The effect of financial inclusion on poverty rate in Sumatra Island

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Abstract
Purpose: Poverty is still one of the main problems faced by developing countries like Indonesia, despite having experienced significant economic progress in recent decades. Economic inequality in Indonesia can be illustrated through an inverted triangle pattern, where most people live in poverty, while a handful of groups enjoy prosperity. Although the poverty rate in Indonesia is decreasing, there are still regions, especially on the island of Sumatra, that record higher poverty rates than other regions. In this case, financial inclusion is one of the solutions that is considered effective to reduce poverty. Access to adequate financial services provides opportunities for poor people to improve their well-being through savings, credit, or insurance. In addition, price stability is also important in poverty control. This study aims to analyze the influence of financial inclusion and inflation on poverty reduction on the island of Sumatra in the period 2017 to 2023.

Research methodology: This study uses a quantitative approach with panel data from 10 provinces on the island of Sumatra.

Results: The results of the regression analysis showed that the Financial Inclusion Index (IKK) had a significant negative effect on the poverty rate. In addition, inflation also has a significant negative effect on the poverty rate.

Keywords: *Financial Inclusion Index, Inflation, Poverty, Panel Data, Economy*

How to Cite: Rosyadi, I., Gunarto, T., & Yuliawan, D. (2025). The effect of financial inclusion on poverty rate in Sumatra Island. *Journal of Multidisciplinary Academic and Practice Studies,* 3(1), 129-147.

1. Introduction

Developing countries, such as Indonesia, often face major challenges in achieving equitable economic progress. This phenomenon can be described using an inverted triangular pattern, where at the bottom of the triangle there is a large layer of people living in poverty, while at the top there is a small group that enjoys wealth and prosperity. This pattern illustrates the economic inequality that occurs in many developing countries, where a large portion of the population does not have adequate access to adequate economic resources, education, and health services (Rahman, Firman, & Rusdinal, 2019).

Although Indonesia's economic growth has been stable in recent decades, poverty is still a problem that must be seriously addressed. Developing countries tend to have higher poverty rates, and these problems are often linked to factors such as unequal income distribution, low levels of education, limited access to basic services, and financial services. This exacerbates social and economic inequalities, and hinders overall economic development (Asep Deni et al., 2024).

Poverty is one of the main problems that continues to be a global concern, especially in developing countries, including Indonesia. Although Indonesia has experienced various economic advances in recent decades, the problem of poverty remains a serious challenge that is not easy to overcome (Asep Deni et al., 2024).

Poverty often hinders people's access to basic services, such as education, health, and decent work, which in turn affects their quality of life. In addition, poverty also has an impact on widening social and economic inequality, hampering sustainable economic growth, and worsening income inequality among people. Therefore, reducing poverty and socio-economic inequality is one of the main goals of economic development in Indonesia, especially in areas that still have high poverty rates such as several provinces on the island of Sumatra (Ningrum, Sumarno, Nursyamsi, & Siregar, 2024).

One of the ways that is considered to be able to reduce poverty is to increase the level of financial inclusion. Financial inclusion refers to the provision of financial services that are affordable and accessible to all levels of society, especially those in low-income groups and have difficulty accessing formal financial services. With access to financial services, people, especially the poor, can improve their well-being through savings, credit, or insurance. These financial services also allow them to start or develop micro and small businesses that can ultimately increase income and reduce poverty (Ariani, Rahmawati, & Anggraini, 2024).

According to the Financial Services Authority (OJK), the definition of financial inclusion is the availability of various financial institutions, products and services that are in accordance with the needs and capabilities of the community in order to improve people's welfare. The goal of financial inclusion itself is to achieve economic growth with equal distribution of income in order to reduce poverty and contribute to financial system stability

Financial inclusion requires a measure of performance commonly called *the Financial Inclusion Index* (IFI). This IFI can combine several information from various dimensions of a financial inclusion system, namely access, use, and quality of banking services. In this study, the data that will be used as *a dependent variable* is the financial inclusion index variable obtained from the results of a survey conducted by the OJK, namely the National Survey of Financial Literacy and Inclusion (SNLIK).

The role of financial inclusion in reducing poverty is very important, especially in areas with high poverty rates such as on the island of Sumatra. Research by Tran and Le (2021), Omar and Inaba (2020), and Inoue (2019) shows a positive influence between increasing financial inclusion and poverty. Increased access to finance can provide opportunities for poor individuals to start micro-businesses, obtain the necessary financing, and have safer savings, which will ultimately increase incomes and reduce dependence on the informal sector. In addition, with access to financial services, people can also more easily access protection through insurance that can protect them from unexpected economic risks (Ekawati & Yudoko, 2024; Thalib, Kuntuamas, Umar, & Sulastri, 2023).

However, although financial inclusion has great potential in reducing poverty, its implementation in certain regions of Indonesia, such as on the island of Sumatra, still faces various obstacles. The existence of inequality in financial access between regions, especially between urban and rural areas, as well as limited public understanding of financial products and services, is a challenge that must be overcome. Therefore, it is important to further analyze the influence of financial inclusion on poverty on the island of Sumatra, which has diverse economic and social characteristics (Sutama, Nyoman Diah Utari, & Luh Riniti, 2023).

Based on this explanation, along with the reduction of poverty in Indonesia, financial inclusion continues to increase from year to year. However, some provinces in Sumatra still experience quite high poverty compared to the national figures. Therefore, this study aims to analyze how financial inclusion can affect poverty reduction on the island of Sumatra. The period used is 2017 to 2023. This study will explore the influence between the level of financial inclusion in each province and the existing poverty rate, to find out the extent to which access to financial services contributes to reducing poverty rates in the region. This study will also use control variables that are suspected to have an effect on poverty, namely Inflation (Amagir, van den Brink, Groot, & Wilschut, 2022; Behnezhad, Razmi, & Sadati, 2021; Blanchard & Johnson, 2017; Hasbullah, Murti, Jasin, & Nugroho, 2022; Hastjarjo, 2023; Iyer, 2024).

Several studies have shown that increasing access to the financial sector will reduce poverty and income inequality, including research by Tran and Le (2021), Omar and Inaba (2020), and Inoue (2019). Meanwhile, in Indonesia, the government considers the level of financial inclusion to be low, so the government promotes the development of the financial sector in various ways in the hope of reducing poverty and inequality. This is a question of whether strategies to increase financial inclusion can reduce poverty levels.

There are even some opinions that state that financial inclusion campaigns are just a marketing strategy from the banking sector to get more profits. Expanding banking access for the poor and remote communities is considered a strategy to increase *funding* as a absorber of community funds, while then the funds will be channeled to urban communities who are considered more *bankable* than remote and poor communities. This will then be able to further increase inequality. In general, this study aims to determine the influence of financial inclusion on poverty levels in 10 provinces on the island of Sumatra.

2. Literature review
2.1 Financial Inclusion
According to Bank Indonesia, financial *inclusion* is a term that became widely known after the 2008 crisis. Because at that time the crisis had a considerable impact on the lower strata of society. Because at that time the crisis had a considerable impact on the lower strata of society, namely those who had low and irregular incomes, lived in remote areas, disabled people, workers who were not legally registered, and so on, who were generally not considered worthy by banks (*unbankable)* who were listed high in developing countries.

The term financial inclusion itself does not yet have a standard definition. There are several definitions issued by different institutions or researchers but have more or less the same meaning. In his research, which is one of the main references for financial inclusion researchers, Sarma (2012) defines the concept of financial inclusion as a process to create ease of access to formal financial institutions, the availability of services and financial institutions, and the use of formal financial institutions for all levels of society. Meanwhile, according to Murtadlo and Sulhan (2023), financial inclusion is a condition of ability or literacy in making decisions, the availability of access to financial service institutions according to what is needed. *The World Bank* (2014) succinctly defines financial inclusion as the sum of the proportion of individuals and companies that use financial services. Meanwhile, according to Bank Indonesia (2014), financial *inclusion* is a variety of efforts made to eliminate all kinds of obstacles faced by the public in accessing financial services. According to the Financial Services Authority (2017), financial inclusion is the availability of access to various financial institutions, products and services in accordance with the needs and capabilities of the community in order to improve people's welfare.

Presidential Regulation of the Republic of Indonesia (Perpres) No. 114 of 2020 concerning the National Strategy for Inclusive Finance (SNKI) formulates one way to achieve the goal of financial inclusion is to strengthen the integration of inclusive economic and financial activities through at least digital financial services. This method, based on the Regulation of the Coordinating Minister for Economic Affairs (Permenko) Number 4 of 2021 concerning the Implementation of the National Strategy for Inclusive Finance, is carried out, among other things, through strengthening inclusive finance integrated with economic empowerment, at least implemented for low-income groups, Micro and Small Business actors, and cross-group communities

To measure the level of inclusive finance in a country, several indicators can be used. The first is the level of availability/access to financial institutions, to measure how far formal financial services can be afforded both physically and pricewise. Second, the level of use, to find out how the actual use of financial products and services is (including the regularity of use, how often to use and the length of time of use). Third, the level of quality, to find out whether the completeness of financial products and services has been able to meet the needs of its users, and the level of welfare to measure how much financial services can have an impact on the lives of financial service users.

Several studies separate the concept of access to financial services from the concept of using financial services. The availability of access to financial services can be determined by the number of banking office networks and *ATM outlets* spread across a region, while usage is measured by the number of savings and credit accounts distributed (World Bank, 2009). Sarma summarized these various concepts into a new form of concept, namely *the Index of Financial Inclusion*. This index is used to measure how high the level of financial inclusion is within a country.

2.2 Inflation

Inflation is a condition in which there is a general and continuous increase in the price of goods and services in a country's economy over a certain period of time. Inflation reflects a decline in the purchasing power of money, which can affect all aspects of the economy, from household consumption to monetary policy (Mishkin, 2007). Inflation is usually measured using the consumer price index (CPI), which records changes in the prices of goods and services typically purchased by consumers (BPS, 2023).

According to Blanchard and Johnson (2017), inflation can arise due to several factors, including: an increase in aggregate demand that exceeds production capacity, an increase in production costs, or changes in inflation expectations that affect economic decisions. On the other hand, deflation is the opposite of inflation, which is a decline in the prices of goods and services in general, which is often associated with an economic contraction or recession (Mishkin, 2007).

Inflation is measured using the Consumer Price Index (CPI), which records changes in the prices of a group of goods and services that consumers usually buy in their daily lives. These goods are grouped into several categories such as food, housing, transportation, and education (BPS, 2023). The CPI provides an overview of consumers' purchasing power and changes in their cost of living.

2.3 Poverty

In the *Handbook on Poverty and Inequality* (Haughton and Khandker, 2009) published by The World Bank, the definition of poverty according to the World Bank is the inability to obtain *well-being*. Amartya Sen, Nobel laureate in economics for his work in welfare economics, further argues that poverty can arise when a person does not have the main key skills, so that one's income is insufficient, or inadequate education, or the emergence of fear and insecurity, or poor physical health, or lack of confidence, or a sense of powerlessness, or the non-fulfillment of rights such as the right to freedom of speech. and so on. In this view, the concept of poverty is a multidimensional phenomenon so it cannot be solved with simple solutions alone.

Meanwhile, the Central Statistics Agency (BPS) views poverty as an inability on the economic side to meet basic needs such as food and other food. To measure it, it is by looking at the expenditure side. Thus, the Poor Population is a population whose average expenditure per head (per capita) per month is below the poverty line. The definition of the poverty line (GK) according to BPS is the limit where a person can be said to be poor, this is determined from the standards of a country at a certain level of its economic development.

GK consists of two types, the first is the Food Poverty Line (GKM) and the second is the Non-Food Poverty Line (GKNM). GKM is the amount of population expenditure on minimum needs in the form of food which is equivalent to the amount of 2,100 kilocalories per capita per day. Commodities for basic food needs in the calculation are represented by 52 types of commodities, including rice, tubers, meat, fish, milk, eggs, vegetables, fruits, and so on). Meanwhile, GKNM is the minimum need in terms of housing (residence), clothing/clothing, education, and health. These non-food basic necessities commodities are represented by 51 types of commodities for urban areas and 47 types of commodities for rural areas. So GK is the sum of GKM plus GKNM. Then the population whose average per capita expenditure per month is below GK, is included in the category of poor people.

2.4 Conceptual Framework

Financial inclusion can have a significant impact in reducing poverty, especially in providing access to communities previously unreached by formal financial services. Koomson, Villano, and Hadley (2020) found that financial inclusion is associated with a reduced likelihood of households becoming poor and reduced exposure to poverty in the future. This suggests that by providing wider access to finance, people can more easily manage their consumption and productive activities, which in turn reduces their vulnerability to poverty. In addition, a study by Inoue (2018) also showed a significant negative relationship between financial inclusion and poverty ratio in India, indicating that access to better financial services can reduce people's dependence on limited resources and improve their well-being.

Inflation can worsen poverty conditions, especially for low-income groups. Fadlan and Lubis (2023) found that high inflation in Medan City increases poverty rates because rising prices reduce people's purchasing power, especially those in the poor group. Inflation reduces the real value of income, thereby reducing consumption and the quality of life of the poor. This is also suggested by Easterly and Fischer (2001), who point out that inflation has a worse impact on the poor, who do not have the resources to protect themselves from the impact of inflation. When inflation increases, poverty also tends to increase, because people with limited incomes are unable to keep up with the increase in the prices of goods and services.
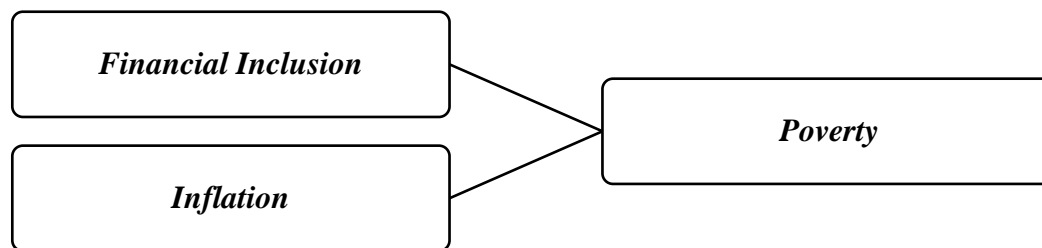

Figure 1. Conceptual Framework

2.5 Hypothesis Development
2.5.1 The effect of financial inclusion on poverty

Several studies have looked at the impact of financial inclusion on poverty. Koomson et al. (2020) examined the influence of financial inclusion on poverty and vulnerability in Ghanaian households. Using data taken from the Seventh Round of the Ghana Living Standards Survey in 2016-2017, multiple correspondence analysis was used to generate a financial inclusion index, and the least three-stage least quadratic method was used to estimate its vulnerability to poverty in households. The endogenicity associated with financial inclusion is solved by using the distance to the nearest bank as an instrument in the instrumental variable probit technique. The results show that although 23.4% of Ghanaians are considered poor, about 51% are vulnerable to poverty. We found that increased financial inclusion had two impacts on household poverty. First, it is related to a 27% reduction in the likelihood of households becoming poor. Second, it prevents household exposure to poverty in the future by 28%.

Inoue (2018) conducted a study on the impact of financial inclusion on poverty reduction in India. This study used panel data regression from 1973 to 2004 using the *generalized method of moments*. The results showed that financial inclusion and financial deepening had a statistically significant negative relationship with the poverty ratio for public sector banks, but not for private sector

banks. According to Park and Mercado Jr (2018), increasing financial inclusion can reduce poverty rates because more people are accessing financial services to help their consumption activities and for productive activities. However, the study also found that in developing countries in Asia, the relationship between financial inclusion and income inequality is weak.

On the other hand, several other studies reveal that financial development has not succeeded in reducing poverty and inequality. Seven and Coskun (2016) found that although financial development (as reflected in banking and capital markets) can increase economic growth in developing countries, it does not provide significant benefits to the poor and does not have a significant role in poverty reduction.

Another reason for the possible negative impact of financial sector developments on poverty is that rapid financial development (which is closely related to financial liberalization) without being accompanied by strong political/economic institutions, and a lack of prudent regulation and (or) supervision can lead to financial/economic crises that impact unemployment rates and a decline in real income levels (Seven and Coskun, 2016).

Guillaumont, Jeanneney and Kpodar (2008) argue that the positive impact of financial development on poverty reduction can be reduced or may even disappear altogether due to the instability of the financial sector due to the crisis.

H1 : Financial inclusion has a negative and significant effect on poverty

2.5.2   The Effect of Inflation on Poverty
According to Boediono (1999), inflation is the tendency of prices to increase overall and continuously. The occurrence of price increases in only a small number of goods is not included in the definition of inflation. What can be called inflation is when the price increase occurs widely or also results in a general increase in the prices of other goods. Therefore, it can be said that inflation is one of the several indicators of macroeconomic conditions that are important for a country.

The relationship between inflation and poverty can be explained in two ways. The first way, namely inflation, has caused the real value contained in money to decrease. So, when there is an increase in prices, the amount that money can buy becomes less, or purchasing power becomes reduced. The second way, namely inflation, causes the value of interest obtained from money storage in the bank to decrease, so that purchasing power also decreases. The decline in purchasing power has resulted in the condition of the community becoming poorer than the previous condition.

According to Easterly and Fischer (2001), inflation has a worse impact on the poor than the rich group. Rich people are better able and prepared to deal with inflation better, and some of them will even like inflation because they will get the potential to benefit from increased interest rates on financial instruments. Thus, the occurrence of inflation can result in an increase in the number of poor people and even worsen the conditions of those who are already in the poor group, so that inequality becomes wider.

Fadlan and Lubis (2023) examined the impact of inflation on poverty that occurred in Medan City in 2008-2020. This study uses the CFA (*Confirmatory Factor Analysis*) method and multiple linear regression. The results of this study show that the inflation variable has a significant influence on poverty in Medan City. Rising consumer prices (inflation) can lead to an increase in poverty. On the contrary, low inflation will reduce the poverty rate. This means that if inflation rises, poverty will also increase because inflation, which is characterized by rising prices, will cause people living in poverty to reduce their consumption levels because the value of the money they have (real income) is also getting smaller, thus reducing their consumption rate and causing the number of poor people to increase. When the inflation rate soars and the value of the real currency fluctuates very high, the rising inflation will in turn be followed by an increase in the poverty line as a result of the increase in the inflation rate, which will lead to an increase in the number of poor people if it is not followed by an increase in the purchasing power or an increase in the income of people, especially low-income

groups. For most people, those who do not have a permanent job or only work part-time are consistently in poverty.

Iyer (2024) examines the problems of inflation and poverty that occur in four BRIC countries. The BRIC countries studied include Brazil, Russia, India, and China. This study uses time series regression from 2000 to 2020. The results of the study show that inflation tends to have a significant and positive relationship with poverty rates.
H2 : Inflation has a positive and significant effect on poverty

3. Methodology
3.1 Research Approach
This research uses a quantitative approach, which is structured by connecting various components, phenomena, and relationships that exist in the research object. The goal of this approach is to develop a mathematical model by integrating relevant theories, previous research, and hypotheses related to an event. In the quantitative approach, the data used is in the form of numbers which are then analyzed using statistical techniques. This study uses panel data, which includes information from 10 provinces in Sumatra during the period 2017 to 2023.

3.2 Data Types and Sources
In this study, a financial inclusion index will be calculated to determine the level of financial inclusion on the island of Sumatra. Then, the financial inclusion index is included in the calculation to be able to find out what factors can affect the poverty rate in the 10 Sumatra Island Provinces for the 2017-2023 period. This study uses the type of secondary data obtained from other parties, or not directly from the research subject. Secondary data types are generally data in the form of documentation or in the form of available report data. In this study, data was obtained from data requests to the Financial Services Authority (OJK), the Bank Indonesia website, and the website of the Central Statistics Agency (BPS). The data is data according to 10 provinces in Sumatra during the 2017-2023 period, including banking, demographic, trade, poverty, and inequality data.

3.3 Analysis Method
3.3.1 Variables and Measurements
This study uses 1 dependent variable and 7 independent variables, while the measurement of each variable can be explained in the following table:

Table 1. Measurement of Research Variables

Notation	Variable	Variable Definition	Source
Pov	Poverty Rate	Percentage of the population of poor (%)	Central Statistics Agency (BPS)
POV (t-1)	Poverty Rate One Year Previous	Percentage of the population of poor (%) one year before	Central Statistics Agency (BPS)
Ikk	Financial Inclusion Index	An index that considers the three dimensions of financial inclusion, namely Accessibility, Availability, and Usage	Central Statistics Agency (BPS)
Inflation	Inflation	The rate of change in the Annual Consumer Price Index (yoy). Inflation is expressed as a percentage.	Central Statistics Agency (BPS)

The Financial Inclusion Index of 10 provinces on the island of Sumatra was measured by the method carried out by Sarma (2015), using three dimensions which are indicators of Financial Inclusion (IIK) as follows:
a. Accessibility

To measure the banking penetration rate of each province in the year t, the number of bank savings accounts per 1,000 adult population (>15 years old) was calculated

$$A_1 = \frac{Number\ of\ Bank\ savings\ accounts\ (year\ t))}{Number\ of\ Adult\ Population\ in\ year\ t}\ X\ \mathbf{1.000}$$

b. Availability

To measure the availability of banking services in each province in the twentieth year, the number of bank outlets is calculated by calculating a weighted average (*wighted average*) of 2/3 for office networks and 1/3 for ATMs per 100,000 adult population with the formula:

$$A_2 = \frac{\left(Number\ of\ Offices\ x\ \frac{2}{3}\right)_t + \left(Number\ of\ ATMs\ x\ \frac{1}{3}\right)_t}{Number\ of\ Adult\ Population\ in\ year\ t}\ X\ \mathbf{100.000}$$

c. Use of Banking Services

To measure the use of banking services in each province in the twentieth year, the nominal amount of credit and savings distributed by conventional commercial banks in each province is calculated divided by the GDP of that province. with the formula:

$$A3 = \frac{amount\ of\ credit\ disbursed\ (year\ t) + third\ party\ funds\ (year\ t)}{PDRB\ (year\ t)}$$

The financial inclusion index can be calculated if the value of each dimension is known. The index of each dimension The formula of the equation above shows that the higher the value, the higher the achievement of an area in the i dimension. For example, the higher the 'availability' dimension index in a province, the higher the number of banking services that can be accessed by the public in that province.

As per the IFI calculation method by Sarma (2015), the determination of the lower limit value is determined by a value of 0 for all dimensions, while the determination of the upper limit uses the 90th percentile of the value of each dimension. The use of the 90th percentile is carried out because if the determination of the limit uses the highest value in each dimension, this will have the potential to cause bias on the value scale if the highest value data is *an outlier* from other data, thus causing other provincial data to have to face   *a benchmark* value that is too high. Furthermore, if a province has a dimensional value that is higher than this upper limit, then it is set equal to the upper limit.

3.3.2   Descriptive Analysis

The descriptive analysis approach in this study is used to describe the phenomenon that occurs on the island of Sumatra, especially related to the CPI that affects the poverty level. Through descriptive analysis, the data collected is presented systematically to provide a clear picture of the CCI and poverty level on the island of Sumatra. In addition, to facilitate the understanding of data distribution and patterns, this study utilizes thematic maps compiled based on the natural breaks method. This method is used to group data into relevant categories, by dividing the data into classes that have naturally similar characteristics. Thematic maps with natural breaks help visualize the distribution of poverty levels and IKK in various provinces on the island of Sumatra. The natural breaks technique separates data based on naturally occurring breakpoints in the data, making it easier to identify patterns or differences between regions.

3.3.3   Panel Data Regression Analysis

Regression analysis is a method that aims to determine the causal relationship between one variable and another. In this study, the calculation used panel data regression. Panel data is a combination of

two pieces of data, namely *cross section* data with *time series* data (Basuki & Prawoto, 2021), 2021). There are several advantages of the data panel method, namely first, panel data which is a combination of *cross section* data and *time series* data so that it can provide more data so that it will affect the *degree of freedom* with a greater value. The second advantage is that information from *cross section* and *time series* data combined will be able to overcome problems that may arise when facing the problem of eliminating variables (Basuki & Prawoto, 2021).

This regression analysis was used to calculate the factors that affect poverty and inequality with an equation model that refers to the research of Tran and Le (2021) with several adjustments.

The method used is the *Ordinary Lest Square* (OLS) method regression using panel data to determine the influence of independent variables (independent variables) on dependent variables (bound variables) in the test. OLS or the smallest quadratic method is an estimation method using the principle of minimizing the number of quadratic deviations between the predicted value of the response variable and the actual value.

The OLS method must be able to meet the assumptions of BLUE (which stands for *Beast Linear Unbiasd Estimator*) in interval estimation and regression parameter testing of the population. The assumptions that must be fulfilled by BLUE include:
1. The regression model must be linear in its parameters.
2. It is not multicollinear, i.e. the free variable is not stochastic (fixed value in the repeated sample) and there is no exactly the same linear relationship with the free variables.
3. Homocedasticity, *Error term* has a constant variance on all observations, $E(\varepsilon 2) = \sigma 2$.
4. *Error term* or error on the regression is expected to be zero, $E(\varepsilon i) = 0$.
5. It is not autocorrelated i.e. *Error term* on observation is not related to *Error Term* other observations.
6. *Error term* in normal distributed regression.

With the above advantages, the test of classical assumptions on the panel data calculation model is basically not always necessary. This is because research using the panel data method allows the identification of a specific parameter without having to make strict assumptions or arguably not requiring the fulfillment of all the classical assumptions of linear regression.

3.3.4   Modeling Selection Testing
Panel data is a combination of two pieces of data, namely *cross section* data with time *series* data. Regression with panel data uses several approach models to estimate panel data, namely *Common Effect Model, Fixed Effects Model,* and *Random Effect Moddel* approaches (Basuki & Prawoto, 2021).
a) *Common Effect Model (CEM)*
The Common Effect *model approach* is the simplest panel data model approach because it only combines time series and cross section data. In this model, neither the time nor individual dimensions are considered, so it is assumed that the behavior of the company's data is the same over various periods of time. This method can use the *Ordinary Least Square* (OLS) approach or the smallest square technique to estimate the pane data model.
b) *Fixed Effect Model (FEM)*
This model assumes that differences between individuals can be accommodated from differences in their interceptions. To estimate the data of the Fixed Effects model panel using the variable dummy technique to capture the difference in interception between companies, the difference in interception can occur due to differences in work culture, managerial, and incentives. However, the slops are the same between companies. This estimation model is often also referred to as *the Least Squares Dummy Variable* (LSDV) technique.
c) *Random Effect Model (REM)*
This model will estimate panel data where interference variables may be interrelated between time and between individuals. In the Random Effect model, the difference in interception is accommodated by the error terms of each company. The advantage of using the *Random Effect* model is that it

eliminates heteroscedasticity. This model is also called *the Error Component Model* (ECM) or *the Generalized Least Square* (GLS) technique

To determine the best model between *common effects (pools), fixed effects*, and *random effects*, two types of model estimation techniques can be used. These two techniques are used in the calculation of panel data regression to be able to obtain the most appropriate model in estimating the calculation of panel data regression. Two types of tests are used, the first is the Chow *test* which is used to choose between *common effect (pooled)* models or *fixed effect* models. The second is the Hausman *test* which is used to determine between *fixed effect* (fixed) or *random effect* (random) models that are better in estimating panel data regression.

3.4 Chow Test
The Chow test is a test used to see which model is more accurate between *common effect* or *fixed effect* to use. The Chow test is based on the zero hypothesis that there is no individual heterogeneity and the alternative hypothesis that there is heterogeneity in the cross section. In this test, the following hypotheses were carried out:
Ho: The right model to use is the *common effect model*.
Ha: The right model to use is the *fixed effect model.*
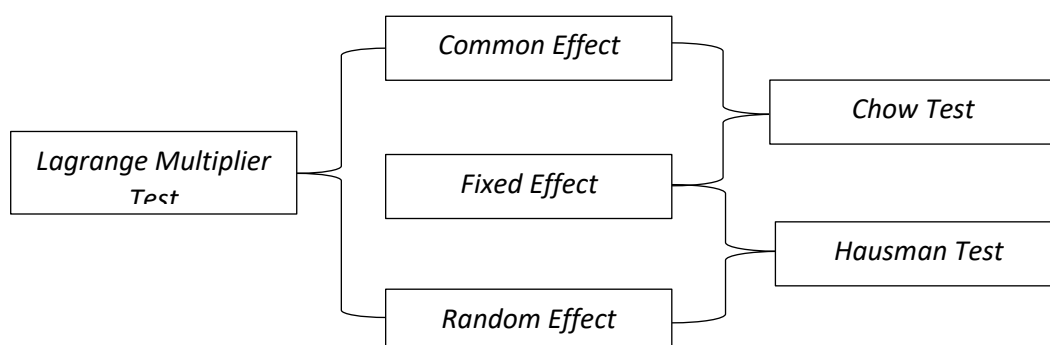
Decision-making criteria:
a. If the *cross-section* probability value of *chi-square* < α 0.05 then H0 is rejected. The selected model is a *fixed effect*. *The Hausman Test* can be performed for further testing.
b. If the *cross-section* probability value of *the chi-square* > α 0.05 then H0 fails to be rejected. The selected model is common effect. *A langrange multiplier* can be performed for subsequent testing.

3.5 Hausman Test
The Hausman test is a test used to choose between two models, namely *fixed effect* and *random effect* , which are better and more appropriate to be used in this study. In addition, the purpose of the Hausman test is to find out the characteristics of each model whether it has heterogeneity. The hypothesis in the Hausman test can be written as follows:
Ho: The right model is a *random effect model.*
Ha: The right model is the *fixed effect model.*

Decision-making criteria:
a. If the *cross-section* probability value of *chi-square* < α 0.05 then H0 is rejected. The selected model is *a fixed effect* to estimate panel data. *The Lagrange Multiplier Test* does not need to be done at the later stage of the test.
b. If the *cross-section* probability value of *chi-square* > α 0.05 then H0 fails to be rejected. The selected model is a random *effect* to estimate panel data. *The Lagrange Multiplier Test* needs to be done at the next stage of the test.

3.6 Lagrange Multiplier Test

The *Lagrange Multiplier* test is a test used to determine the best model in research, namely between *a common effect* model or *a random effect* model. In this test, the following hypothesis tests were carried out:

Ho: The right model is *the common effect.*

Ha: The right model is *a random effect.*

Decision-making criteria:

a. If the *cross-section probability* value of the breusch-pagan < α 0.05 can be interpreted as H0 is rejected. The selected model is a random effect to estimate panel data.

b. If the *cross-section probability* value of the breusch-pagan > α 0.05 can be interpreted as H0 fails to be rejected. The selected model is a common effect for estimating panel data.

3.7 Stationarity Test

A data is said to be stationary if the data pattern is in equilibrium around a constant average value and the variance around the average is constant over a certain time (Makridakis, 1999: 61). Data in the time series is said to be stationary when there is no trend element in the data. Gujarati (2003) explained that time series data is said to be stationary if it meets the following three criteria.

1. Constant data average $E(Y_t) = \mu$
2. Constant data variance all the time $Var(Y_t) = E(Y_t - \mu)^2 = \sigma^2$
3. The covariance between two different time periods does not depend on the time position in which the covariance is calculated, but rather on the data distance (*time lag*): $\gamma_k = E[(Y_t - \mu)(Y_{t+k} - \mu)]$.

The assumption of stationariness in time series data is very important. Non-stationary time series data can only study the behavior of the data for that time, so it cannot generalize to other time periods (Gujarati, 2003). In addition, non-stationary data will provide inaccurate estimates or commonly called sporious regression.

One way to test stationarity can be done is to analyze the plot of the graph from the data or analyze the choreography (Gujarati, 2003). The correlogram is a stationariness test by looking at the values of the Autocorrelation Function (ACF) and the Partial Autocorrelation Function (PACF). ACF is the relationship between the current data and the previous data, while PACF is the relationship between period 1 data and period data by eliminating the intermediate effect on the data (Gujarati, 2003). If the graph on the PACF or ACF does not cross the Bartlett line, then the data is said to be stationary.

The stationarity test was carried out on the dependent variable, namely the poverty level variable. The following are the results of the stationary test:
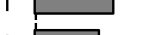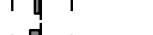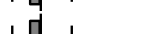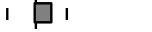
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.862	0.862	61.685	0.000
		2	0.727	-0.061	106.16	0.000
		3	0.606	-0.026	137.43	0.000
		4	0.483	-0.081	157.55	0.000
		5	0.360	-0.082	168.87	0.000
		6	0.236	-0.096	173.79	0.000
		7	0.116	-0.081	175.00	0.000

Figure 2. Stationarity Test

Based on the analysis of the graph with the correlog, it can be seen that the data we have still contain trends, so it can be concluded that the poverty data is not stationary. Therefore, in this model, an independent lag variable from poverty is added to eliminate the trend effect of the poverty level variable so that the results obtained are not biased.

3.7. Simultaneous Test (F-Test)

Simultaneous tests or F-tests are used to find out whether all independent variables together have an effect on dependent variables (Basuki & Prawoto, 2021). The testing steps are as follows:

Hypothesis

$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$ (there is no significant independent variable influence or the model cannot relate between variables)

$H_1 :$ there is at least one (at least one independent variable that affects the dependent variable)$\beta_k \neq 0$

Determine significant level (α) = 0.05

Test Statistics:

$$F_{hitung} = \frac{MSR}{MSE}$$

Decision

Reject if H_0 *the p-value* is less than 0.05

3.8. Goodness of Fit Test (Adjusted R2 Test)

This test aims to predict how much the independent variable contributes to the dependent variable provided that the results of the F test in the regression analysis are of significant value. The value $^{of\,2}$ is between 0 and 1 (0 < R2 > 1), where if the value is close to 1, the independent and dependent variables have a closer relationship. If there are more than two variables, then the *adjusted* $^{value\,is\,2}$ (Basuki and Prawoto, 2021). The criteria for the decision are:

1. If the *adjusted value of R2* is close to 1, then the result shows a very strong relationship between the independent variable and the dependent variable.
2. If the *adjusted value of R2* is close to 0, then the result shows a very weak relationship between the independent variable and the dependent variable.

3.9. Hypothesis Test

The hypothesis test in this study was carried out by t-test, while the model feasibility test was carried out using the determination coefficient and the statistical test F. The determination coefficient came from the results of *the R-square* regression value, while the statistical test F came from the results of *the F-statistical* value. Basuki and Prawoto (2021) said that the t-statistical test is used to find out how the influence of independent variables in explaining dependent variables.

The decision-making policies used for the t-test are:

1. If *sig* t < α (0.05) then Ho is rejected. This means that independent variables have a significant effect on dependent variables.
2. If *the sig* > α (0.05) then Ho fails to be rejected. This means that independent variables do not affect the depeden variables significantly.

3.10. Establishment of Research Models

In this study, the analysis method used was multiple *regression data panel analysis*. The formation of the research model is carried out after all the best model selection tests and classical assumption tests have been fulfilled. This research model describes the influence of independent variables, namely Lag from Poverty, Financial Inclusion Index, and Annual Inflation on dependent variables, namely Poverty Level. The models to be formed are as follows:

$$pov_{it} = \alpha + \beta_1 pov_{i(t-1)} + \beta_2 \text{ikk}_{it} + \beta_3 inflasi_{it} + \varepsilon_{it}$$

Information:

Pov$_{it}$: Provincial Poverty Rate i year t (%)

cow$_{(t-1)}$: Provincial Poverty Rate i year t-1 (%)
Ikkit   : Financial Inclusion Index (Unit)
Inflation : rate of change in provincial CPI i year t (%)

4. Results and discussions
4.1. Descriptive Research Object

This research was conducted using panel data consisting of *time series* and *cross section* data. The research object covers 10 provinces in Indonesia as an analysis unit, with a time period of 2017 to 2023. The variables analyzed in this study consist of one dependent variable and three independent variables, namely:

1. Poverty Rate (pov)
   The poverty rate is measured based on the percentage of the poor population to the total population in each province per year. This data was obtained from the Central Statistics Agency (BPS).
2. Poverty Rate Lag (pov$_{t-1}$)
   The lag of the poverty rate is measured based on the percentage of the poor population to the total population in each province per year t-1. This data was obtained from the Central Statistics Agency (BPS).
3. Financial Inclusion Index (CPI)
   This index reflects the ease of public access to formal financial services such as banking and other financial institutions. The higher this index, the wider the public's access to the financial sector. Data is sourced from the Financial Services Authority (OJK) and BPS.
4. Annual Inflation (inflation)
   Measured from the rate of change in the price of goods and services in general within a period of one year. Inflation affects people's purchasing power, especially low-income groups. Data sourced from BPS and Bank Indonesia.

With a span of eight years and 10 provinces, the total observation data obtained was 70 observation data.

4.2 Descriptive Analysis
The descriptive analysis carried out in this study is by using thematic maps to provide an overview of poverty and financial inclusion index by dividing 3 categories using *natural breaks*. The three categories are low, medium and high. The low category of poverty level is when poverty is in the range of 4.52% to 8.15%. Moderate poverty is in the range of 8.16% to 11.78% and high poverty is in the range of 11.79% to 14.45%. Based on figure 4.1, in 2023 the low poverty rate will gather in the middle of the island of Sumatra such as the provinces, North Sumatra, Riau, West Sumatra, Jambi, Riau Islands and Bangka Belitung. The poverty rate is moderate in southern Sumatra such as the provinces of South Sumatra and Lampung and the high poverty rate is in the provinces of Aceh and Bengkulu.

The low category in the CPI is in the range of 0.49190 to 0.50648. The medium CPI is in the range of 0.50649 to 0.52440 and the high CPI is in the range of 0.52441 to 0.54471. Based on figure 4.2, in 2023 the low CPI levels will be in the provinces of Aceh, West Sumatra, Bangka Belitung and Bengkulu. The CPI level is moderate in the provinces of South Sumatra and North Sumatra and the high CPI level is in the provinces of Riau, Jambi, Lampung and the Riau Islands.

Based on this picture, it can be seen that in some provinces, provinces with low poverty rates have high CPI levels, and vice versa. For example, the provinces of Riau, Jambi and Riau Islands have a low poverty rate and have a high IQ. Aceh and Bengkulu provinces have high poverty rates and low GDIs. This illustrates that poverty and IKK are indicated to have a negative relationship.

4.3 Best Model Selection
There are three panel data models in the *regression method*, including *common effect, fixed effect* and *random effect*. There are test stages of this model, namely the Hausman Test and the Lagrange

Multiplier Test. From the results of the thirst test, it can be found that the selected model is either *fixed effect* or *random effect*. From the results of the lagrange multiplier test, it was found that the selected model was either *random effect* or *common effect*. Here are the test steps from the data analysis panel:

4.3.1. Hausman Test

The Hausman test is used to determine the best model between *a fixed effect model* or *a random effect model*. This test was also carried out to find out whether the model used had heterogeneity. The testing hypothesis is as follows:

H_0: there is no correlation between individual effects and independent variables

H_a: there is a correlation between individual effects and independent variables

The decision-making criteria are as follows:

1. If the p-value is rejected. The accepted model is the $\leq \alpha H_0$ *fixed effect model*.
2. If the value is p-value, it fails to be rejected. The model used is a $> \alpha H_0$ *random effect model*.

Table 2. Hausman Test Results

Dependent Variable	Chi-square	Profitability	Decision
Pov	31,229557	0,000	H_0 rejected. The accepted model is the *fixed effect model*.

Source: *Output Data Panel Regression* E-views 9

Based on the results of the thirst test test, the *probability* value is $0.000 < 0.10$. Therefore, *the fixed effect model* is better than *the random effect model*. Therefore, an advanced testing step using *the Chow* test is required.

4.3.2. Chow Test

The Chow test is used to determine the best model between *a common effect model* or *a fixed effect model*. In this test, the following hypotheses were carried out:

H_0: There is no difference between individuals in the regression model, meaning that the right model to use is the *common effect model*

H_a: There are differences between individuals in the regression model, meaning that the right model to use is the *fixed effect model*

The decision-making criteria are as follows:

1. If the p-value is rejected and $\leq \alpha H_0 H_a$ accepted. The accepted model is the *fixed effect model*. This means that there are significant differences between individuals in the data, so the use of more complex *fixed effect models* is needed to capture these differences.
2. If the value is p-value then it fails to reject . The model used is the $> \alpha H_0$ *common effect model*. This means that there are no significant differences between individuals in the data, so the use of a simpler *common effect model* is adequate.

Table 3. Lagrange Multiplier Test Results

Dependent Variable	Chi-square	Profitability	Decision
Pov	33,100776	0,0001	H_0 rejected, the accepted model is a *fixed effect model*.

Source: *Output Data Panel Regression* E-views 9

Based on the results of the chow test carried out, the *probability* value is $0.000 < 0.10$. Therefore, the conclusion obtained is that *the fixed effect model* is better than *the common effect model*. Based on the thirst test and *the chow* test, the model that will be used in this study is the *fixed effect model*.

4.4 Classic Assumption Test

4.4.1 Normality Test

One of the classic assumptions that must be met is that the residual of the model must be normally distributed. Normality tests are carried out to find out whether the residual is distributed normally or not. The normality test carried out in this study used the Jarque-Bera test. If the *p-value* is more than the significance value of 10%, then it can be said that the residual model is normally distributed, while if the *p-value* is less than the significance value of 10%, then it can be said that the residual model is not normally distributed. The following is a table of the results of the Jarque-Bera test:

Table 4. Jarque-Bera Test Results

Jarque-Bera	*P-value*
(1)	(2)
0,5224	0,7701

Based on table 4, the *p-value* is 0.7701. If the *p-value* is more than the significance value of 10%, it can be concluded that the residual model is normally distributed. It can therefore be concluded that the model has met the assumption of normality.

4.4.2 Multicollinearity Test

One of the classic assumptions that must be met is that there is no correlation between independent or non-multicollinearity variables. The Multicollinearity test is used to determine the linear relationships that occur between independent variables. To test whether there is an autocorrelation or not, the *Variance Inflation Factor* (VIF) test method can be used. If the VIF value is < 10, then there is no linear relationship between the independent variables or there is no multicollinearity. Meanwhile, if the VIF value is ≥ 10, there is a linear relationship between independent variables or there is multicollinearity. The following is a summary of the VIF scores:

Table 5. Value *of Variance Inflation Factor* (VIF)

Variable	VIVID
(1)	(2)
POV(-1)	1,008
IKK	1,008
Inflation	1,005

Based on table 5, there is no VIF value greater than 10. Therefore, it can be concluded that there is no relationship between the four independent variables used in the model. So that in the regression model there are no symptoms of multicollinearity and have met the assumption of non-multicollinearity.

4.4.3 Heteroscedasticity Test

One of the classic assumptions that must be met is the residual variance of the constant model or homocedasticity. The heteroscedasticity test was carried out to determine the variance of the residual regression model used in the study was not homogeneous or in other words not constant. To test the presence or absence of heteroscedasticity, the *Likelihood Ratio* (LR) test method can be used . If *the p-value* is more than the significance value of 10%, then it can be said that the residual model is constant or homokedasticity, while if the *p-value* is less than the significance value of 10%, then it can be said that the residual model is not constant or heteroscedasticity. Here are the results of the *Likelihood Ratio test*:

Table 6. Likelihood Ratio Test Results

Value	Df	P-value
(1)	(2)	(3)
6,984927	10	0,723

Based on table 6, the *p-value* is 0.723. If the *p-value* is more than the significance value of 10%, then it can be concluded that the residual model is constant or homogeneous. Therefore, it can be concluded that the regression model has no symptoms of heteroscedasticity and has fulfilled the assumption of homoscedasticity

4.4.4   Autocorrelation Test

One of the classic assumptions that must be met is the residual variance of the uncorrelated or non-autocorrelated model. The autocorrelation test was carried out to determine whether the residual regression model used in the study was correlated or not. To test whether there is autocorrelation or not, the *Durbin Watson test and* Ljung Box Test methods can be used. If the Durbin Watson value is between Du and 4-Du, then it can be said that the residual model is uncorrelated or non-autocorrelated, whereas if the *p-value* is less than 10% significance, then it can be said that the residual model is correlated or autocorrelated. Here are *the results of the Durbin Watson test*

Table 7. Durbin Watson Test Results

Dl	Du	4-dl	4-du	D
(1)	(2)	(3)	(4)	(5)
1,4943	1,7028	2,5057	2,2972	2,016

Based on table 7, the value of D is between Du and 4-Du, the area is within the area where it can be concluded that there is no autocorrelation in the research model.

4.5 Coefficient of Determination

The merits of the model are measured based on *the adjusted R-Square* value. *The Adjusted R-Square* is used to see how much the variables Lag from Poverty, Financial Inclusion Index, and Annual Inflation can explain variations in poverty. The higher the *adjusted R-Square value,* the better the model produced. Based on appendix 8, the *adjusted R-Square value* on the resulting model is 0.9959 or 99.59%. This means that it can be concluded that the variables Lag from Poverty, Financial Inclusion Index, and Annual Inflation can explain the variation in poverty on the island of Sumatra by 99.59%, while the other 0.41% is explained by other factors outside the model.

4.6 Test F

The F test is used to see the influence between the variables Lag of Poverty, the Financial Inclusion Index, and the Annual Inflation can explain the Poverty variable simultaneously. If the *p-value* $\geq$ a significance value of 10%, then it can be said that the variables are Lag from Poverty, Financial Inclusion Index, and Annual Inflation. On the other hand, if the *p-value* < a significance value of 10%, then it can be said that the variables Lag from Poverty, Financial Inclusion Index, and Annual Inflation affect the poverty variables simultaneously. The following are the results of the F test:

Table 8. F Test Results

F-Stat	P-value
(1)	(2)
952,89	0,0000

Based on table 8, an *F-Stat* value of 952.89 with *a p-value* of 0.000 was obtained. Since *the p-value* is less than 10%, it can be concluded that the Lag of Poverty, the Financial Inclusion Index, and the Annual Inflation affect the poverty variables simultaneously.

4.7 Results of Panel Data Recovery Analysis
In this study, panel data regression analysis was used to test the influence of the independent variables Lag from Poverty, Financial Inclusion Index, and Annual Inflation on the dependent variable, namely Poverty Level. The results of the regression equation in this study are as follows:

Type:
$$pov_{it} = 8,0468 + 0,571pov_{i(t-1)} - 7,340ikk_{it} - 0.098inflasi_{it} + \varepsilon_{it}$$

Information:
Povit   : Provincial Poverty Rate i year t (%)
$cow_{(t-1)}$: Provincial Poverty Rate i year t-1 (%)
Ikkit   : Financial Inclusion Index (Unit)
Inflation   : rate of change in provincial CPI i year t (%)

4.8. T Test Results
The T test aims to assess whether the independent variables, namely Lag from Poverty, Financial Inclusion Index, and Annual Inflation, are against the dependent variable, namely the Poverty Level. Based on the results of the T test, it can be interpreted as follows:

Table 9. T Test Results

Variable	Coefficient	Probability	Conclusion
C	8,046805	0,0009	
$POV_{(T-1)}$	0,571030	0,0000	Positive Influence
Ikk	-7,340344	0,0774	Negative Effects
Inflation	-0,098490	0,0009	Negative Effects

Source: data processed using *E-views* 9

Based on the results of the T test on the dependent variable of the Poverty Level, the interpretation produced by the study is as follows:

H_1: There is an Effect of the Financial Inclusion Index on Poverty Levels
Based on the results of data processing through the T Test, *the ikk* variable has a probability value of $0.0774 < 0.10$ which shows that the probability value is smaller than the significance value. The coefficient obtained has a negative value of 7.34. It can be concluded that the *CPI* variable has a negative effect on the Poverty Rate.

H_2: There is an Influence between Inflation on Poverty Levels
Based on the results of data processing through the T Test, the inflation variable has a probability value of $0.0000 < 0.10$ which shows that the probability value is smaller than the significance value. The coefficient obtained has a negative value of 0.099981. It can be concluded that the *Inflation* variable has a negative effect on the Poverty Rate.

5. Conclusions
5.1 Conclusion
Based on the results and discussion, conclusions have been obtained from the regression analysis carried out, with an adjusted R-Square value of 99.59%, which shows that this regression model is very good in explaining the variation in poverty on the island of Sumatra. The following are the conclusions based on the hypothesis tests that have been carried out:

1. The Financial Inclusion Index (IKK) has a significant negative effect on the poverty rate, where increasing financial inclusion has the potential to reduce the poverty rate on the island of Sumatra.
2. Inflation has a significant negative effect on poverty rates, showing that high inflation can increase poverty levels in people on the island of Sumatra.

5.2 Suggestion

Based on the results of the conclusions that have been obtained, the Financial Inclusion Index (IKK) and Inflation have a significant influence on the poverty rate. Based on these findings, the suggestions that can be given are as follows:

1. For the Government
    a. Given that the CCI has a significant negative effect on the poverty rate, the government should focus on efforts to increase access to financial services, especially in areas with high poverty rates, such as in the xx province. Programs such as providing banking services to underserved communities or improving financial literacy will greatly help reduce poverty on the island of Sumatra.
    b. Inflation has been shown to have a negative effect on poverty, which suggests that high price increases can worsen people's economic conditions. Therefore, it is important for governments to maintain price stability and control inflation, by strengthening monetary policy and paying attention to sectors that are vulnerable to price fluctuations such as food and energy.

2. For the Next Researcher
    a. Deeper Regional Analysis
        The researcher can then conduct a more in-depth analysis of all provinces in Indonesia as well as the district/city level to understand the variation in poverty in more detail. It is possible that there are local factors not covered in this study that affect the poverty rate in each region.
    b. Expanding Variables in a Model
        Further research could try to include other variables, such as unemployment rates, regional fiscal policies, or social assistance received by communities, that may be able to affect poverty levels more clearly. Researchers can also use microeconomic variables to get clearer details as the causes of poverty, such as education level, work experience, and others.

5.3 Research Limitations

This research has several limitations that can be completed in the future by other researchers. First, although the regression model used shows a very high **adjusted R-Square** value , this study only considers macroeconomic variables, such as **the Financial Inclusion Index (CPI) and Inflation** that may not fully describe the complexity of the causes of poverty. Micro factors, not yet part of the analysis, may play an important role in influencing poverty rates at the provincial level. Second, the study was limited to **10 provinces on the island of Sumatra**, so the findings may not be fully generalized to other regions of Indonesia, given the different social, economic, and policy conditions in each region. Third, the time used in this study is only 6 years from 2017 to 2023, during which time there are abnormal conditions such as Covid-19 that can have an impact on the modeling results.

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