

ORIGINAL ARTICLE



The Effect of Food Price Fluctuations on the Poverty Rate in Aceh Province, Indonesia

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Abstract

The government continues to address poverty through various policies including food security initiatives, but the poverty rate in Aceh is still relatively high when compared to other provinces in Indonesia. Given this urgency, this study aims to estimate the short-term and long-term effects of food prices on poverty rates in Aceh using an Error Correction Model (ECM) supplemented by observations of long-term equilibrium or cointegration relationships. The secondary data used is the period 2014Q1 - 2022Q4. The estimation results show that in the short and long run, food prices have a significant effect and are positively related to the poverty rate in Aceh. The imbalance between the actual poverty rate and the desired poverty rate will be adjusted over 3.32 quarters. Therefore, the Aceh Government's measures and policies in alleviating poverty need to be revisited by consistently improving the quality of human resources, quantity, and sustainability of agricultural production.

Introduction

Extreme poverty remains a major challenge for developing countries, including Indonesia. By 2021, an estimated 593 million people in developing countries will still live on less than \$1.90 daily [1,2]. Among the provinces with the highest poverty rates in Indonesia is Aceh. Despite experiencing significant economic growth in recent years, the poverty rate in Aceh Province is still relatively high compared to other provinces in Indonesia. In 2021, the percentage of poor people in Aceh Province was recorded at 15.33%, higher than the national figure of 9.71% [3].

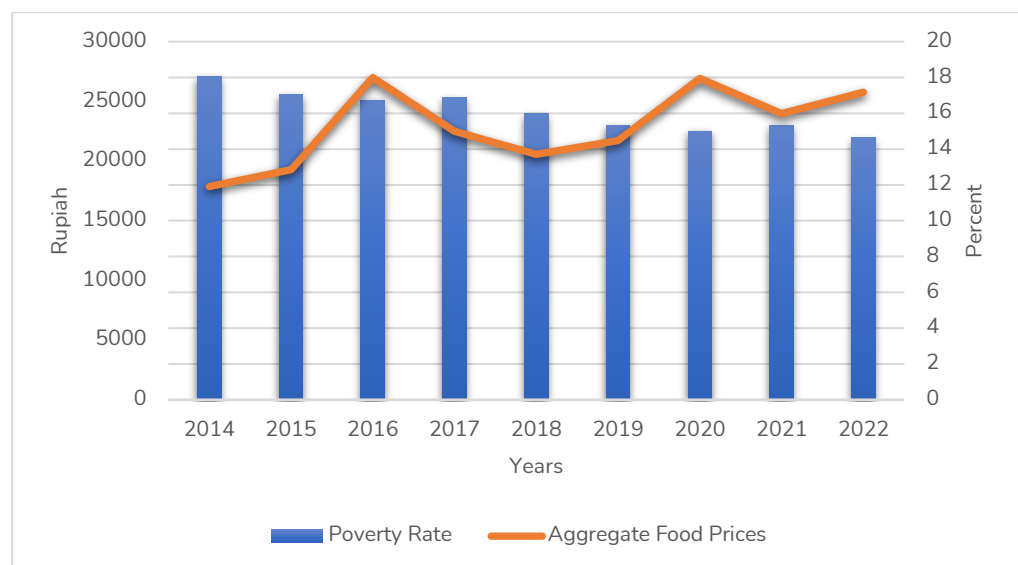


Figure 1. Poverty rate and aggregate food prices of Aceh Province (Source: Statistics of Aceh Province)

Figure 1 illustrates Aceh Province's poverty rate and aggregate food prices from 2014 to 2022. In 2014, the poverty rate in Aceh Province was 18.05%, significantly higher than the national rate of 11.25%. However, within eight years, there was a notable decline to 14.64% in 2022. This decline demonstrates the government's efforts and policies in reducing poverty [4–6]. However, the rate remains higher than in other provinces in Sumatra, such as North Sumatra (8.18%) and West Sumatra (6.09%), as well as the national average (9.19%) [7].

One factor that is indicated to affect the poverty rate is the price of food commodities, which are the basic needs of every household. When food prices increase, poor households must allocate a significant portion of their income to meet food needs, which reduces their ability to fulfill other needs such as education, health, and housing [8]. For poor households, the remedies available are even more limited and can have a devastating impact on their future well-being leading to chronic poverty and generational contagion [9]. In Aceh Province, key food commodities such as rice, vegetables, fruits, and meat frequently experience high price fluctuations. This can harm individuals and households with limited purchasing power, particularly those with low incomes [10,11].

In 2015 and 2019, there was a notable increase in food prices, with a 40.03% and 24.02% surge, respectively. Rising food prices can reduce purchasing power, especially for low-income households [8]. Despite the increase in food prices in 2015, the poverty rate in Aceh Province decreased from 18.05% in 2014 to 17.08% in 2015. This may be due to other factors such as increased income, government assistance programs, or improved access to public services [12]. However, the high increase in food prices in 2019 was followed by a smaller decrease in the poverty rate compared to previous years, from 15.97% in 2018 to 15.32% in 2019.

Figure 1 also indicates an 11.01% decline in food prices in 2020 compared to the previous year. However, the poverty rate in Aceh Province increased to 14.99%. This is likely attributable to the impact of the COVID-19 pandemic, which reduced individuals' income and increased unemployment [3]. Despite the decline in food prices, individuals' purchasing power has diminished due to the pandemic. In 2021, food prices increased by 7.48% compared to the previous year. This was followed by an increase in the poverty rate in Aceh Province from 14.99% in 2020 to 15.33% the following year. Datt & Ravallion [13] posited that rising food prices harm poverty rates, particularly in rural areas where most of the population is net food consumers. Cudjoe et al. [14] in Ghana and Warr [15] in the Philippines and Thailand also demonstrated that high and volatile food prices exacerbate poverty in rural areas.

Aceh is one of the provinces with a relatively robust agricultural sector heavily reliant on producing and distributing food commodities. However, the sector is also susceptible to various external factors, including climate change, natural disasters, and fluctuations in global market prices [16–18]. Food price volatility can harm farmers' incomes and create uncertainty regarding the ability to meet people's food needs. Furthermore, Aceh Province is confronted with challenges in terms of food security. Despite the province's considerable agricultural potential, there are still areas experiencing food insecurity due to uneven distribution and limited access [19,20].

To address the issue of poverty, the government has implemented various policies and programs, including food subsidies, distribution of social assistance, and efforts to increase food production and distribution [21–23]. Nevertheless, the efficacy of these policies still requires comprehensive evaluation to ensure a significant impact on reducing poverty in Aceh Province [24]. Previous research conducted in various countries and regions has demonstrated a correlation between food prices and poverty rates [25,26]. For instance, research conducted by Ivanic & Martin [27] in nine developing countries revealed that rising food prices significantly increased the number of poor people in these countries. However, these studies also emphasize the importance of local context and regional characteristics in understanding the impact of food

price fluctuations. Therefore, it is important to conduct research specific to the case of Aceh Province to provide policy recommendations appropriate to local conditions.

In contrast to previous studies that identified changes in the poverty rate, Keating et al. [28] instead analyzed the impact of rising food prices on household food security in Aceh Province. The results of this study indicate that food price increases are negatively correlated with food security, particularly for low-income households. While this study does not directly measure the impact on poverty, the findings suggest that food price fluctuations may affect the ability of poor households to meet their adequate food needs. One of the variables considered is the price of rice, the main food commodity in Aceh Province. The consistent rise in rice prices could impede the reduction of poverty in Aceh Province [29].

While these studies offer initial insights into the relationship between food prices and poverty in Aceh Province, they also have some limitations. First, these studies focus on a single or a few specific food commodities, such as rice, and do not explore the impact of food prices in aggregate. Second, most previous studies utilize household or district data, which may not fully represent the situation across Aceh Province. Third, some of these studies did not specifically analyze the relationship between food prices and poverty, but only made food prices one of the explanatory variables. Therefore, this study will address these limitations by analyzing the relationship between aggregate food prices and poverty rates at the overall Aceh Province level. The use of longer time series data in this study is expected to provide a more comprehensive picture of the impact of food price fluctuations on poverty in Aceh Province. The results of this study are also expected to provide input for the government in formulating targeted policies to maintain food price stability and improve food security, which in turn can help reduce poverty in Aceh Province.

In light of the explanations above, this study aims to analyze the effect of food prices on the poverty rate in Aceh Province and to estimate the long-run equilibrium or cointegration relationship of the test variables. By elucidating the interrelationship between the two variables, it is anticipated that the findings will furnish policymakers with valuable insights to inform the design of more efficacious strategies and programs to address Aceh Province's poverty and food security concerns. This entails considering many factors influencing food commodity prices, including production, distribution, demand, and government policies [1,30]. Furthermore, this research can serve as a reference for future studies that explore other factors affecting poverty in Aceh Province, such as the price of other crucial food commodities, access to education, health, infrastructure, and other government policies. It is therefore expected to provide a more comprehensive understanding of the poverty problem in Aceh Province and the appropriate solutions to overcome it. The significance of this research is further reinforced by the Sustainable Development Goals (SDGs) established by the United Nations (UN), particularly the first goal to eradicate poverty in all its forms worldwide [31].

Materials and Methods

Data Types and Sources

Poverty in Aceh Province is the object of research tested, where changes in the percentage of poverty are influenced by food price variables (Aggregate Food Prices in Rupiah) supported by control variables, namely Gross Regional Domestic Product (GRDP). The data is obtained from a credible and official institution, namely the Statistics of Aceh Province [3] and the Ministry of Trade [32], so the estimation results in this study will be more accurate and valid. This study uses a secondary quantitative analysis method with a period from 2014Q1-2022Q4 commonly called time series data.

Model and Method

This study uses the Error Correction Model (ECM) to analyze the long-run and short-run relationships between poverty rates, food prices, and GRDP. The ECM is a popular time series data analysis technique in econometrics, especially when the observed variables have a cointegrating relationship or long-run equilibrium. The main advantage of ECM regression is its ability to capture long-run equilibrium and short-run adjustment in one model. This allows researchers to evaluate how variables adjust to each other after a disturbance or imbalance in the short run, while still considering the long-run equilibrium relationship between the variables [33]. The ECM equation model for this study can be expressed as follows:

$$\Delta Poverty_t = \alpha_0 + \alpha_1 \Delta Pfood_t + \alpha_2 \Delta GRDP_t + \lambda ECT_{t-1} - \beta_0 + \beta_1 Pfood_{t-1} + \beta_2 GRDP_{t-1} + \varepsilon_t \quad (1)$$

Where, Δ is the difference or change value, Poverty is the poverty rate, Pfood is the food price, GRDP is the Gross Regional Domestic Product, ECT_{t-1} is the Error Correction Term (residual of the long-run relationship) in period $t-1$, α_0 and β_0 are the short-run and long-run constants, α_1 - α_2 are the short-run coefficients, β_1 - β_2 are the long-run coefficients, λ is the ECT coefficient (adjustment coefficient), and ε_t is the Error term in the t -th period. In the ECM, changes in the dependent variable ($\Delta Poverty$) are explained by changes in the independent variable ($\Delta Pfood$) in the short run, as well as the Error Correction Term (ECT_{t-1}) which is the residual of the long-run relationship between these variables in the previous period ($t-1$).

ECT_{t-1} captures deviations from the long-run equilibrium, and the coefficient λ indicates how quickly the dependent variable (Poverty) adjusts to the long-run equilibrium after a shock. A significant and negative value of λ indicates a long-run relationship between variables. Using the ECM, this study is expected to provide a deeper understanding of the long-run and short-run relationships between poverty, food prices, and GRDP in Aceh Province and provide relevant policy implications to address poverty in the region.

Before conducting regression analysis using the ECM, a series of prerequisite tests are conducted to ensure the validity and reliability of the analysis results. The stationarity test is the first of these prerequisite tests. Its purpose is to determine whether the time series data used is stationary or not. Data stationarity is one of the important assumptions in time series analysis. This is because non-stationary data can produce spurious regression. In this study, the stationarity test was conducted using a unit root test, such as the Augmented Dickey-Fuller (ADF) test [33].

Once the stationarity of the data has been established, the next step is to perform a cointegration test to ascertain whether there is a long-run relationship between the variables included in the model. If a cointegration relationship is identified, the ECM can be employed to capture the short-run and long-run dynamics between these variables. The cointegration test employed is the Johansen test. The cointegration test results will determine the most appropriate analytical approach, namely whether to use the ECM or another regression model. This chapter will discuss the results of the stationarity test, cointegration test, and regression analysis using the ECM in detail [34].

Results and Discussion

Descriptive Statistics

Table 1 presents descriptive statistics for the three variables in this study. These statistics provide an overview of the characteristics of the data used in the analysis. By understanding values such as the mean, median, maximum, minimum, and standard deviation, we can gain

initial insight into the distribution and variation of the data. The variable measuring poverty, expressed as a percentage, has a mean value of 15.945% and a median value of 15.7525%. The maximum value was recorded at 18.05%, while the minimum was 14.64%. The standard deviation of 0.9215 indicates the variation or spread of the data from its mean value. This information indicates that the poverty rate in Aceh Province is relatively high, ranging between 14.64% and 18.05%.

Table 1. Descriptive statistics.

Variable	Mean	Median	Maximum	Minimum	Std. Dev.
Poverty*	15.945	15.753	18.050	14.640	0.9215
Pfood [§]	28134	27950	41155	21955	3766.7
GRDP ^{\$\$}	39.485	38.830	57.400	31.090	6.7482

Note: *unit: percent, [§]unit: rupiah, ^{\$\$}unit: trillion rupiah

The Pfood variable, represented by food prices in Rupiah, has an average value of IDR 28,134.0 and a median value of IDR 27,950.3. The maximum value was recorded at IDR 41,155.9, while the minimum value was IDR 21,955.6. The considerable standard deviation of IDR 3,766.7 indicates that there is significant variation in food prices during the observation period. Conversely, the GRDP variable in trillion Rupiah has an average value of Rp 39.4853 trillion and a median value of Rp 38.83 trillion. The maximum value was recorded at IDR 57.4 trillion, while the minimum value was IDR 31.09 trillion. The standard deviation of Rp 6.7482 trillion indicates a considerable variation in GRDP during the observation period.

Stationarity Test

Table 2 presents the results of the stationarity test for the Poverty, Pfood, and GRDP variables. At the level, the three variables are not stationary, as indicated by the probability values exceeding the 5% significance level. However, at the first difference, the three variables became stationary at the 5% significance level. This is indicated by the probability values, which are less than 0.05 for the Poverty, Pfood, and GRDP variables after first differencing.

Table 2. Results of ADF unit root test.

Variable	Level		1 st Difference		Conclusion Order
	Stat.	Prob.	Stat.	Prob.	
Poverty	-0.8948	0.7770	-6.8629	0.0000**	1 st Difference
Pfood	-2.0564	0.2620	-5.9155	0.0000**	1 st Difference
GRDP	1.1715	0.9970	-5.9561	0.0000**	1 st Difference

Note: ** indicates significance at the 5% level.

This finding indicates that the variables Poverty, Pfood, and GRDP are stationary at first difference. In other words, the data contains stochastic trends and requires differencing to become stationary. Data stationarity is one of the important assumptions in using ECM. As the variables of Poverty, Pfood, and GRDP are stationary at first difference, the requirement to use the ECM has been met.

Cointegration Test

Apart from the unit root test, it is also necessary for the ECM model to conduct a cointegration test to ensure that there is a long-term equilibrium relationship between the variables. In the first row of Table 3, the trace statistic value of 53.315 is greater than the critical value at the 0.05 significance level (47.856), with a probability of 0.0141, which is smaller than 0.05. This indicates that the null hypothesis of no cointegration is rejected at the 5% significance level. In the second row, the trace statistic value of 32.167 is greater than the critical value at the 0.05 significance level (29.797), with a probability of 0.0262, which is also smaller than 0.05. This indicates that the null hypothesis that there is at most one cointegrating equation is also rejected at the 5% significance level. In the third row, the trace statistic value of 14.568 is smaller than

the critical value at the 0.05 significance level (15.495), with a probability of 0.0686, which is greater than 0.05. This indicates that the null hypothesis that there are at most two cointegrating equations cannot be rejected at the 5% significance level. The results of the Johansen cointegration test indicate the presence of two cointegrating equations or long-run relationships between the variables representing poverty, food, and GRDP. This finding justifies the use of an ECM to analyze the short-run and long-run relationship between these variables.

Table 3. Results of Johansen cointegration test.

Hypothesized No. of CE(s)	Trace Statistic	Critical Value (0.05)	Prob.
None	53.315**	47.856	0.0141
At most 1	32.167**	29.797	0.0262
At most 2	14.568	15.495	0.0686

Note: * and ** indicates significance at the 1% and 5% level.

ECM Estimation Results

The results of the ECM estimation indicate that, in the short term, the food price variable (Pfood) has a positive and significant influence on the poverty rate in Aceh Province at the 5% significance level. The coefficient of the Pfood variable, which is 0.2509, indicates that a 1% increase in food prices will result in an increase in the poverty rate by 0.2509%. Agwu [35] concluded that rising food prices have an adverse impact on poverty, especially in low and middle-income countries. Table 4 also shows that the GRDP variable in the short term has a negative influence on the poverty rate in Aceh Province, although it is only significant at the 10% significance level. The coefficient of the GRDP variable of -0.1023 indicates that a 1% increase in GRDP will result in a 0.1023% reduction in the poverty rate. This finding is consistent with research conducted by Sehrawat & Giri [36] which states that high economic growth can contribute to a reduction in the poverty rate in a region.

Table 4. Results of estimation.

Period	Variable	Coefficient	t-Statistic	Prob.
Short-run ECM	D(Pfood)	0.2509	0.7699	0.0447**
	D(GRDP)	-0.1023	-0.1021	0.0919***
	ECT(-1)	-0.3015	-3.4559	0.0016*
	C	0.0984	2.6506	0.0125**
	R-squared = 0.3119			
	Adjusted R-squared = 0.2454			
Long-run	F-statistic = 4.6849			
	Prob. F-statistic = 0.0082			
	Pfood	0.0295	0.0412	0.0967***
	GRDP	-5.0909	-9.0994	0.0000*
	C	14.955	12.609	0.0000*
	R-squared = 0.8132			
	Adjusted R-squared = 0.8019			
	F-statistic = 71.8498			
	Prob. F-statistic = 0.0000			

Note: *, **, and *** indicates significance at the 1%, 5%, and 10% levels, respectively.

The test variables exhibit a long-run equilibrium or cointegration relationship, as evidenced by the ECT coefficient, which is negative and significant at the 5% significance level. The ECT value of 0.3015 or 30.15% of the imbalance between the actual poverty rate and the desired poverty rate will be adjusted over approximately 3.32 quarters. The next estimation result is the long-run regression, where the food price variable (Pfood) has a positive influence on the poverty rate in Aceh Province. However, this influence is only significant at the 10% significance level. The coefficient of the Pfood variable of 0.0295 indicates that every 1% increase in food prices will increase the poverty rate by 0.0295%. This finding is supported by a study conducted by Arndt et al. [37], which concluded that another impact of the consistent increase in food prices is the

phenomenon of child malnutrition. They found that food price shocks negatively impact children's nutritional status in the long run, reflecting how that generation contributes to future poverty levels.

Furthermore, the GRDP variable in the long run has a probability of $0.00 < 0.05$ (critical value), indicating that greater production output will potentially contract the poverty rate in Aceh Province. With a GRDP coefficient of -5.0909 obtained, an increase in GRDP will reduce the poverty rate by 5.0909%. This result also aligns with research conducted by Ngubane et al. [38], which states that sustainable economic growth can help reduce the poverty rate in the long run. Overall, the test variables show a responsive pattern, where they can explain 31.19% of short-run changes in the poverty rate in the model. In contrast, the R-squared value for the long-run model exhibits a considerably greater contribution than the short-run, reaching 81.32%. This finding indicates that the long-run model demonstrates superior explanatory power compared to the short-run model.

In the F-test, the F-statistic value for the short-run model is 4.6849, with an F-statistic probability of 0.0082. This indicates that the short-run model as a whole is significant at the 1% significance level. Consequently, the F-statistic value for the long-run model is 71.8498 with an F-statistic probability of 0.0000, indicating that the overall long-run model is also significant at the 1% significance level. This finding suggests that both the short-run and long-run models demonstrate a robust ability to explain variations in the poverty rate in Aceh Province.

Discussion

The ECM estimation results indicate that, in both the short and long run, food prices positively influence the poverty rate in Aceh Province. This finding is consistent with the conclusions of Morley & Morgan [39], who demonstrated that an increase in food prices can lead to an increase in poverty, particularly in regions where a significant proportion of the population is net food consumers. Conversely, the gross regional domestic product variable has a negative relationship with Aceh Province's poverty rate in both the short and long term. This finding is consistent with classical theory, which states that sustained economic growth can reduce poverty [40]. Consequently, policies that maintain food price stability are crucial in reducing Aceh Province's poverty. Moreover, encouraging regional economic growth through increased investment, infrastructure improvements, and developing leading sectors can also be an effective approach to contract this classic problem.

Alkire et al. [41] posited that poverty is a multifaceted phenomenon influenced by various factors, including education, health, access to basic services, and income inequality. Consequently, eradicating poverty necessitates a multifaceted and interdisciplinary approach that transcends mere economic considerations, encompassing other pivotal aspects such as education, health, equitable development, and environmental sustainability. This perspective is corroborated by Sachs et al. [42], who posit that poverty alleviation initiatives necessitate cross-sector collaboration and active participation from all stakeholders, including the government, non-governmental organizations, the private sector, and the community.

One strategy that can be implemented is to strengthen existing poverty alleviation programs, such as the Family Hope Program (PKH) and the National Program for Community Empowerment (PNPM), by increasing their coverage and effectiveness. Social assistance programs that are well-targeted and supported by adequate assistance can positively impact reducing poverty and improving community welfare [43]. Moreover, the government can also increase investment in sectors that have the potential to absorb a significant number of workers, such as agriculture, tourism, and creative industries. This finding is consistent with research conducted by Todaro & Smith [44], which indicates that the creation of productive and sustainable employment is a crucial element in efforts to alleviate poverty in developing countries.

Conclusions

The Error Correction Model (ECM) estimation results indicate that food prices exert a partial and simultaneous significant effect on the poverty rate in Aceh Province, both in the short and long run. In the short run, food prices have the most dominant influence on the changes in poverty rates compared to the long run. This finding indicates that people in Aceh Province are relatively vulnerable to fluctuations in food prices, which makes it difficult for them to meet their food needs and contributes to an increase in the poverty rate in the province. Therefore, stable and declining food prices can potentially reduce poverty in Aceh Province.

In addition, the estimation results also show the existence of a long-run equilibrium or cointegration relationship among the variables used in the model. The disequilibrium between the actual and desired poverty rates is equalized over 3.32 quarters. This finding confirms the existence of a long-run adjustment mechanism in the ECM estimation, whereby an adjustment process brings the variables back to long-run equilibrium in the event of a shock or disequilibrium.

In light of these findings, it is recommended that policymakers consider measures to enhance the food security of the people of Aceh Province, including strategies to boost agricultural productivity and diversify food sources. Additionally, efforts to stabilize food prices are crucial to protect individuals from the adverse effects of price fluctuations, which can exacerbate poverty conditions. However, it is important to note that this study has limitations regarding data coverage and variables used. Consequently, future research could expand the scope of the data and examine additional factors that influence poverty, such as unemployment, education, and access to public services, to gain a more comprehensive understanding.

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Data Availability Statement: The data can be downloaded for free on the official website of the Statistics of Aceh Province.

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