Human development index modelling in South Kalimantan province using panel regression

M Istiqomah*, N Salam², and A S Lestia³

Statistics Study Program, Faculty of Mathematics and Science, Lambung Mangkurat University, Indonesia

maridhaistiq58@gmail.com

Abstract. Human development is a paradigm and becomes the focus and target of all development activities. Development is a way to improve welfare and a better quality of life. The Human Development Index (HDI) is one indicator to measure the success of a development. The purpose of this research is to describe the factors that are thought to influence HDI in South Kalimantan Province, estimate the parameters of the HDI panel regression model, and determine the best model. The data of this research is sourced from the Central Statistics Agency (BPS) of South Kalimantan Province with a period from 2015-2018. Based on the results of data analysis it can be concluded that the Fixed Effect Model with the time effect is the best model of the HDI panel regression in South Kalimantan Province with an R-Squared value of 99.81.

1. Introduction

Development is a way to improve welfare and better quality of life. Human development is the most important factor in determining how well a community is doing. The United Nations Development Program (UNDP) published a new outlook on human development, namely the Human Development Index (HDI). The HDI is measured using three basic dimensions: (1) a long and healthy life as measured by life expectancy at birth; (2) knowledge as measured by the total amount of expected years of schooling and the average length of schooling; and (3) decent standard of living as measured by purchasing power parity [1]. HDI gives a complete measure of achievement that demonstrates the quality of human existence and the success of a district, province, or country's development [2].

The HDI is a measure of the success of development in every development area in South Kalimantan Province, and it is also used as an indicator of the success of national and even international development. The HDI is the foundation for assessing the quality of economic and other social development, particularly in the areas of education and health. In 2015, the HDI value in South Kalimantan Province increased by 0.55% and has a “high” status in 2018 [3].

Published a study titled “Panel Data Regression Analysis with the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM) approach with a case study of HDI in South Kalimantan Province for the period 2010-2016” The optimum estimation model in this study is to apply REM with individual effects. Life Expectancy, Average Length of School, Expected Length of School, Adjusted Per capita Expenditure, and the General Allocation Fund of Regional Original Income all have a significant impact on HDI in Kalimantan Province South, accounting for 99.89 percent of the variance [4].
An analysis of the HDI of the Province of South Kalimantan in 2015-2018 was carried out again in this study using panel regression to measure the outcome of the development that has been carried out in the Province of South Kalimantan in the following year. Research has identified the factors that have a major impact on HDI estimates in the province of South Kalimantan. Other factors, however, may have influenced the HDI score in South Kalimantan Province. Using a panel regression approach, this study will estimate the regression parameters and determine the optimum HDI model in South Kalimantan Province, as well as estimate the parameters of the HDI panel regression model, and determine the best model.

2. Deep learning theory

2.1. Descriptive Statistics
Descriptive statistics is a strategy for collecting, classifying, and concisely presenting data so that it can be understood more easily [5].

2.2. Panel Regression Analysis
Panel regression analysis is a method for modeling the effect of the independent variable on the dependent variable in different research sectors over a period of time. Model of panel regression [6]:

\[ Y_{it} = \alpha_{it} + \beta X_{it} + \epsilon_{it} \quad i = 1, \ldots, N; t = 1, \ldots, T \]  

(1)

2.3. Estimation Panel Regression Model
Three types of estimations can be used to estimate panel regression [7]

2.3.1 Common Effect Model. The intercept and slope values for all time units and individuals are assumed to also be constant in Common Effect Model (CEM). The CEM equation in the most general from [8]:

\[ Y_{it} = \alpha + \beta X_{it} + \epsilon_{it} \]  

(2)

2.3.2 Fixed Effect Model. The slope is assumed to be constant in Fixed Effect Model (FEM), while the intercept variable between individual units of observation. We add a dummy variable to this model to estimate the parameters using the Least Square Dummy Variable (LSDV) method. The FEM equation and in the most general form [9].

\[ Y_{it} = \alpha_i + \beta X_{it} + \epsilon_{it} \]  

(3)

2.3.3 Random Effect Model. The error model in Random Effect Model (REM) allows for differences in time and individual characteristics. The equation REM in the most general form [10].

\[ Y_{it} = \alpha_0 + \sum_{k=1}^{K} \beta_k X_{kit} + w_{it} \]  

(4)

2.4. Selection Method of Regression Panel
The best model was selected from the three to estimate the panel regression parameters, namely:

2.4.1. Chow Test. The Chow test is used to determine whether the CEM or FEM model is the most suitable. Testing of hypotheses [11]:

\[ H_0: \quad \alpha_1 = \alpha_2 = \cdots = \alpha_n \] (the model that CEM uses)

\[ H_1: \quad \text{at least one existed } \alpha_i \neq 0; \quad i = 1, 2, \ldots, n \] (the model that FEM uses)

Test statistics:

\[ F_{\text{count}} = \frac{(SSE_p - SSE_{DV})/(N - 1)}{(SSE_{DV})/(NT - N - K)} \]  

(5)

\[ H_0 \] is rejected if the values of \( F_{\text{count}} \) is more than the value of \( F_{\text{table}} \). As a result, the \textit{Fixed Effect Model} was used.
2.4.2. **Hausman Test.** The Hausman test is a statistical test that determines whether the best FEM or REM model is employed. Testing of hypotheses [12]:

- **H0:** correlation \((X_{it}, \epsilon_{it}) = 0\) or the model that REM uses
- **H1:** correlation \((X_{it}, \epsilon_{it}) \neq 0\) or the model that FEM uses

**Test statistics:**

\[
W = \chi^2[K] = (\hat{\beta}_{FEM} - \hat{\beta}_{REM})'\left[\text{var}[\hat{\beta}_{FEM} - \hat{\beta}_{REM}]\right]^{-1}(\hat{\beta}_{FEM} - \hat{\beta}_{REM})
\]

(6)

**H0** is rejected if \(\chi^2 \text{ hitung} > \chi^2(k, \alpha)\) and the model employed is Fixed Effect Model. And the Fixed Effect Model is applied instead.

2.4.3. **Lagrange Multiplier Test.** The LM test is used to see if the REM method is better than the CEM technique. Testing of hypotheses [12]:

- **H0:** \(\sigma_{it}^2 = 0\) or the model that CEM uses
- **H1:** \(\sigma_{it}^2 \neq 0\) or the model that REM uses

**Test statistics:**

\[
LM = \frac{NT}{2(T-1)} \left( \frac{\sum_{i=1}^{N} \sum_{t=1}^{T} \sigma_{it}^2}{\sum_{i=1}^{N} \sum_{t=1}^{T} \sigma_{it}^2} - 1 \right)^2
\]

(7)

**H0** is rejected if \(\chi^2 \text{ hitung} > \chi^2(k, \alpha)\) and the model employed is Random Effect Model

### 2.5. Classic Assumption test

2.5.1. **Normality Test.** The purpose of the normality test is to see if the residual data is normally distributed or not. The Jarque-Bera (JB) test was employed in this study [7].

**Hypotheses:**

- **H0:** the distribution of residuals is normally distributed
- **H1:** the distribution of residuals is not normally distributed

**Test statistics:**

\[
JB = n \left[ \frac{S^2(K - 3)^2}{4} \right]
\]

(8)

**H0** is rejected if \(J \text{ B} > \chi^2(\alpha, 2)\) with meaning the residuals is not normally distributed.

2.5.2. **Multicollinearity Test.** In linear regression, the multicollinearity test is used to measure the correlation of independent variables. One method of detecting multicollinearity symptoms is to examine the R2 value of the estimated regression model and analyze it using a correlation matrix of independent variables [6].

2.5.3. **Heteroscedasticity Test.** The homoscedasticity or heteroscedasticity of the residual covariance variance structure is determined using this test [6].

**Hypotheses:**

- **H0:** \(\sigma_{it}^2 = \sigma^2\) (residual variance-covariance structure with homoscedasticity)
- **H1:** \(\sigma_{it}^2 \neq \sigma^2\) (residual heteroscedasticity structure variance-covariance)

**Test statistics:**

\[
BP = \frac{T}{2} \sum_{t=1}^{n} \left( \frac{\sigma_{it}^2}{\sigma^2} - 1 \right)^2
\]

(9)

**H0** is rejected if \(BP > \chi^2(\alpha, N-1)\) with meaning character heteroscedasticity.
2.5.4. Autocorrelation Test. The Durbin-Watson test is one method to detect autocorrelation [6].

Hypotheses:
\( H_0 : \rho = 0 \) (no autocorrelation)
\( H_1 : \rho \neq 0 \) (autocorrelation)

Test statistics
\[
DW = \frac{\sum_{t=2}^{n}(\varepsilon_t - \varepsilon_{t-1})^2}{\sum_{t=1}^{n} \varepsilon_t^2}
\]

2.6. Parameter Significance test

2.6.1. F Test (Simultaneously). The F test testing is used to see if the Fixed Effect Model's independent variables are significant in the model [8].

a. Individual Effect Model

Hypotheses:
\( H_0 : \gamma_1 = \gamma_2 = \gamma_3 = \cdots = \gamma_N = 0 \)
\( H_1 : \) at least there is \( \gamma_N \neq 0 \)

Test statistics
\[
F_{\text{count}} = \frac{(SSE_\rho - SSE_{DV})/(T - 1)}{(SSE_{DV})/(NT - N - 1)}
\]

Conclusion: If \( F_{\text{count}} > F_{\text{table}} \) reject \( H_0 \) this indicates that the independent variable has a concurrent effect on the dependent variable.

b. Time Effect Model

Hypotheses:
\( H_0 : \delta_1 = \delta_2 = \delta_3 = \cdots = \delta_N = 0 \)
\( H_1 : \) at least there is \( \delta_N \neq 0 \)

Test statistics using equation (10)

Conclusion: If \( F_{\text{count}} > F_{\text{table}} \) reject \( H_0 \) this indicates that the independent variable has a concurrent effect on the dependent variable.

2.6.2. The t-test (Partial). The purpose of t-test testing will be how the independent variables in the Fixed Effect Model affect the dependent variable independently [13].

Hypotheses:
\( H_0 : \beta_j = 0 \)
\( H_1 : \beta_j \neq 0 ; \ k = 0,1,2,\ldots,k \) (the slope coefficient is \( k \))

Test statistics
\[
t_{\text{hitung}} = \frac{\hat{\beta}_j}{se(\beta_j)}
\]

Conclusion: If \( |t_{\text{hitung}}| > t_{\text{table}}(\frac{\alpha}{2},n-k) \) or \( H_0 \) is rejected, the independent variable has an individual effect.

2.6.3. Coefficient of Determination. The coefficient of determination is used to estimate how much of the dependent variable's diversity is explained by the independent variable [6].

Test statistics
\[
R^2 = 1 - \frac{\varepsilon^T \varepsilon}{(y - \bar{y})^T (y - \bar{y})}
\]
3. Method
The data used in this study are secondary data obtained from the South Kalimantan Province's Central Statistics Agency. Individual observation units for 13 districts/cities in South Kalimantan Province, but also time units from 2015 to 2018. The variable in this research are:

| Variable                      | Symbol | Unit     |
|-------------------------------|--------|----------|
| Human Development Index       | Y      | Indeks   |
| Expected Years of schooling   | X₁     | Year     |
| School Participation Rate     | X₂     | Percent  |
| Mean Years School             | X₃     | Year     |
| Life Expectancy at birth      | X₄     | Year     |
| Health Facilities             | X₅     | Unit     |
| Adjusted Per Capita Expenditure| X₆     | Rp       |
| Percentage of poor people    | X₇     | Percent  |

The following are the stages of the research method:

a. Do descriptive statistical analysis
b. Are using the Common Effect Model, Fixed Effect Model, and Random Effect Model to estimate panel regression.

c. The Chow and Hausman checks are used to select the panel regression model.
d. For regression models, performing classical assumption tests includes normality, multicollinearity, heteroscedasticity, and autocorrelation.
e. F test, t-test, and coefficient of determination are an example of parameter significance testing.

f. Conclusion

4. Result and Discussion
4.1. Descriptive Statistics
The pattern of HDI distribution in South Kalimantan Province, and also the factors that are thought to influence it.

| Variable                      | Descriptive Statistics | 2015 | 2016 | 2017 | 2018 |
|-------------------------------|------------------------|------|------|------|------|
| Y                             | Mean                   | 67.83| 68.45| 69.14| 69.77|
|                               | Maximum                | 77.56| 77.56| 78.32| 78.83|
|                               | Minimum                | 62.49| 63.38| 64.21| 65.06|
|                               | Mean                   | 12.07| 12.22| 12.40| 12.53|
| X₁                            | Maximum                | 14.75| 14.77| 14.78| 14.79|
|                               | Minimum                | 11.16| 11.24| 11.52| 11.63|
|                               | Mean                   | 92.37| 92.92| 93.01| 93.46|
| X₂                            | Maximum                | 97.04| 98.09| 98.49| 98.83|
|                               | Minimum                | 79.51| 83.36| 82.62| 83.68|
|                               | Mean                   | 7.70 | 7.79 | 7.92 | 7.98 |
| X₃                            | Maximum                | 10.75| 10.76| 10.77| 10.93|
|                               | Minimum                | 6.46 | 6.71 | 7.03 | 7.04 |
|                               | Mean                   | 67.42| 67.64| 67.79| 68.01|
| X₄                            | Maximum                | 71.36| 71.43| 71.50| 71.67|
|                               | Minimum                | 62.49| 62.71| 62.94| 63.24|
|                               | Mean                   | 406.38| 364.53| 381.69| 389.00|
| X₅                            | Maximum                | 756  | 693  | 653  | 682  |
According to the table shows that the HDI value in South Kalimantan Province ($Y$) increased throughout the last four years, from 2015 to 2018. The HDI value of 67.83 in 2015 has increased to 69.77 in 2018. Furthermore, the minimum HDI value in South Kalimantan Province was 62.49 in 2015, while the highest value was 78.83 in 2018. Expected years of schooling ($X_1$) in South Kalimantan Province were 12.07 years in 2015 and increased to 12.53 years in 2018. Furthermore, in 2015, the expected length of schooling in South Kalimantan Province was 11.16 years, with a maximum value of 14.79 years in 2018.

In 2015, the School Participation rate ($X_2$) in South Kalimantan Province was 92.37 percent, with such a decline to 92.92 percent in 2016. The school participation rate increased again in 2017 and 2018, reaching 93.01 percent and 93.46 percent, respectively. Furthermore, the lowest value was 79.51 percent in 2015, while the highest figure was 99.83 percent in 2018. Over the last four years, the Mean year’s school ($X_3$) in the province of South Kalimantan has increased. It was 7.70 years in 2015, and it has increased steadily to 7.98 years in 2018.

Life Expectancy at birth ($X_4$) indicates that in South Kalimantan Province, life expectancy is increasing every year. It was 67.42 years in 2015, and it increased to 68.01 years in 2018. Furthermore, the minimum mean was 62.49 years in 2015, while the maximum value was 71.67 years in 2018. The number of health facilities ($X_5$) in South Kalimantan Province has fluctuated. In 2015, it was 406.38 units, while being in 2016, it was 364.53 units, a decrease. It increased again in 2017-2018, with 381.69 and 389.00 units respectively.

South Kalimantan Province adjusted per capita expenditure ($X_6$) has increased. It was Rp.67.80.- in 2015, with increases of Rp.68.48,-, Rp.69.14,-, and Rp.71.16.- during 2016 to 2018. Furthermore, the minimum mean was Rp. 62.49 in 2015, while the maximum value was Rp. 86.41 in 2018. In 2015, the percentage of poor people ($X_7$) in South Kalimantan Province was 5.26 percent, with a decrease to 5.12 percent in 2016. Then, year after year, the percentage fell to 4.79 percent in 2018. Furthermore, in 2018, the lowest value was 2.70 percent, while the maximum value was 7.07 percent in 2015.

### 4.2. Panel Regression Model

If the probability value for each variable is greater than the significance $\alpha = 0.05$ level in panel regression analysis, the model is not significant. Variables that are not significant will be excluded from the model one at a period, starting with the one with the highest probability value. The following are the results of the model parameter estimation that was repeated, and the results are as follows:

| Variable | Coefficient | Probability Value |
|----------|-------------|-------------------|
| Constant | 0.9671828   | 0.860127          |
| $X_1$    | 0.7974273   | 0.004702          |
| $X_2$    | -0.0569077  | 0.031139          |
| $X_3$    | 1.5169314   | 3.44 x 10^{-6}   |
| $X_4$    | 0.6305251   | 9.45 x 10^{-13}  |
| $X_5$    | 0.0017921   | 0.037762          |
| $X_6$    | 0.1157241   | 0.000503          |

The following are the results of the CEM model equations base on Table 3:

$$\hat{Y}_{it} = 0.9671828 X_1 + 0.7974273 X_2 - 0.0569077 X_3 + 1.5169314 X_4 + 0.6305251 X_5 + 0.0017921 X_6 + 0.1157241 X_7 + \epsilon_{it}$$
The results of the school participation rate variable with a negative coefficient value can be seen in Table 3. This means that as the value of the school participation rate increases, the HDI value decreases or decreases. Meanwhile, HDI is positively influenced by variables such as expected years of schooling, mean years of school, life expectancy at birth, health facilities, and adjusted per capita expenditure.

According to the value of each coefficient, if the projected expected years of schooling, mean years of school, life expectancy, health facilities, and adjusted per capita expenditure are modified to increase, the HDI value will also expand.

Table 4. Significant FEM individual model test result

| Variable | Coefficient | Probability Value |
|----------|-------------|-------------------|
| $X_1$    | 0.9335      | $2.06 \times 10^{-5}$ |
| $X_3$    | 2.1831      | $3.78 \times 10^{-9}$ |
| $X_4$    | 1.3144      | $4.70 \times 10^{-10}$ |

The following are the results of the individual effects FEM model equations, as can be seen in Table 4

$$\hat{Y}_{it} = \hat{\alpha}_i + 0.9335 X_{1it} + 2.1831 X_{3it} + 1.3144 X_{4it} + \varepsilon_{it}$$

The value of the variable expected years of schooling, mean years school, life expectancy at birth has a favorable effect on HDI, according to Table 4. According to the value of each coefficient, if the predicted length of schooling, the average length of schooling, or life expectancy increases, the HDI value will also increase.

Table 5. Significant FEM individual effect model test result

| Variable | Coefficient | Probability Value |
|----------|-------------|-------------------|
| $X_1$    | 0.7974273   | 0.004702          |
| $X_2$    | -0.0569077  | 0.031139          |
| $X_3$    | 1.15169314  | $3.44 \times 10^{-6}$ |
| $X_4$    | 0.6305251   | $9.45 \times 10^{-13}$ |
| $X_5$    | 0.0017921   | 0.037762          |
| $X_6$    | 0.1157241   | 0.0000503         |

The following are the results of the time effects FEM model equations, as can be seen in Table 5

$$\hat{Y}_{lt} = \hat{\alpha} + 0.7974273 - 0.0569077 + 1.15169314 + 0.6305251 + 0.0017921 + 0.1157241 + \varepsilon_{lt}$$

The value of the variable expected years of schooling, mean years school, life expectancy at birth, health facilities, and adjusted per capita expenditure has a favorable effect on HDI, according to Table 5. According to the value of each coefficient, if the projected expected years of schooling, mean years of school, life expectancy at birth, health facilities, and adjusted per capita expenditure are modified to increase, the HDI value will also grow. The school participation rate variable, on the other hand, has a negative value in the equation. This means that as the value of the school participation rate rises, the HDI value decreases.

Table 6. Significant REM time effect model test result

| Variable | Coefficient | Probability Value |
|----------|-------------|-------------------|
| Constant | 1.09137     | 0.8738            |
| $X_1$    | 1.23972     | $7.726 \times 10^{-12}$ |
| $X_3$    | 1.68356     | $7.048 \times 10^{-12}$ |
| $X_4$    | 0.62437     | $3.077 \times 10^{-09}$ |
| $X_7$    | -0.60631    | $1.243 \times 10^{-05}$ |

The following are the results of the REM model equations base on Table 6:

$$\hat{Y}_{lt} = 1.09137 + 1.23972 X_{1lt} + 1.68356 X_{3lt} + 0.62437 X_{4lt} - 0.60631 X_{7lt} + \psi_{lt}$$
Table 6 shows that the variables expected years of schooling, mean years of school, and life expectancy at birth all have positive coefficients, which means that when the HDI value rises, the value of each of these variables rises by the coefficient value. While the variable percentage of the poor people has a negative coefficient, the HDI value will fall by the coefficient value if the percentage value of the poor increases.

4.3. Method of Regression Panel

| Table 7. Result Chow Test |
|---------------------------|
| **Effect Test**           | **Statistic** | **Probability Value** |
| Cross-section F           | 33.236        | 1.216 x 10^{-14}     |

The Fixed Effect Model is the best model if the probability value is less than the value of the significance level \( \alpha = 0.05 \) and it rejects \( H_0 \), as shown in Table 7.

| Table 8. Result Hausman Test |
|-----------------------------|
| **Test Summary**            | **Chi-Sq. Statistics** | **Probability Value** |
| Cross-section random        | 239.93                | 2.2 x 10^{-16}        |

Table 8 shows that the probability value is less than the significance level \( \alpha = 0.05 \), so it is rejected, indicating that the Fixed Effect Model is the best selection. The Fixed model was used in the study and was based on the Chow and Hausman tests.

4.4. Classic Assumption test

4.4.1 Normality Test. The results obtained were based on the normality test using the follow jarque test, the probability value \( 0.9192 > \alpha = 0.05 \) the residual data is normally distributed. With Jarque Bera's residual value of \( 0.16852 < \chi^2_{0.05,2} = 3.84146 \).

4.4.2 Multicollinearity Test. The multicollinearity test is used to see if an independent variable in one model correlates with other independent variables. There must be no correlation between the independent variables in a decent regression model.

| Table 9. Result Multicollinearity Test |
|----------------------------------------|
| \( X_1 \) | \( X_2 \) | \( X_3 \) | \( X_4 \) | \( X_5 \) | \( X_6 \) | \( X_7 \) |
| 1         | 0.214945 | 0.889158 | 0.363925 | -0.29046 | 0.658376 | 0.056828 |
| 0.214945  | 1        | 0.164669 | 0.332067 | -0.63131 | 0.097029 | 0.290544 |
| 0.889158  | 0.164669 | 1        | 0.640929 | -0.23540 | 0.808790 | -0.14668 |
| 0.363925  | 0.332067 | 0.640929 | 1        | -0.38976 | 0.613431 | -0.45796 |
| -0.29046  | -0.63131 | -0.23540 | -0.38976 | 1        | -0.18315 | -0.25298 |
| 0.658376  | 0.097029 | 0.808790 | 0.613431 | -0.18315 | 1        | 0.265275 |
| 0.056828  | 0.290544 | -0.14668 | -0.45796 | -0.25298 | -0.26527 | 1        |

Based on Table 9 values of the correlation coefficient between the independent variables < 0.9, it is free from multicollinearity symptoms.

4.4.3 Heteroscedasticity Test. Heteroskedasticity testing is used to determine whether there is an inequality of variance between one residual and another observation in the regression model. Determine if the residual variance-covariance structure is homoscedastic or heteroscedastic. The Breusch Pagan value was calculated using the results of the heteroscedasticity test. The Breusch Pagan value is 28.47 < \( \chi^2_{0.05,19} = 30.1435 \) and the probability value \( (0.07878) > \alpha = 0.05 \). And Accept \( H_0 \), which indicates that the model's residual variance is homoscedastic.

4.4.4 Autocorrelation Test. The autocorrelation test is used to see if there is a correlation between confounding errors and residuals in the t-1 (prior) period in a linear regression model.
Table 10. Result Durbin Watson Test

| H₀ should be rejected | It is impossible to decide | Is not reject H₀ | It is impossible to decide | H₀ should be rejected |
|----------------------|-----------------------------|------------------|-----------------------------|----------------------|
| This indicates      |                             | There is no      |                             | This indicates       |
| the autocorrelation |                             | autocorrelation  |                             | that the autocorrelation |
| is positive.        |                             | in this case     |                             | is negative.         |
| 0 d_L               | 2 d_u                       | 4- d_u           | 4- d_L                      | 4                    |
| 1.26                | 1.86                        | 1.87             | 2.74                        |

The Durbin-Watson value is 1.4033, based on the results of the autocorrelation test using the Durbin Watson test. This value falls between the dL and dU values of 1.26 and 1.86 (as shown in Durbin Watson with n=52 and k=7, Table 10), rejecting H₀. The rejection of H₀ can be read as a sign that the autocorrelation test's value cannot be determined and so cannot be used to make a decision.

4.5. Parameter Significance test

4.5.1 Result F test using Individual Effect Model. The result of F_count(4,235) > F_table(0,415) as well as the probability value 2,22x10⁻⁶ indicate that rejecting H₀ indicates that the individual effect model has a considerable influence.

4.5.2 Result F test using Time Effect Model. The value of F_count(386,3) > F_table(0,413) as well as the probability value 2,22x10⁻⁶, H₀ rejects, indicating that the time effect model has a considerable influence.

4.5.3 Result t-Test Using Individual Effect Model

Table 11. Result t-Test Using Individual Effect Model

| Variable | t_count | Probability Value | t_table | Decision |
|----------|---------|-------------------|---------|----------|
| X₁       | 5.271   | 9.04 x 10⁻⁶       | 0.68038 | Significant |
| X₂       | -0.374  | 0.71070           | 0.68038 | No Sig. |
| X₃       | 6.938   | 7.40 x 10⁻⁸       | 0.68038 | Significant |
| X₄       | 6.340   | 4.07x 10⁻⁶        | 0.68038 | Significant |
| X₅       | 1.325   | 0.19462           | 0.68038 | No Sig. |
| X₆       | 0.657   | 0.51562           | 0.68038 | No Sig. |
| X₇       | -0.970  | 0.33940           | 0.68038 | No Sig. |

Four factors have no significant effect utilizing individual effects with t_count > t_table and probability value.

4.5.4 Result t-Test Using Time Effect Model

Table 12. Result t-Test Using Time Effect Model

| Variable | t_count | Probability Value | t_table | Decision |
|----------|---------|-------------------|---------|----------|
| X₁       | 1.738   | 0.0897            | 0.68038 | No Sig. |
| X₂       | -1.868  | 0.0690            | 0.68038 | No Sig. |
| X₃       | 6.137   | 2.76 x 10⁻⁷       | 0.68038 | Significant |
| X₄       | 6.901   | 2.27x 10⁻⁸        | 0.68038 | Significant |
| X₅       | 1.257   | 0.2160            | 0.68038 | No Sig. |
| X₆       | 2.562   | 0.0142            | 0.68038 | No Sig. |
| X₇       | -1.060  | 0.2951            | 0.68038 | No Sig. |

There are 5 variables that have no significant influence using the time effect with t_count > t_table and probability value.

4.5.5 Result Coefficient Determination Using Individual Effect Model. The results of measuring the coefficient of determination using the individual effect model were obtained from the study's findings value coefficient 0.9664 or the independent variable in the individual impact model's Fixed Influence Model has a 96.64% effect.
4.5.6 **Result Coefficient Determination Using Individual Effect Model.** The results of measuring the coefficient of determination using the time effect model were obtained from the study's findings value coefficient 0.981 or the independent variable in the individual impact model's Fixed Influence Model has a 98.1% effect.

5. **Conclusion**

The following conclusions are drawn from the findings and discussion.

1. Based on the results of descriptive statistical analysis, the average value of the Human Development Index (HDI) in the Province of South Kalimantan and other independent variables used in the study is relatively increasing every year.

2. The best model that can explain the independent variable on HDI is the Time Effect Model. This shows that the proportion of diversity of HDI in South Kalimantan can be explained by expectations of years of schooling, school enrollment rates, average years of schooling, life expectancy, health facilities, and adjusted expenditure per capita.

3. Based on the Chow test and Hausman test, the best panel regression model that is suitable for HDI modeling in South Kalimantan starting from 2015 to 2018 is the Fixed Effect Model using the time effect with the following panel regression equation:

\[
Y_{it} = \beta_0 + \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \beta_4 D_4 + \beta_5 X_1 + \beta_6 X_2 + \beta_7 X_3 - \beta_8 X_4 - \beta_9 X_5 + \beta_{10} X_6 - \beta_{11} X_7
\]

**References**

[1] BPS 2015 *Indeks Pembangunan Manusia 2014 (Metode Baru)* (Jakarta: Badan Pusat Statistik)

[2] Shaw D J 1991 *Human development report, 1990* In Futures 23.

[3] BPS Kalimantan Selatan 2020 *Indeks Pembangunan Manusia (IPM) Provinsi Kalimantan Selatan Tahun 2019* (Kalimantan Selatan: BPS Kalimantan Selatan) 1–8

[4] Asyiah N 2018 Analisis Regresi Data Panel Dengan Pendekatan Common Effect Model (CEM), Fixed Effect Model (FEM), dan Random Effect Model (REM) Studi Kasus: IPM Kalimantan Selatan Periode 2010-2016 (Yogyakarta: Universitas Islam Indonesia)

[5] Ibe O C 2014 *Introduction to Descriptive Statistics Fundamentals of Applied Probability and Random Processes* (Massachusetts: Elsevier)

[6] Gujarati, D N 2004 *Basic Econometrics Fourth Edition* (United States: Mc Graw Hill)

[7] Alwi W, Rayyan I, Nurfadillah K 2018 Analisis Regresi Data Panel Pada Faktor-Faktor Yang Mempengaruhi Tingkat Kemiskinan Provinsi Sulawesi Selatan Tahun 2011-2015 Jurnal Matematika dan Statistika serta Aplikasinya 2 30–44

[8] Pangestika S 2015 Analisis Estimasi Model Regresi Data Panel Dengan Pendekatan Common Effect Model (Cem), Fixed Effect Model (Fem), Dan Random Effect Model (Rem) (Semarang: Universitas negeri Semarang)

[9] Astuti A M 2010 Fixed Effect Model pada Regresi Data Panel Beta 3 134–145

[10] Baltagi 2014 *The Oxford Handbook of Panel Data Journal of Materials Processing Technology* 1 3–661

[11] Srijadriani M and Mustafid A P 2016 Metode regresi data panel untuk peramalan konsumsi energi di indonesia Jurnal Gaussian 5 475–85

[12] Greene W H 2000 *Econometric Analysis 4th Ed* (UK: Springer)

[13] Astuti T D and Maruddani D A I 2012 Analisis Data Panel Untuk Menguji Pengaruh Risiko Terhadap Return Saham Sektor Farmasi Dengan Least Square Dummy Variable Media Statistika 2 71–80