ICORHESTECH 2024
Vol. 1, No. 1, 2024, pp. 526~535
Journal Homepage: https://journal.ibrahimy.ac.id/index.php/icorhestech

Factors Affecting Economic Growth in Java Island Using Panel Data Regression

Rafika Nanda Setyawati [1*], Sri Subanti[2], Irwan Susanto [3]
[1,2,3]Department of Statistics, Faculty of Mathematics and Natural Sciences, Sebelas Maret University, Indonesia, 57126
*Corresponding author: *raffikaa.uns.ac.id@student.uns.ac.id*

ABSTRACT

Economic growth is one of the important indicators used to evaluate the success of a country's economic development. Economic growth in Indonesia is not only shaped by a single region but is also the result of contributions from all regions within the country. In the 2018-2022 period, Java Island made the largest contribution to Indonesia's economic growth, with an average exceeding 50%. However, economic growth on Java Island is still experiencing fluctuations due to various factors. The purpose of this research is to estimate and identify the factors that affect economic growth on Java Island in 2018-2022. This research uses independent variables, which are investment, labor productivity, tax ratio, and ICT usage, while the dependent variable is economic growth. The research data is secondary data that was obtained from the Indonesian Central Bureau of Statistics. The data type is panel data , which consists of six provinces in Java Island spanning the time period from 2018-2022. The analysis method used is panel data regression using the Common Effect Model (CEM), Fixed Effect Model (FEM) and Random Effect Model (REM) approaches. The results show that Fixed Effect Model (FEM) is the best model for estimating economic growth on Java Island, with an adjusted-R^2 value of 99.80%. The other results show that simultaneously there is a significant influence between investment, labor productivity, tax ratio, and ICT usage on the economic growth in Java Island from 2018-2022.

Keywords:

economic growth; panel data; fixed effect model

INTRODUCTION

Economic growth is the development of activities in the economic sector that have an impact on increasing the production of goods and services and the prosperity of society [8]. This can indicate the prosperity and success of a country's development. Economic growth is also included in macroeconomic indicators which are measured by Gross Domestic Product (GDP) for national coverage and Gross Regional Domestic Product (GRDP) for regional coverage. In Indonesia, the formation of national economic growth is inseparable from regional economic growth. Ref [7] states that optimizing economic growth at the national level can be realized if accompanied by a significant increase in Gross Regional Domestic Product (GRDP).

Java Island is an island region that makes the largest contribution to national economic growth. Data from the Central Bureau of Statistics [1] shows that in 2018–2022, the contribution made by Java Island to the formation of national GDP averaged more than 50%. Although Java Island consistently makes the largest contribution to the formation of national GDP, its economic growth rate still fluctuates.

Fluctuations in economic growth in Java during the 2018-2022 period were caused by various factors. The high level of investment entering Java Island is one of the factors that affect the economic growth of the region. Increased investment productivity is known to trigger GRDP growth [6]. Another factor that has the potential to affect economic growth in Java is labor productivity. Increased labor productivity has the potential to enhance the added value of production, which directly contributes to economic growth [3]. The level of economic growth is also assumed to be influenced by the tax ratio and ICT usage. The tax ratio shows the government's ability to collect tax revenue. The greater the tax revenue, the tax function as a source of state revenue and economic regulator becomes more optimal [5].

Meanwhile, Information and Communication Technology (ICT) is a form of technology contribution in economic growth. Research related to the ICT usage found that this factor has a positive and significant impact on economic growth [9].

Based on the previous description, this research was conducted with the aim of estimating and identifying factors that affect economic growth on Java Island in 2018–2022. This topic is important to be further researched, considering its significant contribution to the formation of the national Gross Domestic Product (GDP). In this research, the variables of investment, labor productivity, tax ratio, and ICT usage will be analyzed using the panel data regression method to determine their effect on economic growth.

METHOD

The data used in this research are secondary data obtained from the official publication of the Indonesian Central Bureau of Statistics. The data analyzed is in the form of panel data, which is a combination of time series and cross-section data. In this research, the coverage used is time series data from 2018–2022 and cross-section data from six provinces on the island of Java. The data produces 30 observations on each variable.

The variables in this research consist of two types, namely dependent variables and independent variables. Information regarding research variables is shown in Table 1.

Table 1. Research Variable

Variable	Indicator	Symbol
Economic growth	Gross regional domestic product at constant 2010 prices	Y
Investment	Domestic investment (PMDN)	X_1
Labor productivity	Labor productivity	X_2
Tax ratio	Ratio of regional tax revenues to GRDP at constant 2010 prices	X_3
ICT usage	ICT usage subindex	X_4

The data analysis method in this research uses panel data regression. The general form of the panel data regression model is stated in equation (1).

$$Y_{it} = \alpha_{it} + \sum_{k=1}^{K} \beta_k X_{k_{it}} + \varepsilon_{it} \quad (1)$$

where

Y_{it} : value of the dependent variable of the *i*-th individual unit and the *t*-th time period,

α_{it} : intercept,

β_k : slope coefficient of the *k*-th independent variable,

$X_{k_{it}}$: value of the *k*-th independent variable for the *i*-th individual unit and *t*-th time period,

ε_{it} : residual value of the *i*-th individual unit and *t*-th time period.

The analysis process was carried out with Eviews 12 software. The analysis steps are as follows:

1. Estimating the panel data regression model.
   There are three approaches used to estimate the panel data regression model, including the common effect model, fixed effect model, and random effect model [10].
   i. Common Effect Model (CEM)
      The main assumption of this model is that the intercept and slope are constant, both between cross section units and time periods. The Common Effect Model (CEM) is stated in equation (2).

$$Y_{it} = \alpha + \sum_{k=1}^{K} \beta_k X_{k_{it}} + \varepsilon_{it} \quad (2)$$

   ii. Fixed Effect Model (FEM)
      Fixed Effect Model (FEM) is one of the approaches in panel data estimation that considers differences between individuals and time. There are several variations of the fixed effect model, including:
      a. FEM with a constant slope coefficient but the intercept varies for each individual.This model is stated in equation (3).

$$Y_{it} = \alpha_i + \sum_{k=1}^{K} \beta_k X_{k_{it}} + \varepsilon_{it} \quad (3)$$

b. FEM with a constant slope coefficient but the intercept varies at each time. This model is stated in equation (4).

$$Y_{it} = \alpha_t + \sum_{k=1}^{K} \beta_k X_{k_{it}} + \varepsilon_{it} \quad (4)$$

c. FEM with a constant slope coefficient but the intercept varies with each individual and time. This model is stated in equation (5).

$$Y_{it} = \alpha + \mu_i + \lambda_t + \sum_{k=1}^{K} \beta_k X_{k_{it}} + \varepsilon_{it} \quad (5)$$

where

α_i : index *i* shows the intercept of each individual is different,

α_t : index *t* shows the intercept of each time is different,

λ_t : intercept for time *t*,

μ_i : intercept for individual *i*.

iii. Random Effect Model (REM)

Random effect model (REM) is an approach that involves correlation between error terms due to changes in time and individuals. The Random Effect Model (REM) is stated in equation (6).

$$Y_{it} = \alpha + \sum_{k=1}^{K} \beta_k X_{k_{it}} + w_{it} \quad (6)$$
$$w_{it} = u_i + \varepsilon_{it}$$

where

w_{it} : *composite error term*,

u_i : *i*-th individual error component,

ε_{it} : combined error component.

2. Conducting panel data regression model estimation selection test.

There are two tests conducted to determine the best panel data regression model estimation in this research.

i. Chow Test

The Chow test is used to determine whether the common effect model is better than the fixed effect model [2]. H_0 will be rejected if $F_{statistic} > F_{\alpha;(N-1,NT-N-K)}$ or $p - value < \alpha$, so the selected model is the fixed effect model. The Chow test statistic is stated in the following equation:

$$F_{statistic} = \frac{(R^2_{FEM} - R^2_{CEM})/(n-1)}{(1-R^2_{FEM})/(nT-n-K)} \quad (7)$$

where *n* is the number of cross-section units, *T* is the number of time-series units, *K* is the number of independent variables, R^2_{FEM} and R^2_{CEM} is the coefficient of determination of fixed effect model and common effect model.

ii. Hausman Test

The Hausman test is used to choose between two models, namely the fixed effect model and the random effect model [12]. H_0 will be rejected if $W > \chi^2_{\alpha;K}$ or $p - value < \alpha$, so the selected model is fixed effect model. The Hausman test statistic is stated in the following equation [10]:

$$W = \left[\mathbf{b} - \widehat{\boldsymbol{\beta}}\right]' \widehat{\boldsymbol{\Psi}}^{-1} \left[\mathbf{b} - \widehat{\boldsymbol{\beta}}\right] \quad (8)$$
$$\widehat{\boldsymbol{\Psi}} = \mathrm{Var}[\mathbf{b}] - \mathrm{Var}\left[\widehat{\boldsymbol{\beta}}\right]$$

where $\mathbf{b}$ is the matrix of the fixed effect estimated coefficients, $\widehat{\boldsymbol{\beta}}$ is the matrix of the random effect model estimated coefficients, and $\widehat{\boldsymbol{\Psi}}$ is the difference in the covariance matrix of the fixed effect model and random effect model, without intercept.

iii. Lagrange Multiplier Test

The Lagrange Multiplier test is used to determine whether the random effect model is better than the common effect model [2]. H_0 will be rejected if $LM > \chi^2_{(n-1,\alpha)}$ or $p - value < \alpha$, so the selected model is Random Effect Model. The Lagrange Multiplier Test statistic is stated in the following equation:

$$LM = \frac{nT}{2(T-1)}\left[\frac{\sum_{i=1}^{n}\left[\sum_{t=1}^{T} e_{it}\right]^2}{\sum_{i=1}^{n}\sum_{t=1}^{T} e_{it}^2} - 1\right]^2 \quad (9)$$

where *n* is the number of cross-section units, *T* is the number of time-series units, and e_{it} the common effect model residual.

3. Conducting assumption tests on the chosen model.
   The classical assumption tests in panel data regression include:
   i. Normality Test
      The normality test is used to check whether the residual distribution is normal or not [11]. H_0 will be rejected if $JB > \chi^2_{tabel}$ or $p - value < \alpha$, then the residuals are not normally distributed. The method used is the Jarque-Bera test with the following equation:

$$JB = n\left[\frac{S^2}{6} + \frac{(K-3)^2}{24}\right] \quad (10)$$

      where *n* is the sample size, *S* is the coefficient skewness, and *K* is the kurtosis coefficient.
   ii. Heteroscedasticity Test
      The heteroscedasticity test is used to detect whether the regression model has constant residual variances or not [11]. H_0 will be rejected if $|t_{statistic}| > t_{\left(\frac{\alpha}{2};N-K\right)}$ or $p - value < \alpha$, then there is a heteroscedasticity problem. The method used is the Glejser test with the following equation:

$$t_{statistic} = \frac{\hat{\beta}_k}{SE(\hat{\beta}_k)} \quad (11)$$

      where $\hat{\beta}_k$ is the regression coefficient and SE is the standard error of the regression coefficient.
   iii. Multicollinearity Test
      The multicollinearity test is carried out to detect the existence of a linear relationship between the independent variables. The basis for decision making in the multicollinearity test is as follows [4].
      a. If the correlation value between independent variables is < 0.85, then there is no multicollinearity problem
      b. If the correlation value between independent variables is > 0.85, then there is a multicollinearity problem
4. Conducting parameter significance test.
   The significance testing of parameters in the regression model is conducted twice, both simultaneously and partially [12].
   i. Simultaneous Test (F test)
      The simultaneous test (F test) is conducted to check the overall significance of the independent variables in influencing the dependent variable. H_0 will be rejected if $F_{statistic} > F_{\alpha;(N+K-1,NT-N-K)}$ or $p - value < \alpha$, so that the independent variable simultaneously influences the dependent variable. The F test statistic is stated in the following equation:

$$F_{statistic} = \frac{\frac{SSR}{(N+K-1)}}{\frac{SSE}{(NT-N-K)}} \quad (12)$$

   ii. Partial Test (t-test)
      Partial test (t-test) is used to evaluate the individual effect of each independent variable on the dependent variable. H_0 will be rejected if $|t_{hitung}| > t_{\left(\frac{\alpha}{2},NT-N-K\right)}$ or $p - value < \alpha$, so that each independent variable individually affects the dependent variable. The t-test statistic is stated in the following equation:

$$t_{statistic} = \frac{\hat{\beta}_k}{SE(\hat{\beta}_k)} \quad (13)$$

5. Conducting a goodness-of-fit test using the coefficient of determination.
6. Interpreting the panel data regression model.

RESULTS AND DISCUSSION

Estimation of panel data regression models

In this section, economic growth in Java Island in 2018-2022 is modeled using three approaches.

1. Common Effect Model (CEM)
   Estimation using the common effect model approach combines all data without considering differences between individuals or time. The estimation result is summarized in Table A1 and stated in the following equation:
   $$\hat{Y}_{it} = 2162051 + 15.9X_{1_{it}} + 2559.9X_{2_{it}} - 792358.5X_{3_{it}} - 173200.8X_{4_{it}} \quad (14)$$
2. Fixed Effect Model (FEM)
   Estimation using the fixed effect model approach considers differences between individuals and time. The estimation result is summarized in Table A2 and stated in the following equation:
   $$\hat{Y}_{it} = 394087.7 + 1.560929X_{1_{it}} + 1322.136X_{2_{it}} + 109042.7X_{3_{it}} + 42475.46X_{4_{it}} \quad (15)$$
3. Random Effect Model (REM)
   Estimation using the random effect model approach involves correlation between error terms due to changes in time and individuals. The estimation result is summarized in Table A3 and stated in the following equation:
   $$\hat{Y}_{it} = 445117 + 1.822578X_{1_{it}} + 1302.121X_{2_{it}} + 85854.83X_{3_{it}} + 38272.2X_{4_{it}} \quad (16)$$

Selection of panel data regression model estimates

The best estimated model will be selected to model economic growth on the island of Java in 2018–2022. The results of the model selection test are as follows:

1. Chow Test
   This test is conducted to select the best model estimate between the Common Effect Model (CEM) and the Fixed Effect Model (FEM). Based on Table A4, the statistical results of the Chow Test show that the value of $F_{statistic}$ = 395.09 > $F_{0.05;(5,20)} = 2.71$ and $p - value = 0.0000 < (\alpha) = 0.05$, so H_0 is rejected. This means that the Fixed Effect Model (FEM) is better than the Common Effect Model (CEM).
2. Hausman Test
   This test is conducted to select the best model estimate between the Fixed Effect Model (FEM) and the Random Effect Model (REM). Based on Table A5, the statistical results of the Hausman Test show that the value of W = 16.17 > $\chi^2_{0.05;4} = 9.4877$ and $p - value = 0.0028 < (\alpha) = 0.05$, so H_0 is rejected. This means that the Fixed Effect Model (FEM) is better than the Random Effect Model (REM).

The model estimation selection test above states that the best model estimate is the Fixed Effect Model (FEM), so the lagrange multiplier test does not need to be used. The conclusion is that the Fixed Effect Model (FEM) is the best model estimate for modeling economic growth in Java Island in 2018–2022.

Classical assumption testing

The classical assumption test of panel data regression is carried out on the best model selected previously, namely the fixed effect model. The results of the classical assumption test are as follows:

1. Normality Test
   The method used to check the normality of residuals is the Jarque-Bera Test. Based on Table A6, the Jarque-Bera (JB) value = 0.702471 < $\chi^2_{0.05;4}$ = 9.4977 and p-value = 0.703818 > (α) = 0.05, so H_0 fails to be rejected. This means that the residuals are normally distributed.
2. Heteroscedasticity Test
   The method used to check the residual variance is the Glejser Test. Based on Table A7 which contains the results of the Glejser Test, it is found that the $|t_{statistic}|$ of each independent variable $< t_{(0.025;2)} = 4.3$. Therefore, H_0 fails to be rejected, which means that the residual variance is homoscedasticity or there is no heteroscedasticity problem.
3. Multicollinearity Test
   Multicollinearity test is conducted by identifying the correlation value between independent variables. Table A8 contains the correlation values between independent variables. The results show that all correlation values between independent variables are < 0.85. This means that there is no multicollinearity between the independent variables.

Parameter significance testing

Parameter significance testing for the fixed effect model is conducted by looking at the simultaneous and partial significance of each variable.

1. Simultaneous Test (F test)

   The F test results in Table A9 show the value of $F_{statistic}$ = 2413.314 > $F_{0.05;(9,20)} = 2.39$ and $p - value = 0.0000 < (\alpha) = 0.05$. Therefore, H_0 is rejected, which means that the variables of investment (X_1), labor productivity (X_2), tax ratio (X_3), and ICT usage (X_4) together have a significant effect on economic growth in Java Island (Y).

2. Partial Test (t-test)

   The t-test results in Table A10 show that the investment variable (X_1), labor productivity (X_2), and ICT usage (X_4) have a value of $|t_{statistic}| > t_{(0.025,20)} = 2.086$. Therefore, H_0 is rejected, which means that individually the variables of investment (X_1), labor productivity (X_2), and ICT usage (X_4) have a significant effect on economic growth. Meanwhile, the tax ratio variable (X_3) has a value of $|t_{statistic}| < t_{(0.025,20)} = 2.086$, so H_0 fails to be rejected, which means that the tax ratio variable (X_3) has no significant effect on economic growth.

Coefficient of determination

Evaluation of the goodness of the regression model is conducted by looking at the adjusted coefficient of determination (adjusted-R^2). The use of adjusted-R^2 is more recommended than R^2 because the value is not affected by the addition of independent variables [4]. In this research, the fixed effect model (FEM) estimation showed an adjusted-R^2 value of 0.998 or 99.8%. This means that the independent variables can explain the variability of economic growth in Java Island in 2018-2022 by 99.8% while 0.2% is explained by other variables that have not been included in the model.

Interpretation of panel data regression models

The analysis results show that the fixed effect model (FEM) is a suitable model for estimating economic growth on Java Island in 2018-2022. The model is stated in equation (15) as follows:

$$\hat{Y}_{it} = 394087.7 + 1.560929X_{1_{it}} + 1322.136X_{2_{it}} + 109042.7X_{3_{it}} + 42475.46X_{4_{it}}$$

The constant and coefficient values of the variables in the regression model are interpreted based on the partial test results (t-test) in Table A10. The panel data regression model in equation (15) shows a constant value of 394087.7. This means that if the independent variables of investment (X_1), labor productivity (X_2), tax ratio (X_3), and ICT usage (X_4) are constant, then GRDP will increase by 394087.7 billion rupiah. Furthermore, the coefficient value of each variable has the following meaning:

1. The regression coefficient for the investment variable (X_1) is 1.560929 and has a significant positive effect on economic growth on the island of Java. These results show that by increasing one unit of investment variable, GRDP will increase by 1.560929 billion rupiah.
2. The regression coefficient for the labor productivity variable (X_2) is 1322.136 and has a significant positive effect on economic growth on the island of Java. These results show that by increasing one unit of the labor productivity variable, GRDP will increase by 1322,136 billion rupiah.
3. The regression coefficient for the tax ratio variable (X_3) is 109042.7 and has no significant effect on economic growth on the island of Java.
4. The regression coefficient for the ICT use variable (X_4) is 42475.46 and has a significant positive effect on economic growth on the island of Java. These results show that by increasing one unit of the ICT use variable, GRDP will increase by 42,475.46 billion rupiah.

CONCLUSION

The results of the analysis and discussion of this research show that the Fixed Effect Model (FEM) is the best model for estimating economic growth on the island of Java in 2018-2022. The model has an adjusted-R^2 value of 99.80% and has fulfilled all classical assumption tests. The Fixed Effect Model (FEM) equation is as follows:

$$\hat{Y}_{it} = 394087.7 + 1.560929X_{1_{it}} + 1322.136X_{2_{it}} + 109042.7X_{3_{it}} + 42475.46X_{4_{it}}$$

Based on the fixed effect model, investment variables (X_1), labor productivity (X_2), tax ratio (X_3), and ICT usage (X_4) together have a significant effect on economic growth in Java. Meanwhile, individually,

there are three independent variables that have a significant effect, namely the investment variable (X_1), labor productivity (X_2), and the use of ICT (X_4).

ACKNOWLEDGEMENTS

We would like to express our deepest gratitude to the Department of Statistics of Sebelas Maret University for providing the necessary resources and support for this research. We are also grateful to the lecturers at the Department of Statistics of Sebelas Maret University for their invaluable guidance, insight, and encouragement during this research. Their expertise and feedback were essential in the completion of this research.

REFERENCES

Badan Pusat Statistik. (2023). *LAPORAN PEREKONOMIAN INDONESIA 2023*.

Desnasari, D. (2021). Analisis pengaruh produktivitas tenaga kerja, ketimpangan pendapatan, dan investasi terhadap pertumbuhan ekonomi di Indonesia periode 2009-2018. Jurnal Investasi Islam, 5(2), 93–110. https://doi.org/10.32505/jii.v5i2.1907

Fitri, I., Syofyan, E., & Aimon, H. (2015). Analisis Faktor-faktor Yang Mempengaruhi Produktivitas Tenaga Kerja dan Pertumbuhan Ekonomi di Sumatera Barat. *Jurnal Kajian Ekonomi*, *4*(7), 1-14.

Ghozali, I. (2018). *Aplikasi Analisis Multivariate dengan Program IBM SPSS 25* (edisi 9). Badan Penerbit Universitas Diponegoro.

Munandar, A. (2017). ANALISIS REGRESI DATA PANEL PADA PERTUMBUHAN EKONOMI DI NEGARA-NEGARA ASIA. *Jurnal Ilmiah Ekonomi Global Masa Kini*, *8*(1), 59–67. https://doi.org/10.36982/jiegmk.v8i1.246

Munthe, M. N. (2019). Pengaruh Tingkat Investasi dan Angkatan Kerja Terhadap Pertumbuhan Ekonomi di Indonesia. *Jurnal Manajemen Dan Bisnis*, *18*(2), 166–183. https://doi.org/10.17605/eko.v18i2.428

Nalle, F. W., & Hidayat, A. S. (2017). Analisis Pengaruh Belanja Pemerintah, Tenaga Kerja, dan Pendapatan Asli Daerah Terhadap Pertumbuhan Ekonomi Regional Provinsi Jawa Timur Tahun 2010-2015. *Jurnal Ekonomi Pembangunan*, *15*(1), 71–86. https://doi.org/10.22219/jep.v15i1.4647

Rofii, A. M., & Ardyan, P. S. (2017). Analisis Pengaruh Inflasi, Penanaman Modal Asing (PMA) dan Tenaga Kerja Terhadap Pertumbuhan Ekonomi di Jawa Timur. *JEB17: Jurnal Ekonomi Dan Bisnis*, *2*(01), 303–317. https://doi.org/10.1234/jeb17.v2i01.1100

Sibarani, D. R., Hutagaol, M. P., Ahmad, F. S., Asmara, A., & Alexandi, M. F. (2023). Dampak Akses-Infrastruktur, Penggunaan, dan Keahlian Teknologi informasi dan Komunikasi Terhadap pertumbuhan ekonomi Indonesia. *Jurnal Resolusi Konflik, CSR, dan Pemberdayaan (CARE)*, *8*(2), 32–42. https://journal.ipb.ac.id/index.php/jurnalcare/article/view/51948

Srihardianti, M., Mustafid, M., & Prahutama, A. (2016). METODE REGRESI DATA PANEL UNTUK PERAMALAN KONSUMSI ENERGI DI INDONESIA. *Jurnal Gaussian*, *5*(3), 475–485. https://doi.org/10.14710/j.gauss.v5i3.14703

Tirtana, D. (2023). Potensi Pertumbuhan Ekonomi di Pulau Jawa dan Bali. *WELFARE Jurnal Ilmu Ekonomi*, *3*(2), 148–157. https://doi.org/10.37058/wlfr.v3i2.6064

Widarjono, A. (2018). *Ekonometrika Pengantar dan Aplikasinya Disertai Panduan Eviews* (edisi 5). UPP STIM YKPN.

APPENDIX

Table A1. Common Effect Model (CEM)

Variable	Coefficient	Std. Error	t-statistic	P-value	Decision ($\alpha = 0.05$)
C	2162051	441474.5	4.897340	0.0000	significant
X_1	15.92980	2.597032	6.133847	0.0000	significant
X_2	2559.927	441.7250	5.795294	0.0000	significant
X_3	-792358.5	219855.9	-3.603990	0.0014	significant
X_4	-173200.8	95449.00	-1.814590	0.0816	not significant

Table A2. Fixed Effect Model (FEM)

Variable	Coefficient	Std. Error	t-statistic	P-value	Decision ($\alpha = 0.05$)
C	394087.7	126017.3	3.127250	0.0053	significant
X_1	1.560929	0.636741	2.451437	0.0235	significant
X_2	1322.136	393.1270	3.363127	0.0031	significant
X_3	109042.7	53542.52	2.036562	0.0552	not significant
X_4	42475.46	13675.00	3.106066	0.0056	significant

Table A3. Random Effect Model (REM)

Variable	Coefficient	Std. Error	t-statistic	P-value	Decision ($\alpha = 0.05$)
C	445117.0	173631.2	2.563578	0.0168	significant
X_1	1.822578	0.608841	2.993521	0.0061	significant
X_2	1302.121	341.6051	3.811772	0.0008	significant
X_3	85854.83	51606.02	1.663659	0.1087	not significant
X_4	38272.20	13615.99	2.810828	0.0095	significant

Table A4. Results of Chow Test

Effect Test	Statistic	d.f.	Prob.
Cross-section F	395.098387	(5,20)	0.0000
Cross-section Chi-square	138.087408	5	0.0000

Table A5. Results of Hausman Test

Test Summary	Chi-Sq. Statistic	Chi-*Sq.* df	Prob.
Cross-section random	16.178618	4	0.0028

Table A6. Results of Jarque-Bera Test

Jarque-Bera	Probability
0.702471	0.703818

Table A7. Result of Glejser Test

Variable	Coefficient	Std. *Error*	t-statistic	Prob.	Decision ($\alpha = 0.05$)
C	291159.0	274212.3	1.061801	0.2985	H_0 not rejected
X_1	0.801084	1.613090	0.496614	0.6238	H_0 not rejected
X_2	96.83428	274.3679	0.352936	0.7271	H_0 not rejected
X_3	130559.4	136558.7	0.956068	0.3482	H_0 not rejected
X_4	-65572.30	59286.08	-1.106032	0.2792	H_0 not rejected

Table A8. Results of Multicollinearity Test

	X_1	X_2	X_3	X_4
X_1	1.00	0.51	-0.02	0.35
X_2	0.51	1.00	0.69	0.80
X_3	-0.02	0.69	1.00	0.76

X_4	0.35	0.80	0.76	1.00

Table A9. Results of F Test

F-statistic	Probability
2413.314	0.0000

Table A10. Results of t-Test

Variable	Coefficient	Std. *Error*	t-statistic	Prob.	Decision ($\alpha = 0.05$)
C	394087.7	126017.3	3.127250	0.0053	H_0 rejected
X_1	1.560929	0.636741	2.451437	0.0235	H_0 rejected
X_2	1322.136	393.1270	3.363127	0.0031	H_0 rejected
X_3	109042.7	53542.52	2.036562	0.0552	H_0 not rejected
X_4	42475.46	13675.00	3.106066	0.0056	H_0 rejected

BIOGRAPHIES OF AUTHORS

Rafika Nanda Setyawati is a final year student in the statistics department at Sebelas Maret University. Currently, she is conducting research on economic growth in Java Island. Additionally, she has completed an internship at the Central Bureau of Statistics in Boyolali Regency and an independent study at Startup Campus. She can be contacted via email at raffikaa.uns.ac.id@student.uns.ac.id

Sri Subanti is a lecturer in the statistics department at Sebelas Maret University. She began her career as a lecturer on January 1, 1986, and was appointed as a professor in 2022. She teaches courses on the application of statistics. She is actively involved in writing scientific papers and has published articles in national and international journals. Additionally, she has published several books with patents. She can be contacted via email at srisubanti@staff.uns.ac.id

Irwan Susanto is a lecturer in the statistics department at Sebelas Maret University. He graduated with a bachelor's degree in mathematics from Sebelas Maret University, a master's degree in applied mathematics from Université Joseph Fourier, Grenoble, France, and a doctoral degree in statistics from Institut Teknologi Sepuluh Nopember. His research interests include Bayesian computation, mixture modeling, and stochastics modeling. He can be contacted via email at irwansusanto@staff.uns.ac.id