

COINTEGRATION ANALYSIS OF STAPLE FOOD PRICES AND REGIONAL INFLATION IN EAST JAVA, 2020–2024

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ABSTRACT

Food is a significant concern in Indonesia, accounting for 58.81% of total household expenses. Changes in the prices of food commodities affect the rate of inflation. The focus of this study is the analysis of inflation in East Java for shallots, rice, chillies, oil, eggs, and chicken. The data are monthly time series for the years 2020 to 2024, obtained from SISKAPERBAPO. The method used in this study is the Autoregressive Distributed Lag (ARDL). The study found that food commodities are subject to monthly price changes and impact inflation. In the short run, inflation is primarily impacted by the prices of rice, red chillies, chicken, and eggs. In the long run, the prices of shallots, rice, chicken, and cooking oil are significant. What these food items have in common is that the items that largely account for that inflation are rice, red chillies, and chicken. Price changes in other food items are likely to be short-lived and can be handled through market forces and civil service policies.

Keywords: Staple food prices, Regional inflation, Cointegration, ARDL

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I. INTRODUCTION

The main occupation of the Indonesian population is subsistence farming. Hence, making it an agrarian society. Subsistence farming is an important pillar of the Indonesian Economy. The sector sponsors agricultural exports, both finished and semi-finished. The sector is also important for providing food security and sustenance and for activating several regions of the country's economy. The integrated economy of regions is determined by the strength of agricultural sectors in the units. It also determines household spending, the economy's main driver. The agricultural sector for food crops is publicly controlled by setting floors and ceilings, resulting in heavy reliance on the sector for public welfare. This explains the link between the agricultural sector and regional economies, as in East Java, which accounts for a major share of the country's economy. The population of Indonesia is 272,229,372, as stated by the BPS in 2021. This population creates an imbalance in food availability. This imbalance can take the form of excess demand, production unavailability, crop failures, constrained distribution, and problems with imports, which can be the main drivers of negative inflation in food prices (Helbawanti et al., 2021).

In an economic region, consumption is the primary determinant of economic activity. In addition, consumption encompasses the household economy and the various ways households spend their income. As such, consumption is the most immediate indicator when analysing changes in the community's well-being and economic health. As of today, East Java Province ranks second in terms of its contribution to the country's economy. From 2010 to 2016, despite the global economic recession, East Java's economy, while experiencing a slight deceleration, achieved positive economic growth. As a result, it could be inferred that East Java's economic structure is quite resilient and able to withstand shocks from the global economy. According to the Central Bureau of Statistics (BPS), East Java's economy grew by 5.25% in 2016, slightly higher than the previous year's 5.16%. Such a growth rate is closely related to the community's level of consumption. Consumption plays a significant role in shaping East Java's Gross Regional Domestic Product (GRDP).

In terms of overall consumption, food accounts for a significant share. The definition of food according to the Government Regulation of the Republic of Indonesia Number 28 of 2004 concerning Food Safety, Quality and Nutrition, is everything that comes from biological sources of agricultural, plantation, forestry, fishery, livestock, aquatic and water products, whether processed or unprocessed intended as food or drink for human consumption, including food additives, food raw materials, and other materials used in the process of preparing, processing, and/or making food and drink. This opinion is reinforced by Law Number 18 of 2012 concerning food, which emphasises the state's obligation to ensure the availability, affordability, and adequacy of food consumption. Food is one of the basic human needs and is part of human rights (HAM), as stated in the Universal Declaration of

Human Rights of 1948 and Law No. 7 of 1996 concerning food. According to Suharjo (1988), food is defined as the substances consumed daily to meet the needs for maintenance, growth, function, tissue replacement, and regulation of bodily processes. In the Republic of Indonesia, food inflation also includes commodities of the utmost importance, such as rice, meat, chicken, chillies, and red onions, which are highly volatile.

The food category had an inflation rate of 6.56% in 2019 due to price volatility in basic, inflation-sensitive necessities. An example was a pattern of overconsumption during religious holidays, with demand surging as people bought food for traditional celebrations and family gatherings. During this period, consumption trends were still dominated by food, with overconsumption driven by high inflation in red chilli and garlic. Because these two commodities are frequently used in daily life, demand is high. Despite these price changes, purchasing power did not decrease, as these two commodities contributed the most to inflation (Yulianti et al., 2024). Small changes in supply or distribution can trigger significant price increases and directly impact regional inflation.

Given their strategic position, the government has designated strategic food commodities as a top priority in achieving food self-sufficiency. These seven food commodities are rice, corn, soybeans, sugar, beef, shallots, and red chillies. These commodities are monitored through the Strategic Food Commodity Information System (SISKAPERBAPO) to maintain supply and price stability. The central and regional governments are responsible for the stability of staple commodity supply and prices by managing national food reserves to ensure a sufficient supply of safe staple food for the public. The government strives to maintain the stability of supply and prices of staple commodities, in addition to carrying out the mandate of Law Number 18 of 2012 concerning food, but also to maintain the public's physical and economic access to strategic foodstuffs as a source of carbohydrates and protein for the majority of the Indonesian people (Supriyono et al., 2024). Fluctuations in the prices of these commodities are often driven by seasonal factors, extreme weather, pests, and distribution disruptions, leading to cost-push inflation. Not only that, but food price fluctuations are also influenced by increasing demand, competition for demand, for example, soaring global food prices, the seasonal and uneven nature of production across seasons, and poor infrastructure, which results in high transportation costs and an increased frequency of natural disasters. This has led to reduced economic access for the community, which in turn affects food security (Shobur et al., 2025).

The effect of food prices on the economy is felt more than that of other goods because agricultural commodity prices are a primary determinant of economic conditions and welfare in developing economies. In a large-scale household survey on the island of Java, Indonesia, households were found to spend 75% of their budgets on food. The prices of agricultural commodities affect the households in the developing economies not only as consumers but also as producers. Agriculture

employs a large share of the workforce and can constitute a substantial share of household income (Rendra et al., 2026; Rezitis & Sassi, 2013). Fluctuations in food commodity prices are often caused by seasonal factors, natural disasters, and supply chain disruptions and require rapid intervention. Research in East Java for the 2015–2017 period showed that cayenne pepper and shallots were the most volatile, with a significant positive effect on short-term inflation, as indicated by the VECM model. Fluctuations in food commodity prices are mostly studied at the macro level, both in terms of exports and imports and in the transmission effect of world food commodity prices on domestic food commodity prices (Puspita Widasari et al., 2023).

The rationale for selecting the 2020–2024 period is that it captures the full cycle of exogenous shocks and their subsequent adjustments, providing a more comprehensive understanding of price and inflation dynamics than a pre-pandemic or pandemic-only sample. The use of a single ARDL model without explicit structural break tests is justified because the ARDL framework with automatic lag selection has been shown to be robust to moderate structural breaks, provided it passes parameter stability tests (Kusmutiarani, 2018; Pesaran et al., 2001). Furthermore, with a sample size of only 60 months, splitting the data into sub-periods would reduce degrees of freedom and estimation precision. Moreover, the CUSUM test results in Section IV have confirmed that the model coefficients remain stable throughout the 2020–2024 period, so the single-regime specification remains econometrically valid.

This close relationship between food prices and welfare is fundamentally dependent on macroeconomic indicators, namely inflation. There are many definitions of inflation in economics. In the early period, the definition of inflation was often used after World War II, according to *AP Lehnneris*, to refer to a situation in which there is excess demand for goods in the economy as a whole (Lestari, 2025). Inflation is the process of continuous increases in the general price level. Inflation is one of the macroeconomic problems in Indonesia that needs to be controlled. Inflation can occur due to widespread increases in the prices of goods and services. The annual inflation rate in Indonesia from 2008 to 2023 fluctuated widely and, at times, did not meet the inflation target. One way to control inflation is to make predictions for the future period. Java Island is the largest contributor to Indonesia's economy and Gross Domestic Product (GDP), so it can be considered a general indicator for measuring the inflation rate in Indonesia as a whole (Urak et al., 2024; Yuliati & Hutajulu, 2021).

Other research has echoed previous studies on the impact of food commodity prices on inflation. One such case is the research by Kuma & Gata (2023), which states that food price inflation has unique effects on lower-income countries, whereby their governments must implement specialised monetary interventions. Although the relationship between prices and inflation is a global phenomenon, the impact is largely unaddressed, and the literature has largely focused on the national context or on a single commodity. East Java Province, known as a food producer and the second most populous region in Indonesia, is considered. This study analyses the short- and

long-term relationships between the prices of several food commodities and general inflation in East Java over the 2020-2024 period. A monthly time-series approach is used to identify seasonal fluctuations that are not visible in annual or quarterly data.

Based on the discussion above, the researcher wants to examine "The Relationship between Food Commodity Prices and Inflation in East Java Province." The purpose of this study is to determine whether fluctuations in food commodity prices are related to the inflation rate in East Java. Regarding the relationship between changes in commodity prices and inflation, Lontakis (2012) argues that commodity prices can serve as leading indicators of inflation. The reasons are: First, commodity prices can respond quickly to economic shocks, such as those affecting aggregate demand. Second, commodity prices can also respond to *non-economic shocks*, such as floods, landslides, and other natural disasters, which can disrupt their distribution. This finding is supported by a study in East Java, where cayenne peppers responded most strongly to shocks, contributing up to 4.8% to inflation, as estimated using the FEVD method.

II. LITERATURE REVIEW

According to the Central Bureau of Statistics, inflation is a condition characterised by a sharp, sustained increase in prices over a long period. Inflation can also be defined as an economic measure that reflects the increase in the average price of goods and services produced within an economy. In this context, inflation can be defined as a tendency for prices to rise, a continuous increase in prices, and a price increase not only for a single item but also for several commodity levels. Not all causes of inflation have negative consequences. Positive benefits of inflation could invigorate the activities of entrepreneurs and producers.

Understanding of inflation has evolved over the years. Initially, inflation was defined as the level of money supply or an increase in liquidity in an economy. This definition referred to the general symptoms caused by an increase in the money supply, which was thought to have caused price increases. In later developments, inflation is defined as a general, continuous tendency for the prices of goods and services to rise (Huang et al., 2021). Fadhilah et al. (2020) added that inflation is a general and continuous increase in the prices of goods and services. From this definition, there are three components that must be met to be associated with inflation: a) price increases, b) general nature, and c) ongoing. An unstable inflation rate also complicates business planning, discourages saving, and has other negative impacts on the economy (Allon-Pineda et al., 2026).

Understanding inflation cannot be separated from prices, because price changes are the main indicator of inflation. The definition of price is the amount of value required to obtain a product. In transactions involving the sale and purchase of a good or service, price is a fundamental factor that influences demand. Within the framework of economics, price is not only a means of exchange but, more importantly,

a medium of information for both buyers and sellers, helping them rationalise buying and selling, respectively. According to the theory of supply and demand, price is the most significant determinant of demand in the market. In the normal scenario, when the price of a good increases, demand usually decreases; conversely, when the price decreases, demand usually increases. Moreover, the price of a given commodity is a determinant of the market's equilibrium, whereby demand and supply determine the equilibrium price of a good that reflects prevailing market conditions. This condition of equilibrium has an effect on the actions of the sellers in the market to determine the quantity of their goods that will be sufficient to satisfy the demand in the market at a favourable price.

The link between prices and inflation can be better understood by analysing trends in food commodity prices. Regarding inflation and food commodity prices, previous work by Emediegwu & Rogna (2024) showed that the prices of rice, shallots, red chillies, and cayenne peppers are inflationary, positive, and statistically significant. Another study by Marson & Saccone (2025) in North Sumatra showed long-run inflation in the prices of rice, red chillies, cayenne peppers, shallots, and garlic. According to Irawati (2022), there appears to be no causal relationship between consumer and producer prices of shallots in Indonesia. This may exist because of market concentration and market failure. This study relies on aggregate consumer-level staple food prices and regional inflation data and does not include producer-side price series, so it cannot directly test the market concentration or market failure mechanisms described by Irawati (2022). This is acknowledged as a limitation of the present analysis, and incorporating producer price data to examine price transmission is left for future research. An increase in commodity prices can reduce people's purchasing power for these commodities. As a result, such behaviour can lead to low public welfare; thus, changes in commodity prices are among the major causes of inflation. The study by Dorosh et al. (2025) in Medan city showed that certain commodity prices contributed to inflation diversity, with the least to most significant influences being garlic, local shallots, green cayenne pepper, and ordinary red cayenne pepper.

III. METHODOLOGY

The current study employs secondary time-series data monthly from January 2020 to December 2024. This period covers the significant economic events related to the COVID-19 pandemic and the post-pandemic economic recovery. The dependent variable in this study is the inflation rate, sourced from the Central Statistics Agency (BPS) of East Java Province's publication tables, an official and reliable source for regional economic data. This inflation data is calculated as the monthly percentage change in the Consumer Price Index (CPI) across East Java Province.

Meanwhile, the independent variables used in this study comprise six staple food commodities sourced from the Commodity Price and Production Information System (SISKAPERBAPO), which is managed and supervised by the East Java

Provincial Government. These six variables include: Rice Price (X_1) as a staple food commodity that is often consumed by the people of East Java, the Price of Shallots (X_2) as one of the volatile horticultural commodities that is often the main contributor to inflation in East Java, the Price of Chilies (X_3) as a food flavouring ingredient that is known for its extreme price volatility because it is sensitive to weather and pests, the Price of Eggs (X_4) as a source of protein that has a low price and is also widely consumed by the community, the Price of Cooking Oil (X_5) as one of the essential needs of the community for cooking both at the household level and in the processed food industry, the Price of Meat (X_6) as one of the sources of animal protein that has a high daily consumption rate in East Java.

These six commodities were selected based on their significant contribution to inflation, particularly in the food group, as found in research across various regions in Indonesia. Research conducted in Magelang City and Medan City suggests that red chiles and shallots are the primary commodities that can affect inflation variability (Marina et al., 2024; Putri Hariyanti et al., 2023; Rahmanta et al., 2020). Moreover, Emediegwu & Rogna (2024) suggest that commodity prices, such as rice, maize, and wheat, have increased in developing countries, contributing to the inflationary spiral. All variable data used is level data observed from month to month (m-to-m) to maintain consistency in the time series analysis.

To meet the requirements for analysis, which require stable variables so that coefficient interpretation can be performed in elasticity form, all independent variables are converted to natural logarithms (ln). This change transforms the level variables into $\ln_{hb}$, $\ln_{hba}$, $\ln_{hc}$, $\ln_{ht}$, $\ln_{hm}$, and $\ln_{hd}$. The ARDL approach was chosen because of its ability to analyse variable relationships in the short and long term, even when data have different levels of stationarity, such as a combination of $I(0)$ and $I(1)$, as long as no variable has a stationarity level of $I(2)$ (Pesaran et al., 2001).

The general form of the ARDL model used in this study is as follows:

$$\begin{aligned} \Delta INF_t = & \alpha_0 + \sum_{i=1}^{p-1} \beta_i \Delta INF_{t-i} + \sum_{j=0}^{q_1-1} \theta_j \Delta \ln HB_{t-j} + \sum_{k=0}^{q_2-1} \gamma_k \Delta \ln HBA_{t-k} + \sum_{m=0}^{q_3-1} \delta_m \Delta \ln HC_{t-m} \\ & + \sum_{n=0}^{q_4-1} \phi_n \Delta \ln HT_{t-n} + \sum_{r=0}^{q_5-1} \psi_r \Delta \ln HM_{t-r} + \sum_{s=0}^{q_6-1} \omega_s \Delta \ln HD_{t-s} + \lambda ECM_{t-1} \\ & + \varepsilon_t \end{aligned}$$

Where ΔINF_t is the dependent variable, namely the change in inflation in period t ; α_0 is the constant term; $\beta_i, \theta_j, \gamma_k, \delta_m, \phi_n, \psi_r$ and ω_s are the short-term coefficients associated with each explanatory variable; $\Delta \ln HB_{t-i}$ = change in rice price in period $t-i$; $\Delta \ln HBA_{t-i}$ = change in shallot price in period $t-i$; $\Delta \ln HC_{t-i}$ = change in chili price in period $t-i$; $\Delta \ln HT_{t-i}$ = change in egg price in period $t-i$; $\Delta \ln HM_{t-i}$ = change in oil price in period $t-i$; $\Delta \ln HD_{t-i}$ = change in meat price in period $t-i$; $p, q_1, q_2, q_3, q_4, q_5, q_6$ denote the optimal lag lengths selected for each variable; λ is the coefficient of the

error correction term, (ECT), which measure the speed of adjustment from short-term disequilibrium toward the long-term equilibrium; and ε_t is the stochastic error term in period t .

This model allows us to check whether there is a long-term equilibrium relationship. Cointegration with the method of Bounds Testing, which can be seen from the variable coefficients that have been carried out by differencing first. This test is conducted by examining whether the coefficient on the lag-level variable is statistically significant using an F- or t-test. Should the result be larger than the $I(1)$ upper critical value, this would tell you that there exists a long-run relationship. This model not only assesses long-run and short-run impacts but also provides a solid platform for exploring how error correction operates within the East Java regional economic system. The estimation steps followed in this study are based on standard practices in time-series econometric analysis and on previous empirical studies such as Anwar et al. (2023) and Fadhilah et al. (2020). These steps include:

Descriptive Statistics aims to provide a general picture of each variable's distribution and characteristics. This step is also the first in order to identify the data distribution, patterns, and possible outliers. We then perform a stationarity test to prevent spurious regression, which is a necessary step to avoid the pitfalls of the data's time-series nature. The unit root tests utilised are the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS). The tests can also be used to determine the order of integration of the data variables and whether the variable is stationary at level $I(0)$ or requires first differencing, $I(1)$, to become stationary. The tests also play a significant role in determining the appropriate ARDL model to be employed. Data that are stationary at level $I(0)$ or, after first differencing, at $I(1)$ can be employed in the ARDL model approach (Pesaran et al., 2001).

The next step in the study is determining the Optimal Lag of the appropriate number of lags for each variable in the ARDL model, which is selected based on information criteria, such as the Akaike Information Criterion (AIC) or the Schwarz Bayesian Criterion (SBC) (Baharumshah et al., 2009). The importance of selecting the appropriate lag cannot be overstated, as it directly affects the model's ability to adequately reflect changes in the underlying data. In the same breath, the selected lags should ensure that the model residuals are temporally uncorrelated as per the classical assumptions.

Once the optimal lag has been established, we proceed with the Bounds Test to determine whether there is a long-term relationship among the variables (Pesaran et al., 2001). H_0 shows there is no long-term relationship among the variables. Moreover, H_1 indicates a long-term relationship among the variables. This test is carried out by analysing the F and t statistics and comparing them with the critical values at the specified levels of integration, $I(0)$ and $I(1)$. If the test statistic exceeds

the critical value, then the null hypothesis must be rejected, indicating a long-term relationship.

After conducting an ARDL estimation, diagnostic tests are then performed to ensure the model is suitable and stable for use (Baharumshah et al., 2009). The diagnostic tests performed include the Autocorrelation test (Breusch-Godfrey LM Test) to ensure the residuals are uncorrelated. Heteroscedasticity test (Breusch-Pagan-Godfrey) to ensure whether there is similarity in the residuals. Residual normality test (Jarque-Bera test) to see whether the residuals are normally distributed according to classical assumptions or not. Model stability test using the CUSUM (Cumulative Sum) test to assess the consistency of the model coefficients over the research period.

IV. RESULTS AND ANALYSIS

Table 1 shows descriptive statistics for all variables used in this study. Before further analysis, all independent variables (food commodity prices) were transformed using natural logarithms. The purposes of this transformation in econometric analysis are: First, using logarithms can help stabilise the variance of the data, thereby preventing heteroscedasticity. Second, the use of logarithms facilitates interpreting estimation results in terms of elasticity, which refers to the percentage change in the dependent variable in response to a percentage change in the independent variable. Third, transforming skewed data with natural logarithms can bring them closer to a normal distribution.

Table 1. Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max	Skew.	Kurt.
INF	60	0,254	0,303	-0,37	1,41	0,963	5,63
ln HB	60	2,499	0,1	2,413	2,731	0,871	2,173
ln HBA	60	3,347	0,235	2,926	3,941	0,355	2,825
ln HC	60	3,586	0,487	2,702	4,539	-0,028	2,118
ln HT	60	3,194	0,124	2,921	3,402	-0,322	2,28
ln HM	60	2,681	0,147	2,387	2,971	-0,265	2,321
ln HD	60	3,498	0,084	3,298	3,716	-0,126	3,227

Source: Data processed, 2026

As shown in Table 1, the inflation variable (INF) has a monthly average of 0.254% with a standard deviation of 0.303. The lowest inflation value was -0.37% (deflation), and the highest was 1.41%. The distribution of the inflation variable is right-skewed (skewness = 0.963), indicating that more months experienced low inflation, with some relatively high spikes. The kurtosis value of 5.63, well above 3, suggests a leptokurtic distribution characterised by a distinctive peak and pronounced fatter tails, reflecting the presence of periodic price shocks that temporarily push inflation to extreme levels (Fadhilah et al., 2020; Liontakis, 2012). This distributional characteristic does not undermine the reliability of the ARDL lag structure; rather, it justifies its application. The ARDL model with automatic lag selection based on AIC inherently accommodates such volatility by allowing short-run dynamics to absorb the effects of immediate shocks. At the same time, the Error Correction Term (ECT) captures the subsequent return to long-run equilibrium. The selected lags (ARDL 1,1,0,0,1,0,0) were specifically chosen to balance shock responsiveness with parameter parsimony, ensuring that outliers do not dominate the estimation.

Moreover, the Breusch-Godfrey LM test (Prob = 0.095) indicates the absence of serial correlation, suggesting that the chosen lag length adequately captures the persistence of these price shocks. Consequently, the high kurtosis rather than biasing the estimates reinforces the appropriateness of the ARDL approach, as its lag-augmented structure and stability diagnostics (CUSUM) ensure that the model remains reliable despite short-term extreme fluctuations. The price variable is also converted to logarithmic form. Rice prices (ln_hb) show relatively low price fluctuations with a standard deviation of 0.1. As a staple commodity, rice tends to have lower, more stable prices due to government interventions. On the contrary, chilli prices (ln_hc) exhibit the highest price volatility, with a standard deviation of 0.487, which is characteristic of horticultural commodities. They are more sensitive to weather, have specific harvest seasons, and exhibit inelastic demand (Fadhilah et al., 2020). This high volatility in chilli prices has also been documented in several other studies in Medan and Pangkalpinang, confirming that horticultural commodities are characteristically volatile (Kusmutiarani, 2018).

The prices of chicken meat (ln_hd) are also normally distributed, with the highest price stability, a standard deviation of 0.084. This reflects maturity across the supply chain and is consistent with Kusmutiarani's (2018) findings, which indicate that chicken meat (broiler chicken) is an important substitute commodity. However, in the study by Fadhilah et al. (2020) in Medan, chicken meat prices have a significant impact on inflation, which reflects a different local context. Meanwhile, egg prices (ln_ht) and cooking oil prices (ln_hm) show a left-skewed price distribution, meaning that more months have relatively high prices than low ones. This pattern may reflect a persistent upward price trend due to policy influences and persistent supply shocks,

as seen in studies of inflation in certain commodity subgroups in the Eurozone, which also found distinct persistence patterns (Liontakis, 2012).

Before estimating the model using the ARDL approach, stationarity tests must be performed using the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests. The results of the stationarity test in Table 2 show that some variables, such as rice price (ln_hb) and oil price (ln_hm), are non-stationary at the level $I(0)$. However, after first differencing, all variables become $I(1)$. Meanwhile, the other variables are stationary at the level or $I(0)$. When the stationarity test results are inconclusive, indicating a mixed $I(0)/I(1)$ condition, this can satisfy the approach's test requirements. Autoregressive Distributed Lag (ARDL) is used to test long-term cointegration relationships and to model short-term dynamics.

Table 2. Stationarity Test Results

Variables	ADF		PP	
	Level	1st Diff.	Level	1st Diff.
INF	-5,293***	-10,970***	-5,361***	-13.103***
ln HB	-0,061	-6,223***	0,032	-6.116***
ln HBA	-3,641***	-6,413***	-3,700***	-6.274***
ln HC	-4,295***	-10,128***	-4,373***	-10.444***
ln HT	-3,361**	-9,618***	-3,123*	-11.505***
ln HM	-1,730	-6,949***	-1,862	-7.032***
ln HD	-4,429***	-8,576***	-4,353***	-9.308***

Source: Data processed, 2026

*Significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

4.1. Lag Selection and Multicollinearity Analysis

Selecting the appropriate lag length is crucial in ARDL modelling, as a lag that is too short can lead to model misspecification. Conversely, a too-long lag can reduce estimation efficiency. Therefore, it is necessary to conduct a lag selection test using four commonly used information criteria: *Final Prediction Error* (FPE), *Akaike Information Criterion* (AIC), *Hannan-Quinn Information Criterion* (HQIC), and

Schwarz’s Bayesian Information Criterion (SBIC). The results of the comparison of the four criteria are presented in Table 3.

Based on Table 3, there is no agreement among the four criteria for selecting the best lag across all variables. Given that this study aims to estimate the long-term cointegration relationship and test the stability of the model, the approach is to let the *Autoregressive Distributed Lag* (ARDL) algorithm automatically select the best model specifications based on the *Akaike Information Criterion* (AIC). The best model selected was the ARDL model with lags (1,1,0,0,1,0,0).

Table 3. Optimal Lag Selection

Variables	FPE	AIC	HQIC	SBIC	Lag
dinf	4.40e-14	-10,892	-10,107	-8,867	1
dln_hb	1.80e-14	-11,854*	-10,382	-8,056	2
dln_hba	2,50e-14	-11,777	-9,618	-6,207	3
dln_hc	2.80e-14	-12,106	-9,269*	-4,764	4
dln_ht	4,00e-14	-10,986	-10,888*	-10,733*	0
dln_hm	4.40e-14	-10,892	-10,107	-8,867	1
dln_hd	1.80e-14	-11,854*	-10,382	-8,056	2

Source: Data processed, 2026

* Lag Optimal, Endogenous: dinf dln_hb dln_hba dln_hc dht dhm dhd, Exogenous: _cons

This model specification indicates that inflation dynamics are best explained by its own lag or by one previous period. These include lags in rice, egg, and other commodity prices at that time. This approach is considered capable of capturing the system's core dynamics without overcomplicating the model. After selecting the optimal lag, the next test is a multicollinearity test to ensure there is no high correlation among the independent variables that could affect the accuracy of parameter estimation.

Table 4. Variance inflation factor/Multicollinearities

Variables	VIF	1/VIF
ln HT	2,04	0,489
ln HB	1,67	0,600
ln HD	1,46	0,685
ln HM	1,43	0,698
ln HBA	1,22	0,822
ln HC	1,15	0,869
Mean VIF	1,49	.

Source: Data processed, 2026

VIF Results in Table 5 indicate no serious multicollinearity issues in the model. All VIF values are below 5, even below the more stringent threshold of 2.5, with an average VIF of only 1.49. The highest VIF value is for the egg price variable (ln_ht), at 2.04, which is still within the acceptable range. These results indicate that each independent variable provides unique, non-redundant information for explaining variation in inflation, so the parameter estimates are reliable.

4.2. ARDL Model Estimation and Long-Run Cointegration

Before discussing the results of the ARDL model estimation, a cointegration test—the *Bound Test*— is first conducted to assess the long-term cointegration relationship between the variables. The results of the boundary test (*Bound Test*) produce an F statistic value of 7.129 and a t statistic value of -6.206, both of which are above the critical limit value of I(1) at the 5% significance level. This indicates that the null hypothesis (H0), which states that there is no cointegration between the variables under test, must be rejected. This condition provides strong evidence of long-term cointegration in the model.

In other words, the results of this test clearly indicate a stable, long-term equilibrium relationship between inflation and food commodity prices in East Java Province during the study period. This means that even though short-term price fluctuations occur, these variables will tend to move together and will return to a common long-term equilibrium path. Thus, the movement of inflation and food commodity prices is closely related in shaping the economic dynamics in East Java Province. The finding of a long-term relationship was also found in research conducted by Kusmutiarani (2018) in Pangkalpinang, although using a different

approach, namely VECM, which confirms the long-term relationship between commodity prices. *Volatile food* and inflation can indeed occur in a regional economic system.

After the long-term cointegration relationship is confirmed, the next step is to use the *Autoregressive Distributed Lag* (ARDL) approach to estimate the long- and short-term relationship coefficients between the variables.

Table 5. ARDL Model Estimation Results

Variables	Coefficient	Std. Error	t-Statistic	Prob.
SHORT-TERM				
dln_hb	0,394	0,164	2,40	0,020**
dln_ht	0,027	0,016	1,64	0,106
constant	0,427	0,496	0,86	0,393
ERROR CORRECTION TERM				
ECT(-1)	-0,893	0,144	-6,21	0,000*
LONG TERM				
ln_hb	-0,099	0,039	-2,51	0,015**
ln_hba	0,001	0,006	0,20	0,840
ln_hc	0,001	0,002	0,72	0,473
ln_ht	0,009	0,020	0,48	0,631
ln_hm	0,064	0,022	2,88	0,006*
ln_hd	-0,009	0,018	-0,52	0,606

Source: Data processed, 2026

* significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

4.3. Discussion of Estimation Results

4.3.1. Error Correction Term - ECT

The ECT coefficient of -0.893, with high statistical significance, indicates a very rapid adjustment speed in returning variables toward their long-term equilibrium after a disturbance or deviation. In other words, any deviation from the long-term equilibrium is corrected by 89.3% within one month. This finding indicates that inflation in East Java Province has a strong internal mechanism to return to its long-term trend following external disturbances. From a policymaker's viewpoint, the outcome is quite favourable, as the policy measures aimed at managing inflation are perceived as both timely and effective (Baharumshah et al., 2009). This also confirms that inflation in East Java is largely transitory and that no inflationary shocks are permanent, as the market's adjustment mechanisms can readily absorb them.

4.3.2. Long-Term Relationship

Of the various relationships we investigate, only two appear to influence inflation to the same extent in the long run. One of them is the price of cooking oil (hm), which has a positive effect on inflation at the 99% confidence level. A long-run inflation growth prediction of 6.4% is to be expected for every unit rise in the price of oil. Cooking oil is a basic ingredient in many household meals and in catering. This means every increase in oil prices will adversely affect living standards and production costs, thereby fuelling inflation. The price of rice (hb) is the second variable, showing a negative effect at an elasticity of -0.099, which holds at the 95% confidence level. This unusual negative correlation must be properly addressed, as it runs counter to the common assumption that inflation worsens when rice prices rise. However, it seems that some control exerted by the East Java Province Government, such as stabilising supplies and conducting market operations, has effectively contained inflation that would have resulted from higher rice prices. Therefore, this rise in rice prices is a response aimed at controlling inflation and, as such, must be seen as an effect.

This effect is also more evident regarding the prices of shallots, chillies, eggs, and chicken, as they do not appear to have a marked effect on inflation in the long run. This is probably due to their prices being more erratic in the short run, but it does not heighten inflation, or to the smaller share of household income spent on these commodities compared to rice and cooking oil. (Kusmutiarani, 2018) found that these commodities had a relatively small contribution to volatile food inflation. The variation in responsiveness to inflation triggered by changes in these commodities is largely shaped by the population's consumption patterns and the region's market structure.

4.3.3. Short-Term Relationship

For this temporary understanding, things also work differently. Changes in rice prices are relevant. As rice prices go up, so does inflation. For example, if these

prices go up by 1 rice unit, inflation will rise by 39.4%. This short-term coefficient is almost four times as large as the long-term coefficient. This indicates a rapid, direct impact of commodity price changes on inflation before policy responses and market mechanisms work to neutralise this effect in the long run. On the other hand, the prices of other commodities such as chillies, eggs, and meat also did not show a significant impact in the short or long term. This indicates that the volatility in the prices of these commodities is temporary and can be absorbed by market mechanisms without causing prolonged inflationary pressure.

4.4. Diagnostic Testing and Model Stability

To verify the model's validity, a series of diagnostic tests is required. Based on the results of the diagnostic tests, the estimated model has passed all diagnostic tests. First, the Breusch-Godfrey test shows no autocorrelation (Probability = 0.095). Second, the Breusch-Pagan test indicates the absence of heteroscedasticity in the model, with Probability = 0.370. Third, the Jarque-Bera test indicates that the model residuals are normally distributed (Probability = 0.633). Next, to test the stability of the overall model parameters, the CUSUM (Cumulative Sum) test needs to be conducted.

The results of the CUSUM test are presented in Figure 1 below. Figure 1 shows that the movement of the CUSUM line consistently remains within the area bounded by the two critical lines at the 5% significance level.

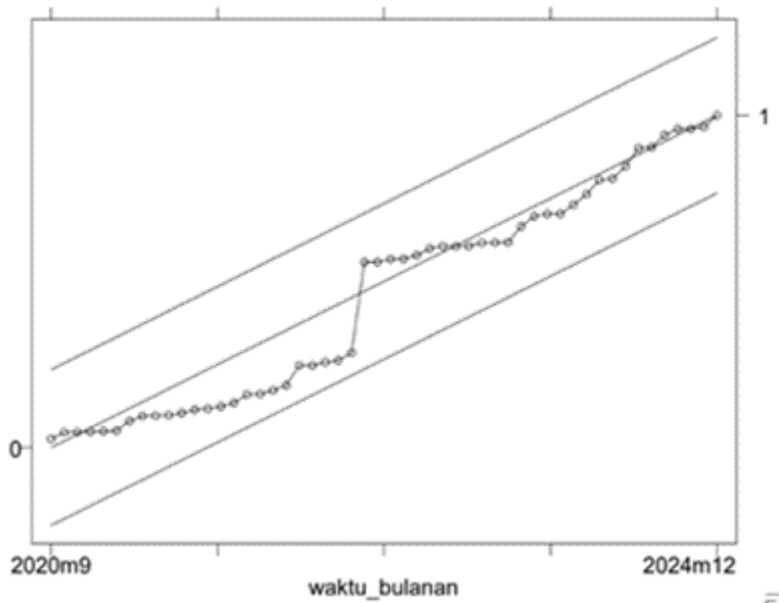


Figure 1. CUSUM Stability Test Results

Since the CUSUM line never crossed or exceeded this critical boundary throughout the observation period, it can be concluded that all parameters used in the ARDL model are stable. This stability provides strong empirical evidence that the structural relationship between inflation and food commodity prices in East Java did not change significantly during the study period (2020 to 2024), despite the impact of the COVID-19 pandemic and other global economic shocks. However, effective policy responses resulted in lower inflation, thereby pushing the CUSUM curve downward. In other words, the stability of this model also strengthens the validity of the estimation results and provides confidence that the model can be used for policy analysis, as well as being a positive indicator of the effectiveness of inflation policy in East Java.

V. CONCLUSION AND RECOMMENDATION

Based on the previously described analysis and discussion, a cointegration analysis using the Bound Test demonstrates a long-term equilibrium relationship between inflation and food commodity prices in East Java from 2020 to 2024. Cooking oil prices are a significant long-term driver of inflation. In contrast, rice prices exhibit a complex relationship with a positive long-term impact, which is also strongly suspected to reflect the effectiveness of the government's policy response. The high monthly figure reflects the short and volatile 2020-2024 study period, during which pandemic-related and post-pandemic price shocks were often sharp but short-lived rather than persistent, as well as the sensitivity of ECT estimates to sample size and lag specification in a relatively short time series. Even allowing for this caveat, the significant and negative ECT coefficient confirms that deviations of staple food prices from their long-term equilibrium with regional inflation are indeed corrected over time, indicating a functioning, if rapid, equilibrium-restoring mechanism in East Java. The ARDL model was used and proved to be both robust and stable. All classical assumptions were met, and the model passed the required diagnostic tests. Hence, a strong empirical basis was established for the formulation of inflation governance in East Java, the stabilisation of cooking oil prices, the efficient utilisation of rice, and coordination across sectors.

The empirical results on the stabilisation of cooking oil prices indicate that cooking oil is a commodity with a significant impact on inflation. For this reason, a primary policy initiative must centre on strengthening supply, an efficient distribution chain, and price stock control. Because rice has a considerable short-term impact, optimising rice policy can enhance early warning and speed up policy response. Strengthened collaboration between sectoral ministries and monetary authorities is required to support pricing policies and enhance food security.

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