Journal of International Conference Proceedings (JICP) Vol. 6 No. 6, pp. 460-469, December, 2023
P-ISSN: 2622-0989/E-ISSN: 2621-993X
https://www.ejournal.aibpmjournals.com/index.php/JICP

Strategic Commodity Food Price Volatility of Central Java in 2020-2023

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ARTICLE INFORMATION

Publication information

Research article

HOW TO CITE

Safitri, M. (2023). Strategic Commodity Food Price Volatility of Central Java in 2020-2023. *Journal of International Conference Proceedings*, *6*(6), 460-469.

DOI:
https://doi.org/10.32535/jicp.v6i6.2830

Received: 07 October 2023
Accepted: 06 November 2023
Published: 04 December 2023

ABSTRACT

This study aims to analyze the volatility of food prices, especially rice, in Central Java from 2020 to 2023. Food price volatility can have a negative impact on consumer welfare and costs. Indonesia, as a country that still imports basic food needs, is vulnerable to food price volatility. Spikes in food prices can cause inflation to rise and economic growth to decline, which impacts the condition of people's households, especially the poor. This research uses a quantitative method using ARCH GARCH time series data. The results of this study are expected to identify and analyze the volatility of rice food prices, predict rice food prices at the end of 2023, and determined Bank Indonesia's policies related to rice food price volatility. This research is based on the concepts of volatility, food prices, and inflation. Quantitative methods such as ARCH and GARCH models are used to analyze the volatility of rice food prices. Secondary data is used in this study, and the research steps include data collection, data analysis and interpretation, and presentation of results to provide recommendations.

Keywords: ARCH GARCH, Food Price, Red Chili, Rice Price, Shallot, Volatility

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INTRODUCTION

Volatility is basically a natural phenomenon. Indonesia as one of the developing countries is vulnerable to food price volatility. This is because basic food needs are still imported, so if world food prices are unstable, it will affect the condition of domestic food prices. As stated by Huchet-Bourdon (2011), unstable food prices are a risk for developing countries. If food prices increase, inflation will rise and economic growth will fall, which will then have an impact on the condition of community households, especially the poor.

Research by Von Braun and Tadesse (2012) explains that price volatility of food commodities is one of the biggest contributing factors in the development of food security. Price volatility of food commodities is one of the biggest contributing factors in the determination of inflation, especially in developing countries where the majority of determination of inflation, especially in developing countries where the majority of low-income population.

According to the Directorate General of Food Crops (Indonesia. Direktorat Jenderal Tanaman Pangan, 2011), the strategic issues are global climate change, food, and energy crises, which have an impact on food price increases so that food exporting countries tend to hold their products to be used as food stocks. Indonesia's positive growth, if not accompanied by an increase in food production, is likely to face difficulties in meeting the food needs for the consumption of its population in the future. Food demand is always increasing along with the increase in population. In its fulfillment, not all food needs can be met, because the power of food production and distribution is increasingly limited. This causes food instability between food demand and its fulfillment nationally. Economic activity is basically the process of producing a product using the factors of production (Wijaya, Ismail, & Santosa, 2023).

Given the important role of food, it requires a resilient local production base. Changes in food supply with inelastic elasticity of supply and demand will lead to large price fluctuations (Nicholson, 2000). The above phenomena of food production, trade and consumption demand a role for the government to protect domestic producers and consumers. This role is expected to stabilize food prices, which can be done through food price policies to reduce farmers' uncertainty and ensure more stable food prices for consumers (Ellis, 1992). However, the implementation of food price policy faces two main problems. The external problem is that the strategic environment of international trade tends to increase the degree of liberalization. The internal problem is the increasingly limited government budget to support development. These two problems have led to policy inconsistencies. There are groups that want the government to continue supporting domestic food production, but there are also those who want to leave food issues to market mechanisms.

Changes in food prices have had an impact on Indonesia's macro economy which can be seen from its contribution to inflation. The percentage change in food prices makes a significant contribution to general inflation in Indonesia. The large contribution of changes in food prices to inflation makes food prices an important issue. This is because food commodities are the largest contributor consumption of the poor and also on the commodity bundle that forms the poverty line. An increase in food prices will increase the poverty line which is relatively high, which then has an impact on increasing the poverty rate.

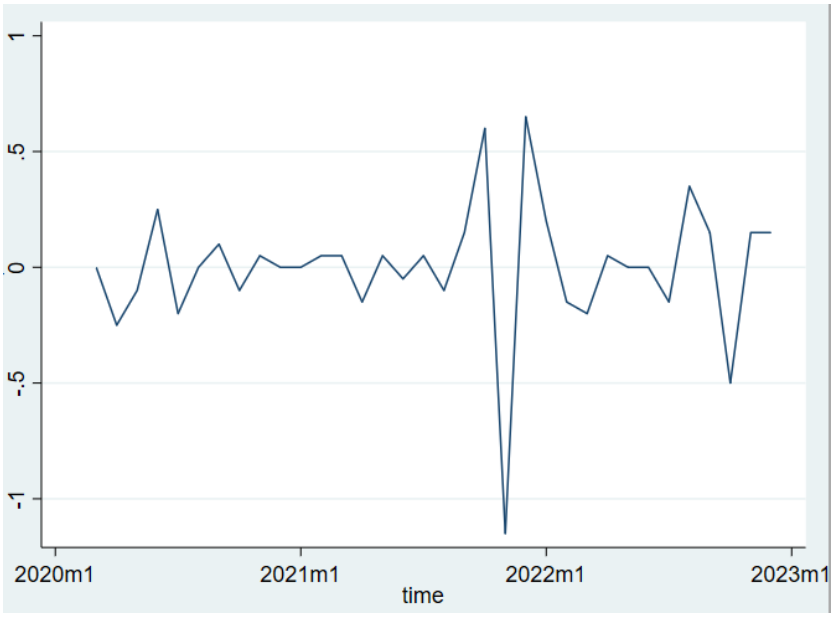
The uncertain development of the global economy makes the volatility of commodity prices contribute to the creation of economic risks that can hamper the economy. Commodity price volatility contributes to the creation of economic risks that may hamper the global recovery efforts. This was reinforced by the World Bank's prediction in early 2011 in its Global Commodity Market Outlook that commodity prices, especially basic commodities such as food, metals, minerals, and basic commodities such as food, metals, minerals, and energy, in general, tend to experience price since reaching peak prices in early 2011. This is caused by the decline in global economic conditions, which is characterized by a decrease in commodity demand and an increase in the supply side. Demand for commodities and an increase in the supply side, one of which is supported by an increase in investment due to rising prices. Increase in the investment side due to rising prices.

Food group prices, which are included in the price of the volatile goods group (volatile foods) make a sizable contribution to the inflation rate. Inflation rate. In 2015-2022, food price fluctuations have influenced Indonesia's macroeconomy, namely inflation, which can be seen from the following figures to Indonesia's macro-economy, namely inflation, which can be seen from its contribution to inflation by expenditure group. From the available data, the percentage change in food prices makes a considerable contribution to general inflation in Indonesia. The occurrence of excessive food price volatility in many countries leads to higher uncertainty for economic actors and undermines financial stability. Financial stability. Indonesia's growing population when food price fluctuations tend to increase will reduce welfare and increase poverty. This is because most of the income earned by obtained by the population is used to fulfill basic food needs. If food prices rise, the expenditure on basic food will be greater and make real income fall.

Food is one of the primary needs that must be met for domestic consumption. One of the primary needs is in the agricultural sector as the largest contributor to import figures in Indonesia, especially food commodities.

For Indonesia, food is identified with rice as it is the main staple food. Demand for food (rice) is in-elastic, which implies that price fluctuations will not result in large changes in demand. Demand tends to be constant over time. In the long run, demand increases, mainly due to population growth. Meanwhile, food availability is fraught with uncertainty.

Figure 1. Food Price Volatility



The graph above shows the volatility of rice food prices. Food commodity prices that need to be considered are the prices of strategic food commodities. Some of them are rice, shallots, cayenne pepper, red chili.

In addition, these commodities are contained in the regulation of the minister of trade No. 63/M-DAG/PER/9/2016 (Indonesia. Audit Board [BPK RI], 2016). The regulation is a follow-up to presidential regulation No.71/2015 on the determination and storage of essential goods. Large or small price volatility illustrates how much price risk will be faced in the future. Information about volatility is important for market participants, namely traders. The higher the volatility value, the higher the risk that will be faced (Rosyida, Firmansyah, & Wicaksono, 2020). Related to the risks that will be faced due to the volatility of rice, shallot and red chili prices, alternative strategies are needed. Directorate General of Food Crops (2011) states that the activities of regulating the distribution and marketing of price food aim to ensure food availability in the territory of Indonesia.

In 1970, world food prices experienced a high increase and caused a world food crisis, and caused the world food crisis, and then the incident was repeated in 2007 after the last thirty years of high world food prices. In 2007 after thirty years of relatively stable world food prices. At a relatively stable price level. The world food crisis that occurred from 2007 to 2010 caused the world food prices to fluctuate. Food prices continued to experience increased in 2007 and then fell again in 2009 and then increased again in 2010. Again experienced an increase in 2010. The impact that occurred due to food price fluctuations in 2007 and 2010 resulted in high food price volatility. Food price volatility was quite high.

Food price changes are one of the main drivers of the inflation rate in Indonesia, because of the high population in Indonesia, the demand for food commodities is also high. The high demand is sometimes not matched by supply so that in this condition producers are unable to meet the demand for foodstuffs.

The volatility analysis measures the standard deviation or variation in price food that fluctuate over a certain period of time. Because data is constantly moving and one of the goals of this study is to predict future volatility, a time series model is needed so that the calculation of price volatility can be used as a basis for choosing a policy strategy. On the other hand, developed countries that are members of the OECD still provide considerable support to their agricultural industries. This is despite the fact that the contents of the WTO agricultural agreement are intended for all members to increase market access, reduce domestic support, and reduce export subsidies.

Under such conditions, the food price policy implemented so far can be used as an excuse to anticipate the inconsistency of developed countries in implementing agricultural agreements. Food security and the stability of national development are also reasons why the policy can still be implemented. For this reason, it is necessary to study whether food price policies to improve food security are necessary and effective. This study aims to analyze the volatility of food prices by the government towards national food security. Food price policies can be in the form of input price policies, output price policies and input and output price policies. The results of this study are useful for evaluating the effectiveness of food price policies that have been carried out so far and used as a basis for consideration to continue to be implemented in agricultural revitalization efforts to improve national food security.

Effectiveness can be interpreted as an effort to achieve maximum results by utilizing existing resources. In relation to policy, the measures of policy effectiveness are (1) Efficiency, a policy must be able to increase the efficiency of optimal resource use; (2) Fair, the weight of the policy must be placed fairly, that is, the public interest is not neglected; (3) Lead to incentives, a policy must lead to or stimulate action in improving and increasing the set goals; (4) Accepted by the public, because it is intended for the public interest, a good policy must be accepted by the public; and (5) Moral, a policy must be based on good morals.

LITERATURE REVIEW

There have been many studies related to price changes and volatility of food commodity prices. The results of research conducted by Christanty and Wahyudi (2012) show that there is an element of volatility in the behavior of food commodity price data. Then, the results of research conducted by Darma, Pusriadi, and Hakim (2018); Rizaldy (2017); Isnaini (2018); and Setiawan & Hadianto (2014) show that changes and volatility in food commodity prices affect inflation.

Based on the above thoughts, there are two hypotheses used in this study. First, it is suspected that there is an element of volatility in the behavior of strategic food commodity price data (rice, shallots, red chili, and cayenne pepper) in Banda Aceh city. Second, changes and volatility of strategic food commodity prices affect inflation in Banda Aceh city. To identify how the volatility reacts to positive or negative news shocks, we rely on two measures. Based on the results of research conducted by Rahmah & Hadianto (2013), it shows that food commodity prices have positive developments accompanied by trends that tend to increase and price changes in the three food commodities tested, namely rice, sugar and soybeans have a real influence on changes in inflation in West Java province. This is in line with research conducted by Apriyadi and Hutajulu (2020) in Yogyakarta province which shows that the surge in the price of beef, chicken, and chicken eggs has no major effect on food prices.

Research by Von Braun and Tadesse (2012) explains that volatility in food commodity prices is one of the biggest contributing factors in determining inflation, especially in developing countries where majority of the population has low income. Research conducted by several institutions, namely: FAO, IFAD, IMF, OECD, UNCTAD, WFP, the World Bank, the WTO, IFPRI, and the UN HLTF confirms that concerns about volatility are concerns about price levels, especially the impact from there is an increase in prices for food commodities. Food commodities are agricultural commodities, where the level of volatility that will occur in food commodities is relatively high.

The importance of food makes food a necessity in a country that absolutely must be met. Apart from that, food also plays an important and strategic role in Indonesia based on the influence it has socially, economically, and politically. Arifin (2005) states that price stability is an important dimension of food security. This is because prices can have economic, political, and social consequences society.

Food price instability occurs because of an imbalance between demand and supply of food. The heightened volatility in food prices also contributes to the unpredictability of commodity prices within the agricultural industry (Bhinardi, 2023). The development of demand which is quite high and continues to increase without being accompanied by a balanced development of supply will result in an increase in prices to reach a new balance.

According to Soekartawi (2002), the demand for a food commodity influenced by the price of the product, the price of substitute products or the price of complementary products, tastes and desires, the number of consumers and the income of the consumers concerned. Meanwhile, the supply of a food commodity is influenced by technology, input prices (for example fertilizers and medicines), prices of other products, number of producers, producers' expectations of future production prices, and production elasticity.

Some more in-depth research might consider the impact of climate change, currency exchange rate fluctuations and other factors that may affect the food market.

RESEARCH METHOD

The data used in this study are secondary data in the form of time series data on retail prices of several strategic food commodities including the prices of rice, shallots, red chili peppers, and cayenne pepper. Secondary data is obtained from various sources including www.bps.go.id and www.bi.go.id. This data is processed in daily time series from January 1, 2020 to January 1, 2023.

This research will calculate the value of food price volatility in Central Java province in the last three years, namely 2020 to 2023. The analysis used to calculate food price volatility is the ARCH (Autoregressive Conditional Heteroscedastic) and GARCH (Generalized Autoregressive Conditional Heteroscedasticity) model analysis. ARCH-GARCH model analysis is available.

Several stages that must be carried out are: (1) Data stationarity test; and (2) ARCH-LM test. This research will analyze the influence of the prices of rice, shallots, and red chilies on food price volatility in Central Java province. The analysis tool used is Eviews 11.0 with a Vector Autoregression (VAR) analysis model with several stages, namely: (1) Data stationarity test; and (2) Determination of optimal lag.

This study will calculate the value of food price volatility including rice, shallots, and red chili in Central Java province in the last three years, namely 2020 to 2023. The analysis used to calculate beef price volatility is ARCH (Autoregressive Conditional Heteroscedastic) and GARCH (Generalized Autoregressive Conditional Heteroscedasticity) model analysis. This study will analyze the effect of rice, onion, chili prices in Central Java province on food price volatility in Central Java province. The analysis tool used is Eviews 11.0.

Model ARCH

The ARCH model is done by considering the simple linear regression equation as follows (Wijoyo, 2016):

$$Yt \mid /t\_1 = \sigma' + \beta Xt + et$$

Description:
Y = Variables observed
/t-1 = On the information available to date (t-1)
X = Vector variable
Et = *Error*

To account for the ARCH effect, the equation becomes:

$$O'^{2}_{t} = Y_0 + Y^1 e^2 t\_1$$

Model ARCH (p):

$$O't^2 = Y^0 + Y_1e^2t_{\_1} + Y_2e^2t_{\_2} + .. + Y_pe^2t_{\_p}$$

If the ARCH effect is indicated, the F statistic can be tested, with the following hypothesis:

$$\text{Hypothesis 0: } H_0: Y_1 = Y_2 = ... = Y_P = 0$$

Model GARCH
For GARCH modeling in general, the initial equation follows the equation, but if variance modification is carried out, the equation becomes GARCH p,q (Wijoyo, 2016):

$$O't^2 = Y^0 + Y^{1u2}t_{-p} + Y^2o'^2t\_q$$

On volatility persistence, the asymmetric effects of positive and negative shocks. The models considered were carefully selected to reflect the literature on their ability to explain volatility dynamics (Baur & Dimpfl, 2018).

RESULTS

Best Model Selection Test
Stationarity Test
This test is carried out on each variable used in the analysis to obtain stationary data. In this study, the stationarity test used is the unit root test with the Augmented Dickey Fuller Test (ADF Test) method. Determine whether the data used is stationary or not. If the probability value is less than 0.05 then the data is stationary, otherwise if the probability value is more than 0.05 then the data is not stationary (Juanda & Junaidi, 2012).

Table 1. Stationarity Test Results

	Variable	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	Rice Variable	-3.055337	0.0395
	Shallot Variable	-5.708352	0.0000
	Red Chili Variable	-6.952156	0.0000

Based on the output above, it is known that rice, shallot, and red chili are stationary, because the probability value is less than 0.05, and the stationarity is at the first difference level because when the level test is done it turns out to be non-stationary. Then testing is done again at the first difference. After being tested using the first difference shows stationary in each variable, then the best model selection is using the first difference.

ARCH-GARCH Test
The ARCH test is conducted to see the effect of the presence of ARCH on the previously obtained model. Determination of the model detected heteroscedasticity or not can be determined by looking at the probability value of F and the Chi-square probability value that is significant with a real level of 5% (Juanda & Junaidi, 2012). The following are the results of ARCH testing.

If the resid value is less than 0.05 then it is significant to use ARCH, if the resid value is less than 0.05 then use GARCH. The table above shows that the resid value is 0.005, so it is significant and uses ARCH.

Table 2. ARCH-GARCH Test Results

Variable	Coefficient	Std. Error	z-Statistic	Prob.
D (BAWANGMERAH)	-0.003083	0.013461	-0.229045	0.8188
D (CABAIMERAHKRITING)	0.003702	0.010449	0.354309	0.7231
C	0.060200	0.108465	0.555017	0.5789
Variance Equation				
C	0.066558	0.080625	0.825523	0.4091
RESID (-1)^2	-0.283074	0.102859	-2.752054	0.0059
GARCH (-1)	0.588573	0.537189	1.095653	0.2732
R-squared	0.014932	Mean dependent var.		0.062500
Adjusted R-squared	-0.044769	S.D. dependent var.		0.358643
S.E. of regression	0.366583	Akaike info criterion		0.761665
Sum squared resid	4.434651	Schwarz criterion		1.025585
Log likelihood	-7.709975	Hannan-Quinn criterion		0.853780
Durbin-Watson stat	1.313206	Mean dependent var.		0.062500

Note:
Dependent Variable = D (BERAS)
Method = ML ARCH - Normal distribution (BFGS / Marquardt steps)
Date = 11/11/23
Time = 01:05
Sample (adjusted) = 2020M02 2023M01
Included observations = 36 after adjustments
Failure to improve likelihood (non-zero gradients) after 50 iterations
Coefficient covariance computed using outer product of gradients
Pre-sample variance = Back-cast (parameter = 0.7)
*GARCH = C(4) + C(5) * RESID(-1)^2 + C(6) * GARCH(-1)*

Heteroscedasticity or the presence of ARCH effect is detected. If the F probability value and the Chi-square probability value are smaller than the real level of 5% or 0.05 then the model has an ARCH effect. If the model does not have an ARCH-effect then the analysis is only done until the analysis of the ARIMA model, otherwise if there is an ARCH effect then the analysis will continue using ARCH-GARCH analysis.

The effect of rice, shallot and red chili prices on price volatility in Central Java province. The 1st lag rice price variable is significant at the 5% level in the long run, where every 1 percent increase in rice prices will cause an increase in rice price volatility in Central Java province in the long run by 3.055 percent. The price variable of shallot lag 1 is significant at the 5% level in the long run, where any increase in the price of rice by 1 percent will cause an increase in the volatility of rice prices in Central Java province in the long run by 5,708 percent. The price variable of red chili is significant at the 5% level in the long run, where every 1 percent increase in the price of rice will cause an increase in the volatility of rice prices in Central Java province in the long run by 6,952 percent. The price of rice, shallot and red chili has a positive effect on food prices in Central Java province.

DISCUSSION

The study also emphasizes the impact of food price volatility on consumer welfare and costs, as well as its effect on inflation and economic growth. The article highlights the need for strategies to manage food price volatility and discusses the importance of Bank Indonesia's policies in this regard. Furthermore, it explores the impact of rice, onion, and red chili prices on beef price volatility in Central Java. Overall, this study provides valuable insights into the dynamics of food price volatility and its implications for the economy and consumer welfare in Central Java.

CONCLUSION

Based on the research findings, one potential solution to address the volatility of food prices, particularly rice, in Central Java is the implementation of a comprehensive risk management strategy. This strategy could involve the following components.

Risk Hedging Mechanisms
Developing and promoting risk hedging mechanisms, such as futures and options contracts for agricultural commodities, can help farmers and traders mitigate the impact of price volatility.

Financial Instruments
Introducing financial instruments, such as weather-indexed insurance and catastrophe bonds, to protect against extreme price fluctuations caused by natural disasters or adverse weather conditions.

Information Dissemination
Enhancing information dissemination and market transparency to provide stakeholders with timely and accurate data on supply, demand, and price trends, enabling them to make informed decisions and manage risks effectively.

Capacity Building
Providing training and support to farmers and small-scale producers on risk management strategies, financial literacy, and access to credit to help them cope with price volatility.

By implementing a comprehensive risk management strategy, Central Java can work towards mitigating the impact of food price volatility and improving the resilience of its agricultural sector.

ACKNOWLEDGEMENT
N/A

DECLARATION OF CONFLICTING INTERESTS
The authors declared no potential conflicts of interest.

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