Dynamics of Rice Prices in Modern and Traditional Markets in East Java

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Abstract. This study looks on the volatility of rice prices in East Javan traditional and contemporary marketplaces and how it affects inflation. The study uses time-series data from 2018 to 2025, measuring price volatility using the ARCH/GARCH model and addressing non-stationarity and spurious regression using the Error Correction Model (ECM). The findings show that changes in rice prices have a substantial impact on inflation, especially for households with low incomes. Global market movements, weather patterns, governmental regulations, and domestic production are important variables that affect volatility. To reduce inflation and guarantee food security in East Java, the report suggests strengthening supply chains, boosting market transparency, and improving price stability programs.

1 Introduction

In East Java, rice price variations are frequently affected by factors including crop yields, governmental distribution policies, demand fluctuations, and the economic ramifications of both domestic and global policies. The disparate availability of infrastructure between traditional and modern markets significantly influences rice pricing in these market[1]. Traditional markets rely more on local dynamics, but modern markets are influenced by global market trends and macroeconomic policies[2]. This study seeks to examine the dynamics of rice price volatility in traditional and modern marketplaces in East Java, as well as to compare the factors influencing price swings in each market. This research aims to analyze rice price data from various market types to elucidate the factors contributing to rice price volatility and its implications for food security, particularly for low-income households. This study's conclusions are anticipated to provide policy recommendations that will more effectively mitigate rice price volatility, hence enhancing food security and general welfare.

1.1 Literature Review

The volatility of rice prices and its impact on food security has garnered considerable focus in economic research, especially in developing nations such as Indonesia. The price volatility of rice, a fundamental food for millions, can significantly impact the economy, particularly

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affecting low-income households that rely on it as their main source of sustenance. This section examines the current literature on rice price volatility, its determinants, and effects on food security, emphasizing the distinctions between traditional and modern markets.

The rice market in Indonesia is acutely responsive to both internal and international influences, resulting in considerable price volatility. Numerous research indicate that rice price volatility in Indonesia is primarily affected by production conditions, policy actions, and global market patterns. As per BPS[3], the primary determinants of rice price volatility in Indonesia encompass natural phenomena including floods and droughts, governmental policies on rice distribution, and variations in global commodity prices. Emphasized that fluctuations in global rice supply and demand, influenced by climatic conditions and trade regulations, significantly affect domestic rice prices in Indonesia[4].

In Indonesia, rice is marketed through two main categories: traditional and modern markets. Conventional markets are generally more susceptible to price fluctuations owing to their dependence on local supply chains and opaque pricing structures. Traditional marketplaces in East Java are especially vulnerable to supply disruptions and price volatility, as they rely on numerous small-scale distributors and sellers who have difficulties with pricing determination and logistics[5]. These markets frequently exhibit increased price volatility due to inefficient distribution mechanisms and restricted access to information. Conversely, contemporary marketplaces, encompassing supermarkets and larger retail chains, possess a more coordinated and structured supply chain.

Research conducted by BPS [6]indicates that modern markets in East Java exhibit more pricing stability than traditional markets, attributable to enhanced logistical management, purchasing power, and access to global rice suppliers. These markets also leverage economies of scale, enabling them to mitigate some shocks that would otherwise result in price surges in conventional markets. Multiple factors influence the fluctuations of rice prices in both market types. Factors associated to production, including rice crop output and harvest seasonality, are essential in ascertaining the available supply of rice. BPS [7] observes that unfavorable meteorological circumstances, including extended droughts or floods, adversely impact rice production, resulting in diminished supply and an ensuing increase in pricing. Government measures, especially concerning rice imports, subsidies, and price controls, significantly influence price volatility, either intensifying or alleviating it[8]. The behavior of consumers and dealers is another crucial factor influencing rice price fluctuation. During uncertain times, traders in conventional markets may stockpile rice in expectation of elevated future prices, so exacerbating current price increases. This hoarding behavior is rarer in contemporary marketplaces, which advantage from more dependable supply sources and pricing data [2]. Consumer demand, subject to variations in income levels, population expansion, and consumption habits, significantly impacts rice prices. BPS Jatim[9] indicates that as income levels increase in metropolitan regions, the demand for rice escalates, resulting in elevated prices during peak consumption periods.

Price fluctuations, particularly in essential commodities such as rice, directly impact food security. Variations in rice prices can intensify poverty, especially among low-income households who allocate a significant amount of their income to food expenditures. The increase in rice prices may diminish the purchasing power of these households, hindering their ability to obtain enough nutrition. food price volatility as a significant factor contributing to food insecurity, particularly impacting impoverished households that are less equipped to cope with abrupt price increases. Furthermore, the stability of rice prices is essential for ensuring a continuous and dependable food supply. Volatile price swings may result in disruptions to food accessibility, prompting households to reduce their rice consumption or replace rice with less nutritious substitutes. This is especially apparent in rural regions where reliance on rice is significant, and access to alternative food sources may be restricted [6]

In reaction to the issues presented by rice price fluctuations, the Indonesian government has enacted several policy initiatives. These encompass price regulations, rice subsidies, and the creation of food stockpiles to alleviate the effects of price volatility on consumers. BPS Jatim[6] asserts that the government's involvement in regulating rice prices via the National Food Logistics Agency (Bulog) and implementing strategies to stabilize rice supplies during crises is essential for sustaining price stability. Efficacy of these strategies is frequently hindered by logistical limitations, market manipulation, and fluctuations in global rice prices[4].

2 Research method

2.1 Method of Collecting Data

This study employs secondary data sourced from multiple pertinent government organizations and institutions. The research concentrates on East Java because it is the foremost rice producer in Indonesia. The utilized data is time-series, spanning from January 2018 to July 2025. The initial purpose is to assess price volatility, utilizing data from rice commodity prices in both modern and traditional marketplaces. The data source for this information is Bank Indonesia then to fulfill the second research aim, which examines the influence of volatility on inflation in East Java, the dataset include inflation rates, rice price volatility in both contemporary and traditional markets, interest rates, exchange rates, and monthly data.

2.2 Data Analysis Method

ARCH-GARCH model is employed to evaluate the volatility of basic food prices, specifically rice. These two commodities have seen significant price volatility, marked by abrupt jumps and reductions, requiring assessment of their swings. Volatility occurs due to the non-constant residual variance of the model, which contravenes the assumption of homoscedasticity. The ARCH model is utilized to examine data characterized by significant volatility, indicating that a phase of low residuals leads to a dependence of residual variance on the residual variance of the preceding period. This model was initially proposed by Engle in 1982 to resolve residual variance concerns in time series data. The formula for the ARCH model is articulated as:

$$\sigma^2 t = \alpha_0 + \alpha_1 e_{t-1}^2 \text{........(1)}$$

The GARCH model, introduced by Bollerslev in 1986, is an advancement of the ARCH model. This model posits that the current period's residuals are influenced by both the preceding period's residuals and the variance of those prior residuals. The GARCH model, introduced by Bollerslev[10] can be articulated in the subsequent manner:

$$ht = K + \delta 1 h_{t-1} + \ldots + \delta 1 h_{t-p} + \alpha 1 \varepsilon_{t-1}^2 + \ldots + \alpha q \varepsilon^{2t-q} \text{......(2)}$$

2.3 Error Correction Model

Time series data denotes information gathered at designated time intervals, whether daily, weekly, monthly, quarterly, or annually. A major difficulty with time series data is that numerous datasets exhibit non-stationarity. Non-stationary data may result in issues such as heteroscedasticity and autocorrelation. Stationary time series data can occasionally result in spurious regression, characterized by a deceptive regression relationship between dependent and independent variables that lacks theoretical justification, hence creating a misleading perception of a robust association. Wu and Xu (2021) assert that non-stationary data in time series analysis may result in inaccurate regression outcomes.

Error Correction Model (ECM) can be employed to tackle the challenges of pseudo-regression and non-stationarity in time series data. The ECM rectifies short-term imbalances to synchronize them with long-term equilibrium, mitigating discrepancies that may arise when a model attains long-term equilibrium [11] A time series model is said to be in long-term equilibrium if the variables are cointegrated, indicating they exhibit concurrent movement in the same direction. This research emphasizes the need of comprehending non-stationarity, pseudo-regression, and the application of the Error Correction Model (ECM) in the analysis of time series data, particularly for economic, financial, or temporally dependent variables. A primary problem in time series analysis is the non-stationary characteristic of numerous datasets, indicating that the data exhibits patterns or changes across time. This may result in problems such as heteroscedasticity or autocorrelation. Even with stationary time series data, a seemingly correct regression relationship may be a false regression, wherein two variables appear to be strongly correlated despite lacking any theoretical association.

This research use ECM to tackle non-stationarity and pseudo-regression challenges. ECM rectifies short-term discrepancies among the studied variables, guiding them towards long-term equilibrium. For instance, if variables such as inflation and interest rates exhibit analogous trends in the short term yet lack a definitive theoretical correlation, the Error Correction Model (ECM) can rectify this short-term divergence and yield a more precise depiction of the long-term link between these variables.

3 Result and Discussion

Following the evaluation to identify the optimal model utilizing the ARIMA methodology. The acquired model will undergo testing for the ARCH Effect. This examination is conducted on every model. The subsequent results pertain to the evaluation of the ARCH Effect on price data for strategic food commodities.

Table 1. Result the best model with the ARIMA method tradiosional market

Variable	Model	Chi- Square	Conclusion
DKB1_TRD	**ARIMA (2,1,1)**	0,0012	Not ARCH *Effect*
DKB2_TRD	**ARIMA (2,1,2)**	0,3150	Not ARCH *Effect*
DKM1_TRD	**ARIMA(3,7,6)**	0,7780	Not ARCH *Effect*
DKM2_TRD	**ARIMA(11,7,10)**	0,5890	Not ARCH *Effect*
DKS1_TRD	**ARIMA(5,9,11)**	0,1245	Not ARCH *Effect*
DKS2_TRD	**ARIMA(8,9,10)**	0,9900	Not ARCH *Effect*
DAVE_TRD	**ARIMA(1,1,1)**	0,0609	Not ARCH *Effect*

Table 2. Result the best model with the ARIMA method modern market

Variable	Model	Chi- Square	Conclusion
DKB1_MDR	**ARIMA (12,1,9)**	0,1897	Not ARCH *Effect*
DKB2_MDR	**ARIMA (2,6,2)**	0,7849	Not ARCH *Effect*
DKM1_MDR	**ARIMA(9,7,6)**	0,7900	Not ARCH *Effect*
DKM2_MDR	**ARIMA(1,9,18)**	0,9730	Not ARCH *Effect*
DKS1_MDR	**ARIMA(4,2,7)**	0,2846	Not ARCH *Effect*
DKS2_MDR	**ARIMA(5,3,10)**	0,3097	Not ARCH *Effect*
DAVE_MDR	**ARIMA(2,5,8)**	0,0000	There areARCH *Effect*

The table above indicates that two of the models developed, namely the price model AVE_MDR and AVE_TRD, display an ARCH effect, as evidenced by a Chi-Square Prob value (1) less than the 0.05 alpha level. This indicates that at least one squared residual coefficient is statistically significant and not equal to zero. Conversely, all other variables do not exhibit an ARCH effect, as indicated by the Chi-Square Prob (1) value exceeding the 0.05 alpha threshold.

This study determined the optimal ARIMA approach by iterative adjustments until the most effective model was selected. The selection of the optimal model considered the goodness of fit test, encompassing the significance of the Autoregressive (AR) and Moving Average (MA) coefficients, the Coefficient of Determination (R^2), and the significance of the established ARIMA model (F Probability Value Test).

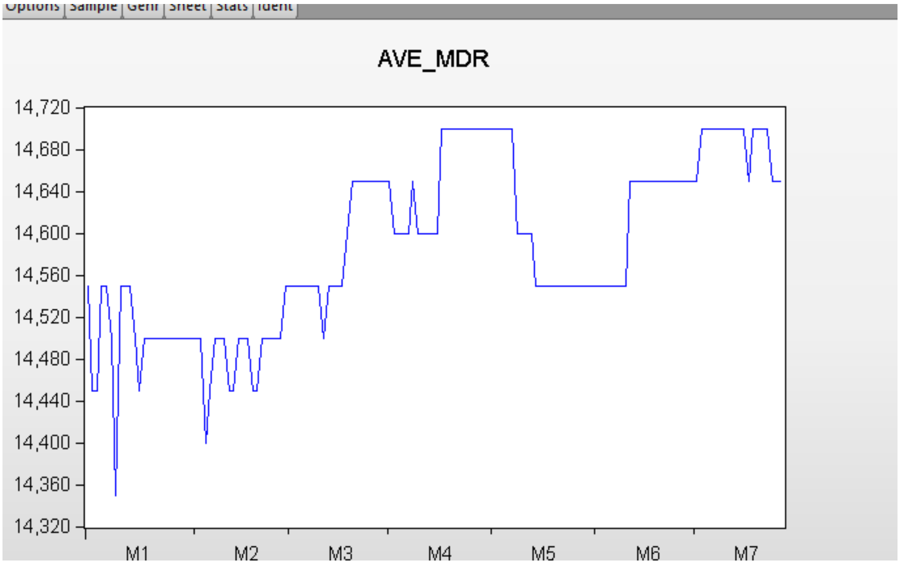
Following multiple modeling experiments with the Eviews 11 software, the optimal ARIMA model for each variable in this research was identified.

The R^2 values for each model constructed are quite low. The ARIMA model is exclusively concerned with a single variable, the dependent variable. Furthermore, the estimation of the ARIMA model employs the Maximum Likelihood technique, in contrast to the OLS method, which seeks to maximize R^2. Nonetheless, the fluctuations noted in the dependent variables can still be elucidated by the independent factors incorporated in the model. The autoregressive coefficient (AR) and moving average (MA) coefficients in each model strongly affect all dependent variables, both individually and collectively. The Prob (tstat) value for each AR and MA coefficient, along with the Prob (F-stat) value, is less than the alpha threshold of 0.05.

3.1 ARCH/GARCH Model models

ARCH Effect research has demonstrated that fluctuations in rice prices exhibit a degree of volatility. The ARCH/GARCH model is employed for estimation because to its incorporation of volatility. All independent variables in both the model (AR and MA coefficients) and the variance model (Square Residual Coefficient) significantly influence the dependent variable in each constructed model. This is signified by a Prob (F-stat) value below 0.05. In the DAVE_MDR model mean (ARIMA (2,5,8)), one of the autoregressive variables (-2) does not significantly influence the rice price in the contemporary market change variable DAVE_MDRt-2, as evidenced by a higher probability (t-statistic) value than the alpha level of 0.05. In comparison to the prior modeling utilizing GARCH (1,0), the autoregressive variable DAVE_MDRt-2) has a considerable impact on the variation of the rice price variable (DAVE_MDRTt). This insignificance has been incorporated into the ARCH element. In all variance models, the coefficient of squared residuals has a significantly positive effect on variance (Rice Price Volatility). This is demonstrated by the p-value (t-statistic) exceeding 0.05.

The GARCH model generated insights into the price changes or volatility of rice commodities. The price volatility data series is derived from the established conditional variance model. Contemporary markets exhibit a greater interconnectedness with the global market than conventional markets. International price fluctuations in rice, driven by worldwide weather variations, export-import regulations, and commodity price dynamics, can directly impact rice prices in contemporary markets. Conversely, traditional markets rely more on local manufacturing and are less affected by global price fluctuations. Overseas markets significantly influence domestic rice prices, particularly in contemporary marketplaces[12]. In traditional markets, prices are predominantly determined by direct discussions between traders and consumers, resulting in greater stability. Highlight that contemporary markets exhibit more responsiveness to price fluctuations due to their transparency and better organized market procedures[4]. Contemporary market prices are often modified in response to global market fluctuations and domestic policies, whereas older markets often exhibit more stable pricing due to dependence on local market mechanisms [9].



Graph 1. Rice Price Average in Modern Market

3.2 The Effect Rice Price Volatility on East Java Inflation

Changes and volatility of rice price known by the formation of multiple ECM models. Eviews 11 software as an analytical tool to get the best model.

Table 3. Result Volality Comodites

Variable	Coefficient	Probability
C	-0.066052	0.9479
D(AVE_MDR)	0.603552	**0.0000**
D(AVE_TRD)	0,315067	0.7699
D(EXT)	4.887230	**0.0015**
D(INT)	-0.180305	**0.0026**
(AVE_MDR-1)	0.382587	**0.0003**
(AVE_TRD)-1	-0.187908	0.7867
(EXT)-1	0.508051	0.0367
(INT)-1	-0.049144	0.0007
R- Squared= 0.342959		

The volatility of rice prices significantly impacts the 5 percent level of significance and exhibits a positive correlation. The coefficient of rice price volatility is 0.6, indicating that a 1 percent increase in rice price volatility will result in a 0.6 percent increase in inflation, ceteris paribus. The elevated demand for rice arises from its status as a crucial food staple essential in every household. The domestic market's rice availability remains constrained, with the reduction in national production attributed to a dip in farmers' willingness to cultivate rice. Fluctuations in food prices, especially rice, are frequently the principal catalysts of inflation in Indonesia. An increase in rice prices may also precipitate a rise in the pricing of other food commodities, including corn, cooking oil, and processed food items, as rice frequently serves as a fundamental ingredient in other food products. This phenomenon is referred to as secondary inflation. Higher rice prices frequently result in escalations of other food prices due to the interdependence of food commodities. Government policies, including food subsidies, price controls, and rice import laws, can influence market rice prices. If policies are ineffectual or rice import limits are stringent, rice prices may rise, intensifying inflation in areas such as East Java, which strongly depends on local rice supplies. BPS[13] indicates that governmental measures frequently affect rice price volatility and, consequently, inflation.

The real exchange rate variable exhibits a positive and statistically significant coefficient of 4.88 at the 5 percent significance level. A positive coefficient indicates a unidirectional relationship between the dependent and independent variables. When associated with the real exchange rate, it may be understood that a 1 percent increase in the real exchange rate will result in a 4.88 percent increase in inflation, ceteris paribus. The elevated exchange rate of the rupiah relative to the dollar led to a rise in commodity prices, particularly for imported goods, culminating in significant inflation. Rice is subject to imports; hence, the exchange rate will influence inflation via the commodity price mechanism. The real exchange rate variable for the preceding year was significant at a real level of 10 percent, with a coefficient of 0.5 and a positive sign, indicating that 1 percent increase in the real exchange rate would result in a 0.5 percent increase in inflation. The exchange rate is a significant variable due to its substantial impact on the current account balance and other macroeconomic factors[14]. This exchange rate enables countries to engage in transactions with one another. An exchange rate crisis, if it develops in a country, will have detrimental effects. Exchange rate fluctuations result in escalating prices and a significant economic contraction [15].

Real interest rates significantly influence inflation, exhibiting a contrasting relationship with rice price volatility and the real exchange rate, which is negative. The coefficient of real interest rates is 0.18, indicating that a 1 percent increase in real interest rates will result in a 0.06 percent decrease in inflation, ceteris paribus. The interest rate for the preceding year was statistically significant at the five percent level, with a coefficient of 0.18 and a negative correlation with real interest rates. An increase of 1 percent in the real interest rate over the preceding year will result in a 0.18 percent decrease in inflation, ceteris paribus. Interest rates, inflation, and currency rates are intricately interconnected. Fluctuations in interest rates, influenced by a nation's central bank, can impact inflation and currency exchange rates [16]. Elevated interest rates dissuade investors from committing capital[17], resulting in a static aggregate supply despite a rising aggregate demand driven by population growth, thereby inducing demand-side inflation. Inflation can be analyzed from both the supply and demand perspectives. Demand-pull inflation is a form of inflation originating from the demand side. Cost-push inflation arises from the supply side, triggered by escalating manufacturing costs that restrict supply, hence resulting in inflation.

4 Conclusion and Policy Implication

The findings demonstrate a significant link between rice prices and inflation in East Java. Being a fundamental food source in the region, any fluctuation in price immediately influences the Consumer Price Index (CPI), therefore affecting inflation. This study emphasizes that inflation in rice prices, especially within the food sector, is influenced by factors including climatic circumstances, governmental policies, and global trade dynamics. Moreover, rice price inflation disproportionately impacts low-income households that depend significantly on rice as their main dietary staple.

Moreover, escalations in rice prices have extensive economic ramifications, frequently resulting in inflation of non-food commodities, so generating a ripple effect across the economy. East Java's economic significance as a prominent rice-producing region means that variations in rice prices can profoundly affect the social and economic welfare of the area, thereby exacerbating poverty and hindering economic growth. These findings indicate the necessity for efficient price regulation and market stabilization strategies to avert inflationary consequences and their adverse effects on households. The government can enhance current rice price stabilization efforts to mitigate the effects of price variations. This entails improving subsidy programs, implementing efficient price control mechanisms, and refining rice reserve management. By sustaining optimal inventory levels and guaranteeing a consistent supply rhythm, the government can alleviate the danger of acute price inflation resulting from supply delays. Furthermore, efficient price stabilization would mitigate food price inflation, thereby aiding low-income households most impacted by these escalations.

The variability in domestic rice supply, resulting from local production fluctuations, is a significant factor contributing to rice price volatility. The government can give resources to agricultural research and development, infrastructure, and support for rice farming to stabilize supply. Moreover, enhancing the distribution system and mitigating post-harvest losses will contribute to price stabilization, hence diminishing inflation and averting price surges.

Augmented pricing transparency and refined information systems can mitigate speculation and diminish the likelihood of abrupt price volatility. Consistently disseminating data on rice prices would facilitate more informed decision-making for growers and consumers. Moreover, enhancing regulation of rice merchants and augmenting market oversight might mitigate manipulative tactics that contribute to price volatility.

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