Factors That Influence Dependency Ratio In Sumatera Island

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Abstract: This study examines the impact of education level, life expectancy, and per capita income on the dependency ratio in Sumatra Island using panel data regression. The research utilizes cross-sectional data from 10 provinces over the period 2011–2020. The analysis involves selecting the best-fit model through Chow, Hausman, and Lagrange Multiplier tests, ultimately identifying the Random Effects Model (REM) as the most suitable. Hypothesis testing includes t-tests and F-tests to evaluate the significance of independent variables. Results indicate that education level and life expectancy negatively and significantly affect the dependency ratio, while per capita income has a positive and significant effect. The model explains 60% of the variation in the dependency ratio, highlighting the importance of improving education and workforce readiness to reduce dependency. This research contributes to understanding the demographic and economic factors influencing dependency ratios in the context of Sumatra Island.

Keywords: Dependency ratio, Education level, Life expectancy, Per capita income.

1 Background

The dependency ratio represents the proportion between the unproductive population, comprising individuals aged 0–14 years and above 65 years, while the productive population aged is 15–64 years. This metric reflects the economic burden on the working-age group (15–64 years) to support dependents outside this age range. If the proportion of the working population is large, it will benefit the country if it is able to produce (from the workforce) in such a way that the wheels of the economy can run well.

In 2020, the dependency ratio of the productive age population in Indonesia was 44.33%. This indicates that approximately 44 to 45 percent of every 100 individuals in the non-productive age group in Indonesia rely on the productive age population. Meanwhile, the dependency ratio on the island of Sumatra averaged 49.2% between 2011 and 2020. The province with the highest dependency ratio on Sumatra Island is North Sumatra Province with a dependency ratio of 56.33%, while the lowest is in Jambi Province with a ratio of 32.10%. If more people have the ability to work and earn money, then dependence on social assistance will decrease. [1] One way to work well is through achieving a good level of education. Sumatra Island has an average length of education of 8.5 years during 2011 - 2020. The highest average is in the Riau Islands Province. Meanwhile, the province with the lowest average length of schooling is in the Bangka Belitung Islands Province.

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The average period of finishing study on Sumatra Island in this study was 69.5 years. This means that more people will finish high school and have the ability to work in higher fields, which will reduce the dependency ratio. If life expectancy is high, more people will live to old age and fewer people will be unemployed, conversely, if life expectancy is low, more people will die young and more people will be unemployed [2].

The average Gross Regional Domestic Product (GRDP) per capita on the island of Sumatra for the period 2011–2020 reveals that the Riau Islands Province recorded the highest average per capita income, amounting to 77,503 million rupiah. While Bengkulu become the province with a lowest per capita income that is 20,617 million rupiah in average. When the per capita income is high, the dependency ratio will be lower because the community will be less dependent on the government or other institutions to fulfill their basic needs. While in the low condition of per capita income, the community will be more dependent on the government or other institutions to meet their needs, which means the dependency ratio will increase. [1].

Based on the background explained above, this study focuses to analyze the effect of education level, life expectancy, and per capita income on the dependency ratio of Sumatera Island.

2 Theoretical basis

A demographic bonus refers to the economic advantage that arises from a gradual decline in the dependency ratio, driven by decreasing birth rates and increasing life expectancy [3]. The National Population and Family Planning Agency (BKKBN) claims that the increase of people on the productive age range (ages 15 to 64) is a demographic bonus. Therefore, A change in population composition that alters the distribution of age groups is referred to as demographic growth. Demographic bonus occurs when the amount of productive populations is higher than the amount of unproductive populations. This will affect the dependency ratio and reduce the economic costs that must be borne by the productive population compared to the unproductive population. The dependency ratio is explained as the ratio of the population that is too young or too old to work compared to the population that is of working age [4].

The hypothesis of this study such as the level of education and life expectancy are expected to have a negative and significant affected on the dependency ratio of Sumatra Island. While per capita income is expected to have a positive and significant affected on the dependency ratio of Sumatera Island.

3 Data Types and Sources

The employed model is a panel model, utilizing cross-sectional data from ten provinces on the island of Sumatra across a decade, specifically from 2011 to 2020.

Table 1. Variable Research

Variables	Symbol	Unit	Data source
Dependency Ratio	DR	Ratio	BPS
Level of education	EDU	Year	BPS
Life Expectancy	LE	Percent	BPS

Income per capita	IC	Thousands of Rupiah	BPS

3.1 Panel Data Regression Model

$$DR = \beta o + \beta_1 EDUit + \beta_2 LEt + \beta_3 ICit + \epsilon t$$

Information:

DR	= Dependency Ratio
EDUit	= Level of Education
LEit	= Life Expectancy
ICit	= Per Capita Income
βo	= Constant
β_1, β_2 and β_3	= Coefficient
ϵt	=*Error Term*

3.2 Best Model Selection Method

a. Chow Test

According to [3], the Chow test compares the typical effect model with fixed effects. The following are the hypotheses that emerge from the Chow test:

Ho : General Effect Model
Ha : Fixed Effect Model

If Chi Square is more than 0.05 means accepting Ho and rejecting Ha. Thus, the best model used is Common Effect Model, while if Chi Square is less than 0.05 then Ho is rejected means Fixed Effect Model is the best model.

b. Hausman Test

This test used to decide whether fixed effects model or random effects model is the best model for this study [4]. The hypothesis as follows:

Ho : Random Effects Model
Ha : Fixed Effect Model

The assessment of the Chi Square statistical probability value is carried out before a hypothesis is accepted or rejected. Ha reject and Ho are accepted if the Chi Square probability is higher than 0.05. Therefore, the Fixed Effect Model is used. Ho is rejected and the Random Effect Model is applied if the Chi Square statistical probability is less than 0.05.

3.3 Hypothesis Testing

1. t-test
   a.) Level of education

H0 : $\beta 1 \geq 0$ means the level of education has not negative effect on dependency ratio.

Ha: $\beta 1<0$ means that the level of education has negative effect on dependency ratio.

b.) Life Expectancy

H0 : $\beta 2 \geq 0$ means that Life Expectancy has not negative effect on dependency Ratio.

Ha: $\beta 2<0$ means that Life Expectancy has negative effect on dependency Ratio.

c.) Income per capita

H0 : $\beta 3 \leq 0$ means that Per Capita Income has not positive effect on dependency Ratio.

Ha: $\beta 3> 0$ means that Per Capita Income has positive effect on dependency Ratio.

2. If t count > t table, means rejecting Ho, thus the independent variable partially has significant effect on dependent variable.
3. If t count < t table, means accepting Ho, thus the independent variable partially has not significant effect on dependent variable.

a. F Test

The hypothesis in this test is:

H0 :$\beta 1$, $\beta 2$, $\beta 3= 0$ The independent variables do not have significant effect simultaneously on dependent variable.

Ha :$\beta 1$, $\beta 2$, $\beta 3\neq 0$ The independent variables have significant effect simultaneously on dependent variable.

The decision for this hypothesis, ff the F-count value is higher than the F-table value, means rejecting Ho and accepting Ha. Thus, independent variables affect dependent variables simultaneously. Conversely, if the F-count value is less than the F-table value, means independent variable do not have affect simultaneously to dependent variable.

4 Results and Discussion

4.1 Panel Data Model Test

Chow Test

Table 2. Chow Test Result

Overtesting of Fixed Effects
Similarities: Untitled
Cross-sectional fixed effects test

Effect Test	Statistics	df	Possible.
Cross section F	261.508991	(9.87)	0.0000
Chi-square cross section	333.408325	9	0.0000

Based on Chow Test, the chi square value was obtained 0.0000 <0.05, means rejecting Ho and accepting Ha. So, the Fixed Effect Model (FEM) is the appropriate model.

Hausman test

Table 3. Hausman Test Result

Correlated Random Effects - Hausman Test
Similarities: Untitled
Cross-sectional random effects test

Test Summary	Chi-Sq Statistics	Chi-Sq.df (Chi Equation)	Possible.
Random cross section	3.653645	3	0.3014

Based on the Hausman test, a probability value is 0.3014 or more than 0.05. Thus, accepting Ho, means the best model to be used is the Random Effect Model (REM).

4.2 Lagrange Multiplier (LM) Test

Lagrange Multiplier Test used to determine the more appropriate Random Effects Model and General Effects Model to use. The Chow Test and the Hausman Test produce a Fixed Effects model, but the LM test is used when both produce a random effects model and a general effects model.

Table 4. Lagrange Multiplier (LM) Test Estimation Results

	Hypothesis Testing Cross section	Time	Both of them
Breusch Paganism	389.4258 (0.0000)	2.896377 (0.0888)	392.3222 (0.0000)
Honda	19.73388 (0.0000)	-1.701875 (0.9556)	12.75055 (0.0000)
King Wu	19.73388 (0.0000)	-1.701875 (0.9556)	12.75055 (0.0000)
Honda Standardization	28.79780 (0.0000)	-1.497975 (0.9329)	12.56922 (0.0000)
Standardized King Wu	28.79780 (0.0000)	-1.497975 (0.9329)	12.56922 (0.0000)
Gourieroux, et al.	--	--	389.4258 (0.0000)

Source: Eviews. Processed data

Since the Breusch-Pagan probability value is 0.0000 < 0.05, the best model according to the LM test is the Random Effects Model. This test showed that Random Effects Model is the most appropriate model to this study.

4.3 Estimation results

Table 5. Cross-section effect result

Variables	Coefficient	Standard Error	Statistics t	Possible.
C	201.9738	28.92400	6.982915	0.0000
EDU	-1.070862	0.583572	-1.835013	0.0696 years
LE	-2.170474	0.480564	-4.516510	0.0000
IC	0.186175	0.040010	4.653170	0.0000

The regression equation of Random Effect Model as follows:

DR = 201.9738 -1.070862EDU - 2.170474LE +0.186175IC

R^2 = 0.605956

Fstat = 49.20 (0.000)

Table 6. Coefficient Information

Coefficient	Information
β0	The value of 201.9738 means that if all independent variables are constant or unchanged, the dependency ratio will increase by 201.9738%.
β1	The value of -1.070862 means that if the level of education increases by 1 year, dependency ratio will decrease by 1.070862% assuming ceteris paribus.
β2	Sign -2.170474it can be interpreted that if life expectancy increases by 1 year, dependency ratio will decrease by2.170474% assuming ceteris paribus
β3	Sign0.186175it can be interpreted that if per capita income increases by 1 million rupiah, dependency ratio will decrease by0.186175%assuming ceteris paribus

4.4 Classical Assumption Test

When performing linear regression analysis using ordinary least squares, statistically, classical hypothesis testing is required. The dependent variable in OLS is single, even though there are several separate factors.

a.) Normality Test

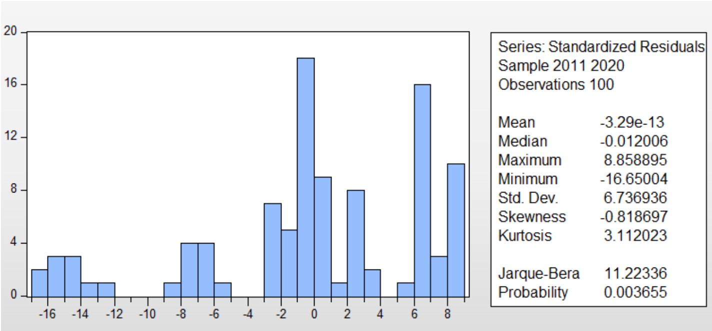

Fig.1. Normality Test

Based on the results, the Jarque-Bera P value is 11.22336, meaning it is higher than 0,05. Thus, the data in this study is normally distributed.

b.) Multicollinearity Test

This detection is for testing whether there is a perfect or imperfect linear relationship between the independent variables used. This detection uses the correlation method. In the following fixed effect model (FEM).

Table 7. Multicollinearity Test

	X1	X2	X3
X1	1.000000	-0.079876	0.544899
X2	-0.079876	1.000000	0.451991
X3	0.544899	0.451991	1.000000

Source: Processed data.

From the estimation results, it can be concluded that none of the independent variable values exceed 0.8. Thus, there is no multicollinearity problem in any of the independent variables.

c.) Heteroscedasticity Test

To find out the inequality of residual variance in model, the Heteroscedasticity Test is applied by conducting certain probability values and degrees of freedom are used that correspond to the variables.

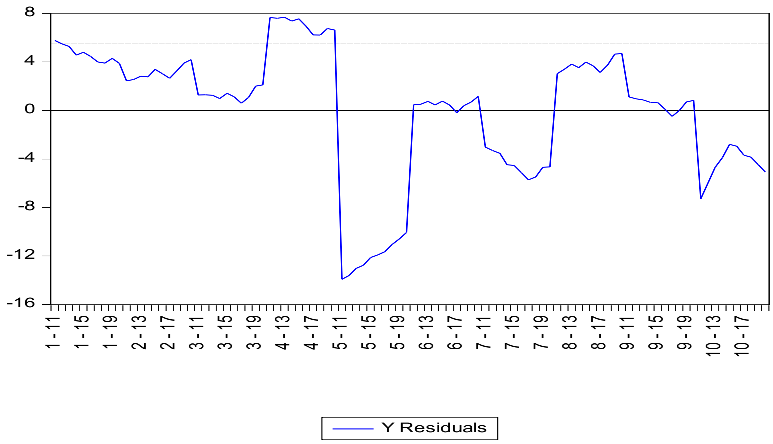

Fig. 2. Heteroscedasticity Test

Source: Processed data.

Based test estimation result, the residual graph is still at a value of 500 to -500, so it can be concluded that there is no heteroscedasticity in the research model [7].

4.5 Hypothesis Testing

a. t-statistic test

The t-statistic test is to decide whether each variable is significant. If the variable is considered significant, then the variable can be used or is valid.

Table 8. t-Test Results Table

Variables	T Statistics	T Table	Probability	Conclusion
X1	-1.835013	1.66105	0.0696	H0 is rejected
X2	-4.516510	1.66105	0.0000	H0 is rejected
X3	4.653170	1.66105	0.0000	H0 is rejected

Source: Processed data

Education Level

Testing was done using α = 0.1 with df 94, the t-table value was 1.66105. The t-stat value (-1.835013) > t-table (1.661) so that rejecting Ho. Thus, the education level variable has negative and significant effect to Dependency Ratio.

Life Expectancy

Testing was done using α = 0.05 with df 96, the t-table value was 1.66105. The t-stat value (-4.516510) > t-table (1.66105) so that rejecting Ho. Thus, the Life Expectancy variable has negative and significant effect to dependency Ratio.

Income per capita

Testing was done using α = 0.05 with df 94, the t-table value was 1.66105. The t-stat value (4.653170) > t-table (1.66105) so that rejecting Ho. Thus, per capita income variable has positive and significant effect to dependency Ratio.

b. F statistical test

Table 9. F statistical test result

F α statistic	Table F	Possible	Conclusion
49.209220.05	2.46	0.0000	H0 is rejected

Source: Eviews. Processed data

The test was conducted using n of 100.α = 0.05. df1 = 4. df 94, then F-table value is 2.46. The results of the study indicate that independent variables affect the dependency ratio simultaneously and collectively. because the f-table value49.20922> f-table 2.46. This finding shows that the dependency ratio is significantly influenced by the independent variables.

c. Coefficient of Determination (R2)

Table 10. Coefficient of Determination (R2)

Model	R2	R2 customized
Random Effects	0.605956	0.593642

Source: Eviews. Processed data

The coefficient of determination (R^2) helps assess the model's capacity to elucidate the dependent variable. The findings indicate a coefficient of determination (R^2) of 0.605956, equivalent to 60 percent. This means the independent variables can explain the dependent variable by 60 percent, the rest is affected by other variables excluded from model.

5 Conclusion

The conclusion of this study are the level of education and life expectancy have negative effect and significant to dependency ratio. While per capita income has positive effect and significant to dependency ratio. The suggestion on this study are conducting collaboration among government sector, non-government sector and private sector to design and implement specific programs for reducing dependency ratio by focusing on the improvement of education and skills for workforce so that they ready on job market, then finally increase per capita income of the people.

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