results of the study show that the unemployment rate in East Java from 2016 to 2018 had a negative and insignificant effect on economic growth. This means that high unemployment leads to a decline in the purchasing power of the population (Ramdani et al., 2025). The effect of the Human Development Index, poverty and unemployment on economic growth in East Java Province based on research findings shows that unemployment has a significant positive impact on economic growth. This indicates a process of structural economic transformation, whereby the increase in unemployment is temporary due to the shift of labour from the traditional sector to the modern sector.

An investigation by Azzahra (2024) entitled “the effect of unemployment on economic growth in West Java: the period 2002–2023”, reveal that the unemployment variable indicates that unemployment has no significant effect on economic growth in West Java Province. This indicates that the unemployment rate affects economic growth, which is accelerating. Therefore, if it does not change, economic growth will be comparable to population growth. However, there are also several studies that contradict previous research.

From various findings in previous studies, it can be seen that there are inconsistencies in the influence of macroeconomic indicators on economic growth, particularly unemployment. Some studies show insignificant or even contradictory impacts, while others indicate a strong relationship. Most previous studies use conventional regression models or time-series models, which are limited in capturing short-term and long-term relationships simultaneously. The uniqueness of this study lies in the use of the panel ARDL approach which allows for a more comprehensive analysis of dynamic adjustments across provinces in Java. Therefore, this study provides a theoretical contribution by enriching empirical evidence on the interaction between unemployment, investment, inflation, and the Human Development Index (HDI), while practically providing insights that can support policymakers in designing strategies for inclusive and sustainable regional growth.

2. Methods

2.1. Type and Source of Data

The type of data used is secondary data, obtained from the official website of the Central Bureau of Statistics (BPS). According to Mayasari (2017) secondary data analysis is the process of analyzing existing survey data, which includes interpretation, drawing conclusions, or additional information from other forms. This approach allows research to re-analyze data from a different perspective compared to the initial report.

2.2. Research Approach

This research uses a correlational quantitative approach. The correlational approach aims to determine the relationship between variables without manipulating these variables. In accordance with its principles, correlational research only seeks correlations (r) between variables, whether positive or negative, to assess how strong the relationship is between independent variables (IV) and dependent variables (DV) (Rukminingsih et al., 2020).

2.3. Population and Sample

The research population includes six provinces on Java Island, namely: Banten, DKI Jakarta, West Java, Central Java, DI Yogyakarta, and East Java for the period 2012–2024. This research uses saturated sampling, where the entire population is used as a sample. As noted by Supriadi (2020), saturated sampling is a sampling technique in which all members of the population are used as samples. With the panel data used, the total research sample is a combination of cross-sectional data and time series data, which amounts to 78 samples (6 provinces x 13 years).

2.4. Panel Data

The data used is panel data, which is a combination of cross-sectional data and time series data. Cross-sectional is data from several units (provinces) at one particular point in time, while time series is data from one unit collected over a certain period. With panel data, each cross-sectional unit is observed repeatedly over time, thus allowing for more comprehensive analysis (Fitriani et al., 2024).

2.5. Data Analysis Technique

The data analysis technique used in this research uses panel ARDL. Gujarati (2004) in Fitriani (2024) states that panel data is a combination of cross-section data and time series. Cross-section data is data from one or more variables collected for several individuals at one time. Meanwhile, time series data is data from one or more variables collected over time. So in this panel data, the same cross-section units are collected over time. According to Jannah & Ernawati (2023), the stages or steps in conducting panel ARDL data analysis consist of:

2.5.1. Stationarity Test

This test is the first step in conducting research before confirming the use of the ARDL model because it determines whether the data to be used or analyzed has statistical significance (Jannah & Ernawati, 2023).

$$\Delta y_{it} = \alpha y_{it-1} + \sum \beta_{ij}\, \Delta y_{it-1} + X_{it}\, \delta + v_{it}$$

With the assumption α = 1 – p. The hypothesis can be written as:

$H_o : \alpha = 0$

$H_1 : \alpha = 0$

Conditions:

Where Ho states there is a unit root while H1 states there is no unit root.

2.5.2. Optimal Lag Test

The best lag test is needed to overcome models that cannot accurately estimate the actual error. If too few lags are used, white noise will not be displayed by the residuals and regression. Conversely, if too many lags are used, it will be difficult to reject the null hypothesis because adding too many parameters can reduce the degrees of freedom (Siregar et al., 2024).

2.5.3. Cointegration Test

The appropriate lag length is very important to obtain reliable panel cointegration results. However, the Hansen Fisher (1995) panel cointegration model in Amrullah et al. (2024) follows a vector autoregressive (VAR) process of order p expressed as:

$$\boldsymbol{y_{it} = \alpha_1 + A_1 Y_{it-1} + \cdots + A_\rho y_{it-\rho} + v_{it}}$$

If p-value < 0.05, then Ho is rejected, meaning there is a long-term relationship.

2.5.4. Panel ARDL Model Estimation

According to Amrullah et al. (2024), to determine whether time series data shows short-term and long-term equilibrium, the ARDL model is used.

$$\boldsymbol{\Delta LOG\_PE_{i,t} = y_0 + \sum_{i=1}^{\alpha} y_1\, \Delta LOG\_PE_{i,t-1} + \sum_{i=1}^{\alpha} y_2\, \Delta TP_{i,t-1} + \sum_{i=1}^{\alpha} y_2\, \Delta LOG\_I_{i,t-1} + \sum_{i=1}^{\alpha} y_2\, \Delta INF_{i,t-1} + \sum_{i=1}^{\alpha} y_2\, \Delta IPM_{i,t-1} + \theta ecm_{i,t-1} + \varepsilon_{i,t}}$$

Here, "error correction" is used, and the speed of adjustment when short-term disturbances change into long-term equilibrium. The error correction mechanism (ECM) coefficient is expected to be negative and significant to maintain equilibrium in the long run.

2.5.5. Panel ARDL Estimation Per Cross-section (Region)

By estimating each cross-section individually, the short-term dynamics within each region can be observed.

1) Cross-Sectional Dependence Test

The spatial effect test is needed to ensure whether there are spatial effects in the data. If variables show spatial dependence (Khansa & Widiastuti, 2022).

H0: $\rho_{ij} = 0$, there is no relationship or correlation between units in the model residuals.
H1: $\rho_{ij} \neq 0$, there is a relationship or interdependence between units in the model residuals.
2) T-Test

Referring to Ghozali (2011) in Ramadhanti & Zaini (2021), the t-statistic test shows how far the influence of one explanatory or IV is on explaining other DV. Variables X1 and X2 affect variable Y partially if t-statistic is greater than t-table and t < 0.05.

3. Results and Discussion

3.1. Stationary Test

Table 1. Level and 1st Order Stationarity Tests

Variable	LLC Test		Im, Pesaran And Shint W-Stat		ADF - Fisher Chi-Square		PP - Fisher Chi-Square	
	Level	1st	level	1st	level	1st	level	1st
LoG_PE	0.0011***	0.0000***	0.5204	0.0048***	0.6634	0.0134	0.2885	0.0169**
TP	0.0127**	0.0000***	0.1173	0.0000***	0.2104	0. 0000***	0.2905	0.0000***
LOG_I	0. 0000***	0. 0000***	0.0491*	0. 0000***	0.0543*	0. 0000***	0.3527	0.0000***
INF	0. 0000***	0. 0000***	0.0611	0. 0000***	0.1211	0. 0000***	0.5006	0.0000***
IPM	0.0035***	0. 0000***	0.8872	0.0127**	0.8837	0.0243**	0.7339	0.0164**

Note: 1, 5, 10 significance %

Table 1 results of the LLC Test, Im, Pasaran and Shint W-stat, ADF unit root panel test – Fisher Chi-Square, PP – Fisher Chi-square above shows that LOG_PE, TPT, INF, IPM are stationary at the 1st level, while LOG_I is stationary at the level, indicating a mixture in the ARDL panel and further testing of the optimum lag.

3.2. Optimum lag test

Table 2. Lag Selection

Lag	Logl	LR	FPE	AIC	SC	HQ
0	-565.0028	NA	37.45784	17.8126	17.9813	17.879
1	-45.50393	941.5918	7.30E-06	2.3595	3.371474*	2.75817
2	-9.775939	59.17449*	5.30e-06*	2.024248*	3.87954	2.755141*

Based on the results, all statistical criteria consistently selected lag 2 as the optimal lag because its value was the smallest compared to lags 0 and 1. Criteria such as LR, FPE, AIC and HQ, although SC indicated that this lag provided more accurate prediction results and a more efficient model. Although SC tends to select lag 1, the better model fit based on the majority of indicators makes lag 2 the optimal choice in this study. Next, we conduct a cointegration test.

3.3. Cointegration Test

Table 3. Johansen Fisher Test

Hypothesized No. of Ce (S)	Fisher Stat* (From Trace Test)	Prob	Fisher Stat* (From Max-Eigen Test)	Prob
None	125.8	0.0000	93.52	0.0000
at most 1	63.42	0.0000	44.84	0.0000
at most 2	28.54	0.0046	20.91	0.0517
at most 3	16.9	0.1533	15.52	0.2144
at most 4	16.64	0.1637	16.64	0.1637

Based on the results of the cointegration test in table 3 using the Johansen Fisher model in the trace and maximum eigen value tests, hypotheses 1 and 2 show that all probabilities are less than 0.05. Thus, the cointegration test results provide evidence that there is a significant long-term relationship between the variables. Next is the ARDL panel model estimation test.

3.4. Estimation of the ARDL Panel Model

Table 4. ARDL Model Estimates

Variable	Coefficient	Std. Error	T-Statistics	Prob
Long-Run (Pooled) Coefficients				
TP	-0.006236	1.22E-06	-5100.264	0.0000
LOG_I	-0.089318	2.50E-06	-35699.86	0.0000
INF	0.000812	6.26E-07	1296.013	0.0000
IPM	0.123176	3.86E-07	319436.4	0.0000
C	3.132352	2.58E-05	121289.8	0.0000
Shot-Run (Mean-Group) Coefficients				
COINTEQ	-0.164178	0.145687	-1.126922	0.2644
D(LOG_PE(-1)	0.275445	0.143615	1.917935	0.0600
D(TP)	-0.013505	0.005272	-2.561546	0.0130
D(LOG_I)	0.010628	0.008134	1.306572	0.1965
D(INF)	0.002174	0.001505	1.444043	0.1541
D(IPM)	0.037418	0.025823	1.449012	0.1527

Note: less than 0.05

From the ARDL panel estimation table, the long-term coefficients of all variables TP, LOG_I, INF, and IPM are significant with a P-value < 0.05, supported by a t-table value of 1.66901. This means that statistically and theoretically, these four variables have a significant aggregate effect on LOG_PE economic growth in the long term. In the short term, COINTEQ has a negative coefficient value with a p-value > 0.05, which, based on the correction mechanism, indicates an imbalance in the short term and in the long term. Meanwhile, D(TP) has a significant effect on LOG_PE with a t-stat of -2.5615 < t-table -1.66901, while other variables such as D(LOG_I), D(INF), and D(IPM) are not significant based on either the p-value or the t-test. This indicates that in the short term, changes in the unemployment rate have a direct effect on economic growth, while other variables are more dominant in the long term.

3.5. Cross-section (Region) ARDL Panel Estimation

Table 5. Cross-Section (Region) Test Results

Variable	Banten	Jakarta	West Java	Central Java	DIY	East Java
COINTEQ	0.2004	0.3291	0.6388	0.2184	0.2164	0.0000
D(LOG_PE(-1)	0.3706	0.0070	0.8848	0.8061	0.9419	0.0000
D(TP)	0.2035	0.0134	0.6479	0.0004	0.7472	0.0000
D(LOG_I)	0.9993	0.0159	0.3212	0.6801	0.4598	0.0000
D(INF)	0.4393	0.2894	0.9822	0.0193	0.2017	0.0000
D(IPM)	0.6556	0.9057	0.0734	0.0032	0.3282	0.0000

From the table 5 above, it can be seen that in the short term, none of the variables in Banten, West Java and DIY provinces show a significant influence with a p-value > 0.05. In the Province of Jakarta, there are three statistically significant variables: D(LOG_PE), D(TP), and D(LOG_I). In the Province of Central Java, there are two statistically significant variables:

D(TP) and D(INF), while in the Province of East Java, all independent variables have a statistically significant effect on economic growth.

3.6. Cross-Sectional Dependence Test

Table 6. Cross-Sectional Dependence CD Test

Test	Statistics	Df	Prob
Breusch-Pagan LM	20.60327	15	0.1500
Pesaran Scaled LM	1.023013		0.3063
Blas-Corrected Scaled LM	0.723013		0.4697
Pesaran CD	-0.126829		0.8991

From the table 6 above, it can be seen that all tests show a p-value > 0.05, meaning that there is no correlation or dependence between cross-sectional units in the residual model.

3.7. The Long-Term Effect of Unemployment, Investment, Inflation and Human Development Index on Economic Growth

Since the t-value for all variables is greater than the t-table (1.66901) and the p-value is < 0.05, it can be statistically concluded that these variables have a significant effect on long-term economic growth. This means that in the long term, it indicates that the correlation between long-term unemployment rates has an effect where high unemployment rates can indicate that many individuals are unemployed. Long-term investment has an effect on infrastructure, technology and capital, which can increase production capacity. This will increase the supply of goods and services in the market. In the long term, stable and well-managed inflation can improve economic expectations. Economic actors tend to accelerate consumption and investment in response to expectations of sustained price increases. The HDI also reflects the quality of human resources, which directly affects aggregate demand.

These results are reflective of the findings reported by Oktavia et al. (2024) which show that unemployment, investment, and inflation variables simultaneously have a significant effect on the economic growth of provinces in Indonesia, although partially investment does not always have a direct effect. This strengthens the evidence that in the long term, capital accumulation through investment can increase production capacity, while unemployment rates and inflation play a role in determining growth stability. Growth theory as modified by Mahmoudi & Pingle (2018) also confirms that increased investment contributes to unemployment reduction and drives aggregate output in the long term.

Furthermore, moderate inflation that is well managed can encourage positive expectations among economic actors, whereas extreme inflation actually increases the risk of unemployment and slows down growth, as found in research by Ahn & Nguyen (2025). On the other hand, the quality of human resources reflected through the Human Development Index (HDI) has been proven to have a positive effect on the economic growth of the ASEAN region, indicating that improvements in education, health, and living standards are capable of strengthening labor productivity and long-term innovation.

3.8. Short-Term Effects of Unemployment, Investment, Inflation, and Human Development Index on Economic Growth by Province

From the table above for Banten Province, it can be seen that all variables are insignificant for economic growth in the short term. This reflects that short-term fluctuations have not had a sufficient impact on economic growth in Banten Province. West Java Province also does not show a significant effect because reducing unemployment takes time to increase production in real terms. It also has not had a significant direct effect on economic growth and has not been able to drive aggregate demand.

Based on the above results, in Jakarta Province, unemployment and investment have a negative and positive effect on economic growth, while inflation and HDI have a negative but insignificant effect on economic growth. This means that an increase in the unemployment rate has a negative impact on the dependent variable, which is most likely related to economic growth or aggregate demand, where an increase in unemployment can reduce people's purchasing power and consumption.

Short-term estimation results in West Java Province show that all independent variables, TP, LOG_I, INF, and HDI, have no significant effect, meaning that TP, because reducing unemployment takes time to increase production significantly, and LOG_I has not been able to drive aggregate demand. INF tends to have no real impact on economic growth in terms of changes in aggregate demand, while IPM is close to the significance threshold, indicating that improvements in human quality have the potential to drive aggregate demand growth in the future.

In Central Java Province, three variables show a significant effect on economic growth in the short term. This means that an increase in unemployment directly reduces economic growth, while INF, which reflects moderate inflation, reflects increased demand and economic activity. Meanwhile, IPM shows a very strong positive effect on economic growth. Conversely, investment is not significant, possibly because the effects of new investment are only felt in the medium term.

In the Province of DIY, all variables, namely unemployment rate (TP), investment (LOG_I), inflation (INF), and Human Development Index (HDI), do not show a significant effect on economic growth in the short term. Low coefficients and high p-values indicate that the DIY economy, which is based on education and services, requires more time to respond to changes in these indicators.

The estimation results show that all variables, TP, LOG_I, INF and HDI, have a significant effect on economic growth. This could be due to structural factors in the labour market or the dominance of the informal sector, which masks the impact of unemployment on public consumption. Investment is also a driver of aggregate demand, while inflation shows a slight increase in prices reflecting an increase in demand. Conversely, IPM indicates that human resources drive aggregate demand.

3.9. Long-Term Adjustment Mechanism (Error Correction Term)

A negative and statistically significant ECT coefficient indicates a valid correction to short-term deviations. The greater the absolute value of this coefficient, the faster the adjustment process takes place.

Table 7. Error Correction Estimation

Province	COINTEQ coefficient	T-Statistics	P-Value	Significant
Banten	-0.1024	-1.4743	0.2004	Not significant
DKI Jakarta	0.0329	1.0810	0.3291	Not significant
West Java	-0.0261	-0.4993	0.6388	Not significant
Central Java	0.0252	1.4073	0.2184	Not significant
DI Yogyakarta	-0.0288	-1.5612	0.2164	Not significant
East Java	-0.8859	-39947.19	0.0000	Significant

From the estimation results, only East Java Province showed a statistically significant ECT coefficient, namely -0.8859 with a p-value of 0.0000. A coefficient value close to -1 indicates a very high rate of correction to economic imbalances in the short term. This means that when there is a deviation from the long-term trend, the economic system in East Java is able to adjust itself almost completely within one period. This adjustment efficiency reflects a mature and strong economic structure. Meanwhile, other provinces such as Banten, West Java, and DI Yogyakarta show p-values above 0.05, which means that there is insufficient statistical evidence to indicate a correction to long-term imbalances. Their COINTEQ coefficients are also relatively small and not statistically significant. This indicates that the economic systems in these provinces do not yet have a strong long-term adjustment pattern, or that the long-term imbalances that occur are not consistently corrected within the analysed time period. DKI Jakarta and Central Java show p-values above 0.05, with positive and insignificant ECT coefficient values. Theoretically, a positive sign on the ECT contradicts the basic principle of the error correction model; the positive direction of this coefficient reinforces the indication that the adjustment mechanism to the long-term path is not occurring.

4. Conclusion

Based on the research findings, unemployment rate, investment, inflation, and Human Development Index (HDI) have a significant influence on economic growth in Java Island in the long term, although in the short term the influence differs across provinces. Some provinces show significant influence from all variables, while other provinces are only influenced by some variables or are not even affected in the short term. East Java appears to have a more consistent adjustment mechanism toward long-term economic equilibrium, while other provinces show less significant adjustments, indicating the heterogeneity of macroeconomic variable impacts across regions.

Looking at the findings, it is recommended that provincial governments design economic policies that adapt to the characteristics of each region. Provinces whose macroeconomic variables are less significant need to improve the effectiveness of investment policies, job creation, and inflation control. The implications of this research emphasize the importance of region-based policy approaches, with coordination between unemployment reduction, investment enhancement, inflation control, and human resource quality development, so that each province can achieve more stable and equitable economic growth in Java Island.

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