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The effect of financial inclusion on poverty rate in Sumatra Island

Imron Rosyadi[1], Toto Gunarto[2], Deddy Yuliawan[3]
University of Lampung, Indonesia[1-3]
kandaebong@gmail.com

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Abstract

Purpose: This study examines the effects of financial inclusion and inflation on poverty reduction across ten provinces on the island of Sumatra, Indonesia, from 2017 to 2023. Despite Indonesia's significant economic progress in recent decades, poverty and inequality remain persistent challenges, particularly in Sumatra, where disparities in access to resources and opportunities continue to exist.

Research Methodology: A quantitative approach was employed using panel data from ten provinces in Sumatra. Regression analysis was conducted to evaluate the relationship between the Financial Inclusion Index (IKK), inflation, and poverty rate.

Results: The findings reveal that the Financial Inclusion Index (IKK) has a significant negative effect on poverty, indicating that increased access to financial services helps reduce poverty levels. Inflation also shows a significant negative effect, suggesting that controlled inflation within a stable range may strengthen household purchasing power and mitigate poverty.

Conclusions: Enhanced financial inclusion effectively reduces poverty by facilitating access to credit, savings, and other financial services that empower local communities. Stable inflation management contributes to a predictable economic environment conducive to poverty alleviation.

Limitations: This study is limited to Sumatra and excludes other socioeconomic factors such as education, employment, and government assistance programs that may influence poverty levels.

Contribution: The study provides empirical evidence of the regional effects of financial inclusion and inflation on poverty, emphasizing the importance of localized economic policy and consistent monitoring to achieve inclusive and sustainable growth.

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

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1. Introduction

Developing countries, such as Indonesia, often face major challenges in achieving equitable economic progress and sustainable development. 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 (Akita & Kataoka, 2022; Maurilla, Suriani, & Nasir, 2022). 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 economic resources, education, and health services (Rahman, Firman, & Rusdinal, 2019). Although Indonesia's economic growth has been stable in recent decades, poverty remains a problem that must be seriously addressed. Developing countries tend to have higher poverty rates, which 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; Sumbogo, Oktaria, Barusman, Defrizal, & Barusman, 2024).

Poverty is one of the main problems that continues to be a global concern, especially in developing countries such as Indonesia. Although Indonesia has experienced various economic advances in recent decades, 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 has an impact on widening social and economic inequality, hampering sustainable economic growth, and worsening income inequality among people (Liyana, 2023). Therefore, reducing poverty and socioeconomic inequality is one of the main goals of economic development in Indonesia, especially in areas with high poverty rates, such as several provinces on the island of Sumatra (E. P. 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 to those in low-income groups who have difficulty accessing formal financial services (Rahu, Neolaka, & Djaha, 2023; Surya et al., 2024). With access to financial services, people, especially the poor, can improve their well-being through savings, credit, and 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).

However, although financial inclusion has great potential for 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 (Endi, Fanggidae, & Ndoen, 2023). 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 in poverty in Indonesia, financial inclusion has continued to increase annually. However, some provinces in Sumatra still experience high poverty compared to national figures. Therefore, this study aims to analyze how financial inclusion affects poverty reduction on the island of Sumatra. The period used was 2017–2023. This study will explore the influence of the level of financial inclusion in each province and the existing poverty rate to determine the extent to which access to financial services contributes to reducing poverty rates in the region (Sinaga & Purba, 2025). 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 reduces poverty and income inequality, including research by Tran and Le (2021), Omar and Inaba (2020), and Inoue (2019). Meanwhile, the Indonesian government considers the level of financial inclusion to be low; therefore, it promotes the development of the financial sector in various ways in the hope of reducing poverty and inequality . This raises the question of whether strategies to increase financial inclusion can reduce poverty levels.

2. Literature review

2.1 Financial Inclusion

According to Bank Indonesia, financial *inclusion* became widely known after the 2008 crisis. At that time, the crisis had a considerable impact on the lower strata of society. 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, were disabled, and were workers who were not legally registered workers. These individuals were generally not considered worthy by banks (*unbankable)* and were listed as high in developing countries (Firaldi, Wibisono, Ngaliman, Indrayani, & Satriawan, 2023; Poushter, 2019).

The term financial inclusion does not yet have a standard definition. There are several definitions issued by different institutions or researchers, but they have more or less the same meaning. In their

research, which is one of the main references for financial inclusion researchers, Sarma and Pais (2011) define the concept of financial inclusion as a process that creates 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 (Adil, Sapar, & Jasman, 2023; Ndun, 2024).

Several studies have separated 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, whereas usage is measured by the number of savings and credit accounts distributed. Sarma and Pais (2011) summarized these various concepts into a new concept, *the Index of Financial Inclusion*. This index is used to measure the level of financial inclusion 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. 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). The BPS in 2023 inflation is usually measured using the consumer price index (CPI), which records changes in the prices of goods and services typically purchased by consumers. 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; M. P. Ningrum, Fachrudin, & Ngaliman, 2024).

2.3 Poverty

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 (Muliyanto, Indrayani, Satriawan, Ngaliman, & Catrayasa, 2023). Meanwhile, the Central Statistics Agency (BPS) views poverty as an economic inability to meet basic needs, such as food and other food. To measure it, we look at the expenditure side.

The GK consists of two types: the Food Poverty Line (GKM) and 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. The commodities for basic food needs in the calculation are represented by 52 types of commodities, including rice, tubers, meat, fish, milk, eggs, and so on). Meanwhile, GKNM is the minimum need in terms of housing (residence), clothing, education, and health. These non-food basic necessities commodities are represented by 51 types of commodities for urban areas and 47 types for rural areas. Therefore, GK is the sum of GKM and 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 (Firaldi et al., 2023). 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 (2019) 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, especially among 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 for 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 its impact. 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 (Fadhillah, Arintoko, & Kamio, 2021; Sari, Wibisono, & Gaddafi, 2025).

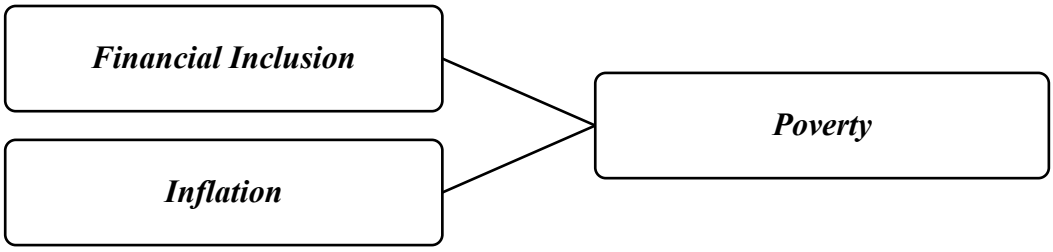


Figure 1. Conceptual Framework

2.5 Hypothesis Development

2.5.1 The effect of financial inclusion on poverty

Several studies have examined the impact of financial inclusion on poverty. Koomson et al. (2020) examined the influence of financial inclusion on poverty and vulnerability among Ghanaian households. Using data 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 endogeneity 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, approximately 51% are vulnerable to poverty. We found that increased financial inclusion has 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%.

Another reason for the possible negative impact of financial sector development 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 & Coskun, 2016).

Jeanneney and Kpodar (2011), 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 (1992), inflation is the tendency of prices to increase continuously. The occurrence of price increases in only a small number of goods is not included in the definition of inflation. Inflation can be defined as a widespread increase in prices or 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. First, inflation causes the real value of money to decrease. Therefore, when prices increase, the amount that money can buy becomes less, or purchasing power is reduced. The second way, inflation, causes the value of interest obtained from money storage in the bank to decrease, so that the purchasing power also decreases (Halim, Astuty, & Hubeis, 2022; Olaniyi & Odhiambo, 2024). The decline in purchasing power has resulted in the community becoming poorer than before.

Shodrokova and Asngari (2024) examined the problems of inflation and poverty 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 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. Research methodology

3.1 Research Approach

This study 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 events. In the quantitative approach, the data used are 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 from 2017 to 2023.

3.2 Data Types and Sources

In this study, a financial inclusion index was calculated to determine the level of financial inclusion on the island of Sumatra. Then, the financial inclusion index was included in the calculation to determine which factors could affect the poverty rate in the 10 Sumatra Island Provinces for the 2017-2023 period. This study uses 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 available report data. In this study, data were obtained from data requests to the Financial Services Authority (OJK), Bank Indonesia website, and the website of the Central Statistics Agency (BPS). The data are 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 one dependent variable and seven independent variables, the measurement of which is 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 and Pais (2011), using three dimensions that 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

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

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 (*weighted average*) of 2/3 for office networks and 1/3 for ATMs per 100,000 adult population with the following formula:

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

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 and 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 dimension i. For example, the higher the 'availability' dimension index in a province, the higher the number of banking services that the public can access in that province.

According to the IFI calculation method by Sarma and Pais (2011), the lower limit value is determined by a value of 0 for all dimensions, while the upper limit is determined using 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 face *a benchmark* value that is too high. Furthermore, if a province has a dimensional value that is higher than this upper limit, 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 poverty levels. Through descriptive analysis, the data collected are presented systematically to provide a clear picture of the CCI and poverty levels on the island of Sumatra. In addition, to facilitate understanding of the data distribution and patterns, this study utilized 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 with naturally similar characteristics. Thematic maps with natural breaks help to 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, 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 two variables. In this study, we 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). The data panel method has several advantages. First, panel data are a combination of *cross-section* and *time series* data, which can provide more data, thereby affecting the *degree of freedom* with a greater value. The second advantage is that information from *cross-section* and *time-series* data combined can 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 using an equation model that refers to the study by Tran and Le (2021) with several adjustments.

The OLS method must meet the assumptions of BLUE (Best *Linear Unbiased 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 with respect to its parameters.
2. It is not multicollinear, that is, 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. *The error term* or error on the regression is expected to be zero, $E(\varepsilon i) = 0$.
5. It is not autocorrelated; that is, *the Error Term* on observation is not related to *the error term* of other observations.
6. *Error term* in normally distributed 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 *the common effect model, fixed effects model,* and *random effect model* 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; therefore, it is assumed that the behavior of the company's data is the same over various periods. This method can use the *Ordinary Least Squares* (OLS) approach or the smallest square technique to estimate the panel data model.

b) *Fixed Effect Model (FEM)*

This model assumes that differences between individuals can be accommodated by 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 slopes are the same for all companies. This estimation model is often referred to as *the Least Squares Dummy Variable* (LSDV) technique.

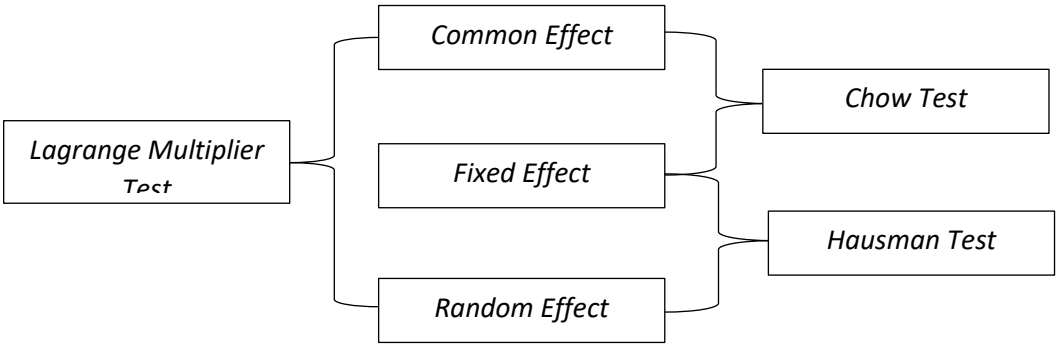
c) *Random Effect Model (REM)*

This model estimates panel data where interference variables may be interrelated between time and 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 effects* model is that it eliminates heteroscedasticity. This model is also called *the Error Component Model* (ECM) or *the Generalized Least Square* (GLS) technique. Two types of model estimation techniques can be used to determine the best model between *common effects (pools), fixed effects*, and *random effects*.

3.4 Chow Test

The Chow test is used to determine which model is more accurate between *the common effect* or *fixed effect*. 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. The following hypotheses were tested:

Ho: The right model to use is the *common-effects model*.
Ha: The fixed effects model is the appropriate *model.*



Decision-making criteria:
a. If the *cross-section* probability value of *chi-square* < α 0.05, then H0 is rejected. The selected model was 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 a common effect. *A Lagrange multiplier* can be used for subsequent testing.

3.5 Hausman Test
The Hausman test is used to choose between two models, namely *fixed effect* and *random effect*, which are better and more appropriate for this study. In addition, the purpose of the Hausman test is to determine the characteristics of each model, whether it has heterogeneity. The hypothesis for the Hausman test can be written as follows:
Ho: The correct model is a *random-effects model.*
Ha: The correct model is the *fixed-effects 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* for estimating panel data. *The Lagrange Multiplier Test* does not need to be performed 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* that estimates the panel data. *The Lagrange Multiplier Test* needs to be performed at the next stage of the test.

3.6 Lagrange Multiplier Test
The *Lagrange Multiplier* test is used to determine the best model in research, namely between *a common effect* model or *a random effect* model. The following hypothesis tests were conducted:
Ho: The right model is *a common effect*.
Ha: The correct model is *a random effect.*
Decision-making criteria:
a. If the *cross-section probability* value of the breusch-pagan < α 0.05, it can be interpreted as H0 is rejected. The selected model is a random effect that estimates the panel data.
b. If the *cross-section probability* value of the breusch-pagan > α 0.05, it can be interpreted as H0 fails to be rejected. The selected model is a common effect for estimating the panel data.

3.7 Stationarity Test
Data are 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 et al., 1999). Data in the time series are said to be stationary when there is no trend element in the data. Gujarati (2006) explained that time series data are said to be stationary if they meet 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*): $\gamma_k = E[(Y_t - \mu)(Y_{t+k} - \mu)]$.

3.8 Simultaneous Test (F-Test)

Simultaneous tests or F-tests are used to determine whether all independent variables together have an effect on the dependent variables (Basuki & Prawoto, 2021). The testing steps were 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

3.9 Goodness of Fit Test (Adjusted R2 Test)

This test aims to predict the extent to which the independent variable contributes to the dependent variable, provided that the results of the F-test in the regression analysis are significant. The value [of 2] is between 0 and 1 (0 < R2 > 1), where a value close to 1 indicates a closer relationship between the independent and dependent variables. If there are more than two variables, the *adjusted* [value is 2] (Basuki and Prawoto, 2021). The criteria for the decision were as follows:

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

3.10 Hypothesis Test

The hypothesis test in this study was carried out using a t-test, while the model feasibility test was carried out using the determination coefficient and the statistical test F. The determination coefficient was obtained from the R-squared regression value, while the statistical test F was obtained from *the F-statistical* value. Basuki and Prawoto (2021) stated that the t-statistical test is used to determine the influence of independent variables on dependent variables.

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

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

3.11 Establishment of Research Models

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

$$pov_{it} = \alpha + \beta_1 pov_{i(t-1)} + \beta_2 ikk_{it} + \beta_3 gdrb_{it} + \beta_4 inflasi_{it} + \beta_5 apm_{it} + \beta_6 gpop_{it} + \beta_7 trade_{it} + \varepsilon_{it}$$

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

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. These data were 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. These data were 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. The data were sourced from the Financial Services Authority (OJK) and BPS.
4. Annual Inflation (inflation)
   It is measured by 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 among low-income groups. Data were sourced from the BPS and Bank Indonesia.

With a span of eight years and 10 provinces, 70 observation data points were obtained.

4.2 Descriptive Analysis

The descriptive analysis carried out in this study used thematic maps to provide an overview of the poverty and financial inclusion index by dividing three 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%–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 be concentrated in the middle of the island of Sumatra, such as in the provinces of North Sumatra, Riau, West Sumatra, Jambi, Riau Islands, and Bangka Belitung. The poverty rate is moderate in southern Sumatra, such as in 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 ranges from 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.

4.3 Best Model Selection

4.3.1. Hausman Test

The Hausman test is used to determine the best model between *a fixed-effect model* and *a random-effect model*. This test was also performed to determine 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 were 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 a 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 was the fixed-effects *model.*

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

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

4.3.2. Chow Test

The Chow test is used to determine the best model between *the common effect model* or *the fixed effect model*. The following hypotheses were tested:

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 were as follows:

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

4.4 Classic Assumption Test

4.4.1 Normality Test

One of the classic assumptions that must be met is that the residuals of the model must be normally distributed. Normality tests were performed to determine whether the residuals were normally distributed. The normality test used in this study was the Jarque-Bera test. If the *p-value* is greater 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 table presents 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* was 0.7701. If the *p-value* is greater than the significance value of 10%, it can be concluded that the residual model is normally distributed. Therefore, it can be concluded that the model 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 was used to determine the linear relationships between independent variables. To test whether there is an autocorrelation, 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 the independent variables or 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, no VIF value exceeds 10. Therefore, it can be concluded that there is no relationship between the four independent variables used in this model. Therefore, in the regression model, there are no symptoms of multicollinearity and the assumption of non-multicollinearity is met.

4.4.3 Heteroscedasticity Test

One of the classic assumptions that must be met is the residual variance of the constant model or homocedasticity. A heteroscedasticity test was conducted to determine whether the variance of the residual regression model used in the study was not homogeneous, or in other words, not constant. The *Likelihood Ratio* (LR) test method can be used to test the presence or absence of heteroscedasticity. If *the p-value* is greater 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. The results of the *Likelihood Ratio test* are as follows:

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 greater 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 models. An autocorrelation test was performed to determine whether the residual regression model used in the study was correlated. To test whether there is autocorrelation, 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 were measured based on *the adjusted R-squared* value. *The adjusted R-squared* is used to determine the extent to which the variables Lag from Poverty, Financial Inclusion Index, and Annual Inflation can explain variations in poverty. The higher the *adjusted R-squared value,* the better the model produced. Based on Appendix 8, the *adjusted R-squared value* of 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 determine whether the variables Lag of Poverty, Financial Inclusion Index, and Annual Inflation can explain the Poverty variable simultaneously. If the *p-value* ≥ a significance value of 10%, then it can be said that the variables are Lag from Poverty, Financial Inclusion Index, and Annual Inflation. However, 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, the following can be interpreted:

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 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 was negative (0.099981). It can be concluded that *inflation* 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-squared 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 were conducted:

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 in Sumatra.
2. Inflation has a significant negative effect on poverty rates, showing that high inflation can increase poverty levels among people on the island of Sumatra.

5.2 Suggestion

Based on the results of the conclusions obtained, the Financial Inclusion Index (IKK) and inflation have a significant influence on the poverty rate. Based on these findings, the following suggestions can be made:

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 the xx province. Programs such as providing banking services to underserved communities or improving financial literacy will greatly help reduce poverty in Sumatra.
   b. Inflation has been shown to have a negative effect on poverty, suggesting 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 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 at 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 include other variables, such as unemployment rates, regional fiscal policies, or social assistance received by communities, which may affect poverty levels more clearly. Researchers can also use microeconomic variables to obtain clearer details on the causes of poverty, such as education level, work experience, and others.

5.3 Research Limitations

This study has several limitations that can be addressed by future researchers. First, although the regression model used shows a very high **adjusted R-squared** value, this study only considers macroeconomic variables, such as **the Financial Inclusion Index (CPI) and inflation**, which may not fully describe the complexity of the causes of poverty. Micro factors, which are 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 generalizable 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 there are abnormal conditions such as Covid-19 that can have an impact on the modeling results.

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