DETERMINATION OF THE HUMAN DEVELOPMENT INDEX: PANEL DATA ANALYSIS OF PER CAPITA GRDP, OPEN UNEMPLOYMENT RATE, AND HEALTH COMPLAINTS IN JAVA ISLAND 2015-2024

Sri Dewi Miladiyah[1]
UIN Siber Syekh Nurjati, Cirebon, Indonesia
sridewimiladiyah99@mail.uinssc.ac.id

Rosidah[2]
UIN Siber Syekh Nurjati, Cirebon, Indonesia
rosidah@mail.uinssc.ac.id

Tarudi[3]
UIN Siber Syekh Nurjati, Cirebon, Indonesia
tarudiidm38@gmail.com

Syaeful Bakhri[4]
UIN Siber Syekh Nurjati, Cirebon, Indonesia
syaefulbakhri@syekhnurjati.ac.id

Abdul Aziz[5]
UIN Siber Syekh Nurjati, Cirebon, Indonesia
abdul.aziz@uinssc.ac.id

Abstract

Determination of the Human Development Index: Panel Data Analysis of Per Capita GRDP, Open Unemployment Rate, and Health Complaints in Java Island 2015–2024. This study aims to analyze the influence of GRDP per capita, Open Unemployment Rate (TPT), and Health Complaints on the Human Development Index (HDI) in six provinces in Java Island during the period 2015–2024. Using a quantitative approach based on panel data regression analysis, this study processed 60 observation units sourced from the official publication of the Central Statistics Agency (BPS). The results of the model selection test through the Chow Test and Hausman Test determined the Fixed Effect Model (FEM) as the best estimation model. The results of the simultaneous test showed that the three independent variables together had a significant effect on the HDI (F = 641.0955; prob. = 0.0000) with an Adjusted R-squared value of 0.9886, which means that 98.86% of the variation in the HDI in Java Island can be explained by the model. Partially, only GRDP per capita has a positive and significant effect on the HDI (coefficient = 13.3333; prob. = 0.0000), confirming that regional economic capacity is the dominant determinant of human development in Java. Meanwhile, Health Complaints (prob. = 0.6413) and TPT (prob. = 0.5637) do not have a significant effect on the HDI, which is thought to be caused by the subjective-perceptual nature of health variable measurements and the effectiveness of social safety net programs in mitigating the impact of unemployment. This study recommends inclusive and equitable economic growth policies, strengthening primary health services, and optimizing social financial instruments to accelerate the achievement of sustainable human development in Java.

Keywords: Human Development Index, Per Capita GRDP, Open Unemployment Rate, Health Complaints, Panel Data, Fixed Effect Model, Java Island

INTRODUCTION

Human development is a key indicator for assessing a country's success, measured not only by economic growth but also by the quality of life of its citizens, encompassing aspects of health, education, and a decent standard of living. To measure these achievements, the United Nations Development Programme (UNDP) introduced*Human Development Index*The Human Development Index (HDI) is a concise measure encompassing three key dimensions: a long and healthy life, access to knowledge, and a decent standard of living. Prior to the HDI, a country's development level was generally measured solely using economic indicators such as national income, often neglecting the social dimension and quality of life (UNDP, 2023). In Indonesia, the HDI has shown an upward trend year after year, but significant regional disparities remain. For example, the HDI of West Java Province was recorded at 74.24 in 2023 and increased to 74.92 in 2024. However, inter-provincial disparities still exist, requiring serious attention in development policies (BPS, 2024).

In addition to economic factors, labor market conditions are also an important determinant of human development. The Open Unemployment Rate (TPT) reflects the proportion of the labor force that is unemployed. High unemployment rates can impact public welfare by reducing individuals' ability to earn income and meet their living needs. Empirical research shows that unemployment is significantly related to various indicators of public welfare and can indirectly affect the quality of human development by reducing people's purchasing power (Arianto & Cahyono, 2025)..

Furthermore, health factors also play a crucial role in determining the quality of human development. Public health is directly related to workforce productivity and quality of life. A high percentage of the population experiencing health problems can reflect poor public health, which can ultimately reduce productivity and quality of life. Therefore, public health is a crucial aspect of human development because good health enables individuals to participate optimally in economic and social activities.

Several previous studies have analyzed the factors influencing the Human Development Index in Indonesia using various economic and social indicators. However, most studies still use a national scope or all provinces in Indonesia, thus not specifically highlighting the dynamics of human development in specific regions with different economic characteristics (Caniago & Wibowo, 2024). No study has used the HDI as the dependent variable, while simultaneously including GRDP per capita, TPT, and health complaints as three main explanatory variables in a single model at the provincial/district/city level. There are three partial groups: GRDP with morbidity (health) but without TPT (Hadi et al., 2025; Supandi et al., 2022), and GRDP with TPT but without morbidity (health) (Anwar et al., 2025; Nasution, 2019). This research study will fill a clear structural gap such as a provincial HDI model that explicitly combines the economic (GRDP), labor market (TPT), and health (health complaints) pillars in one empirical framework.

Based on these conditions, there remains a research gap regarding the analysis of factors influencing human development in regions with high levels of economic activity, such as Java. A more specific analysis of this region is crucial because Java is the center of national economic activity, contributing significantly to the Indonesian economy, and also because of significant variations in human development levels between provinces.

Therefore, this study aims to analyze the influence of GRDP per capita, open unemployment rate, and health complaints on the Human Development Index in provinces on Java Island during the period 2015–2024 using a panel data approach. This study is expected to provide an empirical overview of the factors that influence human development in areas with high economic activity and can serve as a reference for the formulation of more effective development policies in improving the quality of human resources.

REVIEW OF LITERATURE

The concept of human development was developed by the United Nations Development Programme (UNDP), which places humans as both the ultimate goal and the means of development. Human development is defined as the process of expanding human choices.*(enlargement of choices)*which enables every individual to live a long and healthy life, obtain an education, and achieve a decent standard of living (UNDP, 2023). The Human Development Index (HDI) is a composite index used to measure human development achievements across three main dimensions: health (life expectancy), education (expected years of schooling and average years of schooling), and a decent standard of living (adjusted per capita expenditure).

This theory is rooted in the thinking of Amartya Sen who emphasizes the concept*human capabilities*Human development is defined as the human capacity to function and lead a meaningful life (Garces Velastegui, 2020). In the context of this research, the HDI serves as the primary proxy for human development, influenced by regional economic capacity, labor market conditions, and public health status.

GRDP per capita is a proxy for the average income of a region's population, reflecting purchasing power and access to public services. In economic growth theory, increasing per capita income is expected to drive increased consumption in the health, education, and basic needs sectors, which in turn will improve the Human Development Index (HDI). Empirical evidence shows that economic growth has a positive and significant impact on the HDI, particularly in developing countries.

The Open Unemployment Rate (TPT) reflects the labor market's inability to absorb the existing workforce. A high TPT directly impacts household income, which in turn limits access to education and healthcare and drives poverty (Aryanti et al., 2024). Within the framework of human capital theory (*human capital theory*), unemployment results in inefficient utilization of human resources so that individual contributions to the economy and welfare become suboptimal (Prasetyo, P. Eko; Cahyani, 2022).

Health complaints are an indicator of public health status from the demand side, reflecting the prevalence of health disorders in a population. In Grossman's (1972) health production model, health is viewed as a form of capital (*health capital*) that contribute to individual productivity. Higher levels of health complaints indicate a lower quality of life, which directly impacts the health dimension of the Human Development Index (HDI), particularly life expectancy (Grossman, 2022). Furthermore, high levels of health complaints also reduce productive work hours, increase household health expenditures, and ultimately reduce people's purchasing power (Sanoussi et al., 2024).

RESEARCH METHOD

This research uses a quantitative approach with secondary data in the form of panel data which is of a quantitative nature.*balanced panel*, covering six provinces on the island of Java, DKI Jakarta, West Java, Central Java, DI Yogyakarta, East Java, and Banten for the period 2015 to 2024, resulting in 60 observations. Data sourced from the publication of the Central Statistics Agency (BPS) of the Republic of Indonesia, including: (1) Human Development Index (HDI) as the dependent variable; (2) GRDP Per Capita at constant 2010 prices (in million rupiah); (3) Open

Unemployment Rate (TPT) in percentage; and (4) Percentage of the population experiencing health complaints in the past month. The use of panel data was chosen because it is able to overcome unobserved heterogeneity between individuals (*unobserved heterogeneity*) and increase estimation efficiency compared to single cross-section and time series data (Baltagi, 2021).

The data collection technique used in this study was a documentation study, which involved collecting secondary data through searching official documents published by authorized agencies. Data were systematically collected from BPS publications, including the provincial HDI, Gross Regional Domestic Product of Indonesian Provinces, and People's Welfare Statistics. All data used are annual aggregates at the provincial level. The use of official secondary data sourced from national statistical agencies was deemed to meet adequate validity and reliability standards for scientific analysis (Creswell, J. W., & Creswell, 2022).

There are three estimation approaches commonly used in panel data analysis, namely*Common Effect Model (CEM), Fixed Effect Model (FEM)*, And *Random Effect Model (REM).*To determine the most appropriate model, there is the Chow Test (F-test), Hausman Test (*Hausman Specification Test*), and Test*Breusch-Pagan Lagrange Multiplier*(LM) (Baltagi, 2021).

Before interpreting the regression results, classical assumption tests adapted for panel data are performed, including: Multicollinearity test, using the Variance Inflation Factor (VIF) value. A VIF value > 10 indicates serious multicollinearity that needs to be addressed. Heteroscedasticity test, using*Modified Wald Test*for FEM or test*Breusch-Pagan*for REM. The presence of heteroscedasticity is addressed by estimation*Generalized Least Squares*(GLS) or Robust Standard Error. Autocorrelation test, using the Wooldridge test for panel data. The presence of autocorrelation in panel data can result in biased standard error estimates, invalidating the significance test. Residual normality test, using the Jarque-Bera test. Although the normality assumption is asymptotic in panel data, this test is still performed as part of the model diagnostics (Wooldridge, 2019).

Hypothesis testing in this study was conducted through three stages of statistical testing: the coefficient of determination (R^2), the simultaneous significance test (F test), and the partial significance test (t test), with a significance level (α) of 5%. The coefficient of determination (R^2) test is used to measure the proportion of variation in the dependent variable that can be jointly explained by all independent variables in the model. The R^2 value ranges from 0 to 1; the closer it is to 1, the better the model's ability to explain variation in the dependent variable. The F test aims to determine whether all independent variables together have a significant effect on the dependent variable (Sugiyono & Puji Lestari, 2024). The formulated hypothesis is as follows:

H_0 : $\beta_1 = \beta_2 = \beta_3 = 0$ (variables GRDP ADHK per capita, Health Complaints, and TPT simultaneously do not affect the HDI)

H_1 : at least one $\beta k \neq 0$ (at least one independent variable has a significant effect on HDI)

RESULTS AND DISCUSSION

Before carrying out the estimation, a series of tests were carried out to determine the most appropriate panel data estimation model from three alternatives, namely*Common Effect Model* (CEM), *Fixed Effect Model*(FEM), and*Random Effect Model*(REM). The test results are presented in Table 1.

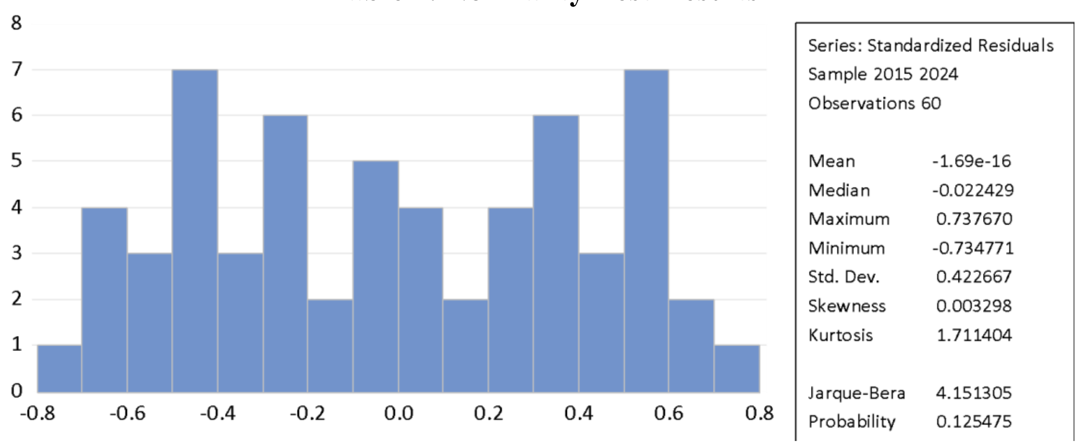
Table 1. Model Selection Results

Test	Test Statistics	Probability	Results
Chow Test (CEM vs FEM)	F-statistic	0,0000 < 0,05	Tolak H_0 → FEM
Hausman Test (FEM vs REM)	Chi-square	0,0000 < 0,05	Tolak H_0 → FEM
Selected Model	*Fixed Effect Model (FEM)*		

Results *Chow Test*shows a probability value of 0.0000 < 0.05, so H_0 which states that CEM is better is rejected and FEM is selected. Next,*Hausman Test*produces a probability value of 0.0000 < 0.05, so H_0 which states that REM is more efficient than FEM is also rejected. Based on these two tests,*Fixed Effect Model (FEM)*was determined as the best estimation model. The selection of FEM indicates that there are specific individual effects in each province that are correlated with the independent variables.

After the selected model is established, classical assumption testing is carried out to ensure the validity and reliability of the estimation results. The normality test is carried out using the*Jarque-Bera*.

Table 2. Normality Test Results



The test results show a Jarque-Bera value of 4.1513 with a probability value of 0.1255 > 0.05. Thus, H_0 is accepted, which means the model residuals are normally distributed.

Multicollinearity testing using values*Variance Inflation Factor*(VIF) shows the following results:

Table 3. Multicollinearity Test Results

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	100.0562	613.2611	NA
X1	0.524744	365.9766	1.354048
X2	0.006099	78.38749	1.442227
X3	0.040232	10.94615	1.135667

VIF X_1 (PDRB ADHK) = 1.354; VIF X_2 (Health Complaints) = 1.442; and VIF X_3 (TPT) = 1.136. All VIF values are well below the threshold of 10, indicating there is no serious linear relationship between the independent variables. Thus, the regression coefficient estimates are not distorted by multicollinearity, and each independent variable's influence can be interpreted independently (Hair et al., 2022).

Heteroscedasticity test using test*Gleyser*using the Prob.Chi-Square value shows the following results:

Table 4. Results of Heteroscedasticity Test

F-statistic	20.91217	Prob. F(3,56)	0.0000
Obs*R-squared	31.70205	Prob. Chi-Square(3)	0.0000
Scaled explained SS	36.15004	Prob. Chi-Square(3)	0.0000

produces a Chi-Square Prob value of 0.000 < 0.05, indicating heteroscedasticity in the model. This condition occurs because the panel data includes provinces with highly heterogeneous economic characteristics, particularly DKI Jakarta, which has a much higher per capita GRDP than other provinces (Gujarati, D. N., & Porter, 2020).

Autocorrelation testing using*Serial Correlation LM Test*(Breusch-Godfrey) produces the following Prob.Chi-Square values:

Table 5. Autocorrelation Test Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.432639	6.229611	-0.711544	0.4798
X1	0.156027	0.446280	0.349616	0.7280
X2	0.043942	0.049132	0.894371	0.3751
X3	0.123277	0.125736	0.980444	0.3312
RESID(-1)	0.820531	0.134960	6.079796	0.0000
RESID(-2)	-0.020891	0.137929	-0.151464	0.8802

R-squared	0.636650	Mean dependent var	7.48E-15
Adjusted R-squared	0.603006	S.D. dependent var	3.048197
S.E. of regression	1.920591	Akaike info criterion	4.237782
Sum squared resid	199.1881	Schwarz criterion	4.447216
Log likelihood	-121.1335	Hannan-Quinn criter.	4.319703
F-statistic	18.92340	Durbin-Watson stat	2.017329
Prob(F-statistic)	0.000000		

This output is the Breusch-Godfrey Serial Correlation LM Test from EViews, with:
(H_0): No autocorrelation up to lag 2
(H_1): There is autocorrelation

The value in prob shows prob. = 0.0000 < α = 0.05, meaning there is no autocorrelation. However, autocorrelation occurs at lag 1, marked by a very large and significant coefficient of RESID(-1) = 0.8205. This means that the residuals from the previous period greatly influence the current residuals. The DW value = 2.017 in this auxiliary regression cannot be used as a reference because the residual lag has been included as an independent variable, so the DW is biased towards 2. What is relevant is the DW in the previous main regression which is 0.416 (very problematic). The conclusion is that autocorrelation occurs in this regression model, especially a very strong first-order autocorrelation (lag 1) with a coefficient of 0.82.

Based on the results of the classical assumption test which has gone through the process of handling heteroscedasticity and autocorrelation, the final estimate uses*Fixed Effect Model*(FEM) produces the following output:

Table 6. Fixed Effect Model (FEM) Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-67.79210	7.991821	-8.482685	0.0000
X1	13.33332	0.715918	18.62408	0.0000
X2	0.006549	0.013975	0.468639	0.6413
X3	0.036991	0.063654	0.581122	0.5637

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.990154	Mean dependent var	74.70483
Adjusted R-squared	0.988610	S.D. dependent var	4.259591
S.E. of regression	0.454610	Akaike info criterion	1.398727
Sum squared resid	10.54018	Schwarz criterion	1.712879
Log likelihood	-32.96181	Hannan-Quinn criter.	1.521609
F-statistic	641.0955	Durbin-Watson stat	0.361185
Prob(F-statistic)	0.000000		

The results of the output*Fixed Effect Model*(FEM) with*Cross-section Fixed* (*Dummy Variables*) in the Partial Hypothesis Test (t-Test) with the criteria: Prob. < 0.05 → H_0 is rejected → The variable has a significant effect Where:

The results of the t-test show that the variable X1 obtained a t-statistic value of 18.624 with a probability of 0.0000 which is smaller than $\alpha = 0.05$. Thus, H_0 is rejected, which means that X1 has a positive and significant effect on Y. Every increase in X1 by one unit will increase Y by 13.333 units assuming other variables are constant.

The t-test results show that variable X2 obtained a t-statistic value of 0.469 with a probability of 0.6413 which is greater than $\alpha = 0.05$. Thus, H_0 failed to be rejected, which means that X2 does not have a significant effect on Y.

The t-test results show that variable X3 obtained a t-statistic value of 0.581 with a probability of 0.5637 which is greater than $\alpha = 0.05$. Thus, H_0 failed to be rejected, which means that X3 has no significant effect on Y.

The F-test results show an F-statistic value of 641.096 with a probability of 0.0000 which is smaller than the significance level of $\alpha = 0.05$. Thus, H_0 is rejected, which means that variables X1, X2, and X3 simultaneously have a significant effect on variable Y. This also indicates that the regression model used is suitable (fit) for use in this study.

Based on the estimation results*Fixed Effect Model*, the R-squared value obtained was 0.9902 or 99.02% and*Adjusted R-squared*of 0.9886 or 98.86%. This means that the independent variables X1, X2, and X3 together are able to explain 99.02% of the variation in the dependent variable Y, while the remaining 0.98% is explained by other variables outside the model.*Adjusted R-squared*of 98.86% confirms that the model has very high explanatory power after considering the number of variables and observations used.

Overall, the research results confirm that the ADHK GRDP is the primary and most dominant determinant of the Human Development Index (HDI) achievement in Java. This finding underscores that the foundation of human development in this region remains highly dependent on regional economic capacity. The high value of*adjusted* $R^2$of 98.86%, indicating that the FEM model built is very good at capturing the dynamics of human development in six provinces on the island of Java throughout 2015–2024.

The insignificance of health complaints and TPT does not mean that these two variables are not substantively relevant to human development. It is likely that there are*nonlinear effects*, *time lag*, or *mediation effect*Other variables such as government spending in the health and education sectors, poverty levels, or the ratio of health facilities are not captured in this simple linear model specification. Further research is recommended using a dynamic panel model (*System* GMM) or mediation analysis to capture more complex transmission mechanisms.

In terms of policy implications, there are three strategic recommendations. First, provincial governments need to prioritize improving the quality of inclusive economic growth—not just GRDP growth—through investments that reach all levels of society so that the benefits of economic growth can be enjoyed equally and encourage an increase in the HDI. Second, given the very large disparity in GRDP between provinces (a standard deviation of Rp56.44 million), more aggressive economic equality policies are needed, especially for Banten and West Java, which consistently have HDIs below the regional average. Third, strengthening primary health programs and expanding the coverage of social safety nets needs to be continued to ensure that health complaints and unemployment do not develop into significant obstacles to human development in the future.

CONCLUSION

This study aims to analyze the influence of the ADHK GRDP, Health Complaints, and the Open Unemployment Rate (TPT) on the Human Development Index (HDI) in six provinces on Java Island in 2015–2024 using panel data regression analysis. Based on the results*Chow Test* And *Hausman Test*, the best estimation model selected is*Fixed Effect Model*(FEM). Simultaneously, the three independent variables have a significant effect on the HDI with an F-statistic value of 641.0955 (prob. 0.0000) and*Adjusted R-squared*of 0.9886, which means that 98.86% of the variation in the HDI on Java Island can be explained by the model. Partially, only the ADHK GRDP has a positive and significant effect on the HDI (*coefficient*= 13.3333; prob. = 0.0000), confirming that regional economic capacity is the main determinant of human development in Java. Meanwhile, Health Complaints (prob. = 0.6413) and TPT (prob. = 0.5637) do not have a significant effect on the HDI, which is thought to be caused by the subjective perceptual nature of Susenas measurements for health variables, as well as the effectiveness of social safety net programs in mitigating the impact of unemployment on community welfare. These findings imply the need for inclusive and equitable economic growth policies across provinces, strengthening primary health services, and optimizing social financial instruments to accelerate the achievement of sustainable human development in Java.

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