



PRICE VOLATILITY OF SHALLOT AND GARLIC AND EFFECT ON INFLATION IN EAST JAVA

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ABSTRACT

This study aims to analyze changes in prices and volatility of food commodities and their effect on inflation in East Java. The food commodities in this study were shallots and garlic. The purpose of this study is to identify the existence of price volatility of shallots and garlic, this study uses the ARCH / GARCH model. Then, this study uses further analysis using the ECM (Error Correction Model) model to determine the effect of price changes and the volatility of shallots and garlic on inflation in East Java. The ARCH-LM test results show that price volatility occurs in changes in garlic prices. Then the estimation results of the ECM model show that changes in garlic prices, real exchange rates and real interest rates have a significant positive effect on inflation in East Java. In this study, the price of shallots has no significant effect on inflation in East Java. Thus, government should protect the price stability of food commodities especially garlic which the product depend on impor to keep mild inflation..

INTRODUCTION

Since the beginning of 2020, the COVID-19 pandemic has stopped the movement of community activities. This causes the life of this country to be suspended (Wulandari, 2020). Incidents like this are not only in the capital city of Jakarta, concerns about this dangerous virus have spread to all corners of the country, including the province of East Java. The reduced routine activities during the corona pandemic have disrupted the pace of the economy. An indicator of the decline in the economic graph can be seen from the shift in the value of inflation/deflation. Inflation, both food and non-

food according to its causes, is divided into two, namely from the demand and supply side. According to several studies, inflation tends to come from the supply side.

Social, political and economic turmoil at home and abroad, the public always relates to problems due to inflation (Mankiw, 2007). The rate of change is always tried to be low and stable, this is done to prevent macroeconomic problems which will later cause instability in the country's economy. Inflation is the tendency of prices to rise in general and continuously (Boediono 1995). High inflation is a reflection of the tendency of rising prices for goods and services in general and continuously over a certain period of time. This price level causes the purchasing power of the people to decrease. Production goods will not be sold out and producers will not increase their investment. The reduced amount of investment will result in a decrease in national income which will then affect the stability of the activities of an economy which is a milestone of development.

East Java as one of the producing provinces of several strategic foods, plays a major role in inflation in East Java related to food commodities. The Central Statistics Agency for East Java recorded changes in consumer prices during February 2021. It was recorded in eight cities the Consumer Price Index (CPI) of East Java showed an increase in prices for most of the commodities monitored.

Efforts made to overcome the problem of inflation are controlling and controlling food commodity prices (Wahyudi et al 2013). The price of food commodities is one of the factors driving regional inflationary pressures, this is especially so in areas where consumption is dominated by the food group and also other regions have a fairly high dependence on supplies from other regions. The magnitude of its contribution is quite significant to inflation and its rapid response to various shocks makes it feasible to be used as a leading indicator of inflation (Braun et al, 2012).

Food commodity prices that need to be considered are strategic food commodity prices. Some of them include onions and garlic. Shallots have a significant contribution to inflation in the Indonesian economy (Paskomnas, 2012). The production of shallots is mostly produced by central areas such as East Java (BPS, 2019). Apart from being an irreplaceable staple, shallots are also the most widely cultivated horticultural commodity. Due to the high demand that cannot be matched by sufficient supply from several shallot-producing areas, the price has increased. This is also due to the disproportionate harvest of shallots (BPS, 2019). The limited availability of shallots and the higher demand for shallots resulted in fluctuating prices. This upward trend in prices has prompted the government to open a policy for imports to stabilize domestic market prices.

Garlic is also one of the commodities that have high economic value. Garlic is a horticultural commodity that is of concern to the government. The Central Statistics Agency noted that Indonesia's garlic production reached 88 thousand tons. However, in 2020 when the COVID-19 occurred, the amount of garlic production decreased to 80 thousand tons. Meanwhile, to fulfill this need, the government has set an import policy of 461 thousand tons. Indonesian garlic imports come from China, India, Taiwan and the United States (Ministry of Agriculture, 2020). The condition that occurred in the decline in national garlic production was caused by the declining interest of farmers to grow garlic due to the entry of imported garlic in large quantities and lower price levels so that local garlic products could not compete (Hadianto et al 2019). The lower price of imported garlic was due to the higher productivity of garlic in China, which was 25.3 tons per hectare, while the productivity of local garlic was only 8.7 tons per hectare, this resulted in lower production costs per kg of Chinese garlic. compared to local garlic originating from Indonesia. In addition to the price factor, the government in China also

applies dumping for export commodities including production costs (Hariwibowo, 2014). This is also reinforced by the reason that domestic consumers prefer imported garlic to local ones because the tuber size is much larger (Kementan, 2018). In recent years, the dependence of domestic consumers on garlic is around 95%. Garlic consumption needs in Indonesia are met by imported garlic from China (Sandra et al 2022). The import of garlic creates its own problem, namely depending on supply from imports. If the exporting country changes its trade policy, the domestic market will collapse, resulting in a surge in demand. The price of an item will fluctuate or commonly referred to as volatile.

Volatility is a statistical method to measure fluctuations in the price of goods during a certain period, but not to measure the price level but to measure the level of variation in a certain period. Price variations can be a positive signal but can also be a positive signal but can also be a negative signal if the price variation that occurs is large enough and cannot be anticipated by the government (Carolina et al,2016). The OECD said that high volatility has the potential to limit access to food originating from imports which must be borne by producers and traders, causing resource inefficiency. This study aims to analyze price changes and identify the existence of elements of commodity price volatility of red onion and garlic as well as to analyze the effect of changes and volatility of onion and garlic prices and their effect on inflation in East Java

RESEARCH METHODS

Method of Collecting Data

This study uses secondary data sourced from several related government agencies and institutions. The research location is in East Java because the research location is the largest producer of shallots and garlic on a national scale. The type of data used is a time series with a time period from May 2018 to May 2021. In the estimation of price volatility which is the purpose of the first study, the data used is the commodity prices of shallots and garlic. The source of the data was obtained from Hargapangan.id. The data used to answer the objectives of the two studies is an analysis of the effect of volatility on inflation in East Java. The data used in the inflation section are inflation data, price volatility of shallots and garlic, interest rates, exchange rates and monthly data.

Data Analysis Method

In the ARCH GARCH model, it is used to calculate the volatility of staple food prices, namely onions and garlic. The prices of these two commodities are considered to have experienced sharp increases and decreases, so it is necessary to calculate the volatility. Volatility occurs because the residual variance in the model is not constant so that homoscedasticity cannot be fulfilled.

The use of the ARCH model to estimate high-voltage data. High volatility means that the data in a period has a low residual, so that the residual variance will depend on the residual variance of the previous period. This model was first introduced by Engle (1982) who at that time analyzed the problem of residual variance in time series data. The equation in the ARCH model is as follows

$$\sigma^2_t = \alpha_0 + \alpha_1 e^2_{t-1}$$

The ARCH model has developed with the generalization of the model introduced by Bollerslev (1986) introducing the GARCH model. This model states that the residuals of the previous period, but also depend on the variance of the residuals of the previous period. The GARCH model based on Bollerslev (1986) can be formulated as follows:

$$h_t = K + \delta_1 h_{t-1} + \dots + \delta_p h_{t-p} + \alpha_1 \varepsilon_{t-1}^2 + \dots + \alpha_q \varepsilon_{t-q}^2$$

Theory of Error Correction Model

Time series data is data that is collected based on certain time periods such as daily, weekly, monthly, quarterly or custody. The problem with time series data is that many are not stationary. Data that is not stationary will cause problems of heteroscedasticity or autocorrelation. Stationary time series data can also cause spurious regression. The result of non-stationary time series data is that the regression results will be misleading (Juanda and Junaidi 2012)

Pseudo-regression is a regression between two variables, dependent and independent, both of which have no theoretical attachment, but have the correct coefficient of determination, so it seems as if the two variables have a close relationship. Ways that can be done to overcome pseudo regression and non-stationary problems on time series data are by using the Error Correction Model (ECM) (Thomas 1997)

ECM is a model that incorporates adjustments to correct short-run equilibrium towards long-run equilibrium. Adjustments arise because the cost model reaches equilibrium in the long run, but in the short term it may not reach equilibrium, so an adjustment is needed (Juanda and Juanaidi 2012). A time series data model that is said to be balanced in the long run if it is cointegrated. Cointegrated regression means moving on the same wavelength.

RESULTS AND DISCUSSION

Garlic and Shallot Price Volatility

After testing to get the best model with the ARIMA method. The model obtained will be tested for the ARCH Effect. This test is carried out on each model. The following are the results of testing the ARCH Effect on price data for strategic food commodities.

Table 1. Result the best model with the ARIMA method

Variable	Model	Chi- Square	Conclusion
DBAPUT	ARIMA (2,1,1)	0,0012	There are ARCH <i>Effect</i>
DBAMER	ARIMA (2,1,2)	0,3150	Not ARCH <i>Effect</i>

The table above shows that the two models formed, two of which are the garlic price model (DBAPUT) show the ARCH Effect in the model which is indicated by the Chi-Square Prob value (1) smaller than alpha 0.05. This means that there is at least one squared residual coefficient which is statistically significant not equal to zero. The mean of the shallot price change model (DBAMER) does not show any ARCH Effect in the model as indicated by the Chi-Square Prob (1) value greater than 0.05 alpha. This means that the residual variance is constant. Thus, the element of volatility is found in the behavior of data on changes in garlic prices (DBAPUT) only.

In this study, the determination of the best ARIMA method was carried out by trial and error which was modeled repeatedly so that the best method was obtained by considering the goodness of fit test, namely the significance of the Autoregressive (AR) and Moving Average (MA) coefficients, the Determination Coefficient (R²), and the significance of the ARIMA model is formed (Probability Value Test F). From modeling trials of several ARIMA models with the Eviews 11 program, the best ARIMA model formed from each variable in this study is as follows.

The R² value in each of the formed models looks small. This is because the formation of the ARIMA model only involves one variable, namely the dependent variable itself. In addition, the ARIMA model estimation uses maximum Likelihood so that it is different from the OLS method which aims to maximize R². However, variations that occur in the dependent variable (DBAMER, DBAPUT) can still be explained by the independent variables in the model.

Partially and simultaneously, the autoregressive coefficient (AR) and moving average (MA) in each model formed significantly affect all the dependent variables (DBAMER, DBAPUT). This is indicated by the value of Prob (tstat) on each autoregressive coefficient (AR) and moving average (MA) and Prob (F-stat) which is smaller than alpha 0.05.

ARCH/GARCH Model models

ARCH Effect testing, it has been proven that data on changes in rice prices and changes in garlic prices shows an element of volatility. The ARCH/GARCH model is estimated with this model because it has an element of volatility. Simultaneously, all independent variables in both the model (AR and MA coefficients) and the variance model (Square Residual Coefficient) in each formed model significantly affect the dependent variable. This is indicated by the value of Prob (F-stat) less than 0.05. Partially, in the DBAMER model mean (ARIMA (2,1,3)) one of the autoregressive variables (DBAPUT_{t-2}) does not significantly affect the garlic price change variable (DBAPUT_t) which is indicated by a greater prob (t-stat) value. of alpha 0.05. When compared with before modeling in the form of GARCH (1,0), the autoregressive variable (DBAPUT_{t-2}) significantly affects the change in garlic price variable (DBAPUT_t). This insignificance has been accommodated in the ARCH element. For both variance models, the coefficient of squared residual significantly positive effect on the variance (Garlic Price Volatility). This is evidenced by the prob value (t-stat) greater than 0.05.

Garlic Price (ARIMA (2,1,1))

$$\text{DBAPUT}_t = 0,233511^* + 1,061772^* \text{DBAPUT}_{t-2} - 0,451356^* \text{DBAPUT}_{t-1} - 0,892451^* \text{et}_{-1} + \text{et}_t$$

(0,0022) (0,0000) (0,0005) (0,0003)

R² = 0,308781 R²adjusted = 0,293505 Prob (F-stat) = 0,000003

Shallot Price (ARIMA (2,1,2))

$$\text{DBAMER}_t = 0,156885 + 0,878652^* \text{DBAMER}_{t-1} - 0,798805^* \text{DBAMER}_{t-2} - 0,921013^* \text{et}_{-1}$$

(0,587628) (0,0000) (0,0003) (0,0001)

$$+ 0,602721^* \text{et}_{-2} + 0,310267^* \text{et}_{-3} + \text{et}_t$$

(0,0001) (0,0066)

R² = 0,346085 R²adjusted = 0,22343 Prob (F-stat) = 0,000023

Based on the picture above, the price of garlic, whose price did not increase significantly, was seen to increase at the beginning of 2020. (BPS in Olavia 2020), imports of garlic only reached 50.86 thousand tons in July 2020. That figure fell 62.27% from June 2020 which had reached 134.80 thousand tons. In year on year (yoy) garlic imports also decreased by 29.05%. In July 2020, garlic imports had fallen by 86.12 thousand tons (Olavia, 2020). This decline in imports due to the corona virus that hit China also had an impact on supply which was affected by the high selling price of garlic (Puspita 2020).

The Effect of Garlic and Shallot Price Volatility on East Java Inflation

Changes and volatility of garlic and shallot prices are known by the formation of multiple ECM models. Eviews 11 software as an analytical tool to get the best model.

Table. 2 Result Volality Comodites

Variable	Coefficient	Probability
C	-0.066052	0.9479
D(BAPUT)	0.603552	0.0000
D(BAMER)	0,315067	0.7699
D(EXT)	4.887230	0.0015
D(INT)	-0.180305	0.0026
(BAPUT)-1	0.382587	0.0003
(BAMER)-1	-0.187908	0.7867
(EXT)-1	0.508051	0.0367
(INT)-1	-0.049144	0.0007
R- Squared= 0.342956		
Adjusted R-Squared = 0.320679		

The volatility of garlic prices has a significant effect on the 5 percent level of significance and has a positive sign. The coefficient value of garlic price volatility is 0.6, which means that if garlic price volatility increases by 1 percent, inflation will increase by 0.6 percent ceteris paribus. The high demand for garlic is because garlic is a strategic food commodity that must be in every household. The availability of garlic in the domestic market is still limited, the decline in national production is caused by the decrease in asking farmers to grow garlic. This is due to the entry of imported garlic in large quantities and the price level is lower than local garlic (Hadianto et al 2019). The price of imported garlic is much lower because the Chinese government is dumping export commodities including production costs (Hariwibowo, 2014). this is also reinforced that domestic consumers prefer imported white onions than local because the tuber size is much larger (Kementan, 2018)

The real exchange rate variable has a positive and significant sign at the 5 percent level of significance with a coefficient value of 4.88. The sign of a positive coefficient means that both the dependent and independent variables have a unidirectional relationship. When linked to the real exchange rate, it can be interpreted that if the real exchange rate increases by 1 percent, inflation will increase by 4.88 percent ceteris paribus. The increased exchange rate of the rupiah against the dollar caused commodity prices to increase, especially imported commodities, resulting in high inflation. Garlic has not been free from imports, thus the exchange rate will affect

inflation through the commodity price mechanism. The real exchange rate variable for the previous one year period was significant at a real level of 10 percent with a coefficient value of 0.5 and a positive sign, which means that if the real exchange rate variable for the previous one year period increased by 1 percent, inflation would increase by 0.5 percent. The exchange rate is one of the important variables, this is due to its large influence on the current account balance and other macroeconomic variables (Musyafaa et al, 2017). With this exchange rate, countries can transact with other countries. An exchange rate crisis if it occurs in a country will have a bad impact. Conditions caused by the exchange rate include soaring prices and a sharp economic contraction (Fauji, 2016).

Real interest rates have a significant effect on inflation with a different sign from the variable rice price volatility and the real exchange rate, which is negative. The coefficient of real interest rates has a value of 0.18 which means that if real interest rates increase by 1 percent, inflation will decrease by 0.06 percent *ceteris paribus*. The interest rate for the previous one year period was significant at the five percent level with a coefficient value of 0.18 and the same negative sign as real interest rates. This means that if the real interest rate for the previous one year period increases by 1 percent, then inflation will decrease by 0.18 percent *ceteris paribus*. Interest rates, inflation and exchange rates are closely related. Changes that occur in interest rates, a country's central bank can affect inflation and currency exchange rates (Alawiyah, 2019). High interest rates make investors not interested in investing (Yeniwati, 2014), so that the aggregate production that can be provided (Aggregate Supply) remains constant, even though demand (Aggregate Demand) continues to increase along with population growth, therefore causing inflation from the demand side. Inflation in general can be approached from the supply and demand side. Demand pull inflation is a type of inflation that occurs from the demand side. Cost push inflation is inflation from the supply side which can be caused by rising production costs so that supply becomes limited and causes inflation to occur.

CONCLUSIONS AND POLICY IMPLICATIONS

Conclusions

Garlic price volatility experienced a sharp increase at the beginning of the pandemic. This is because garlic is a strategic food commodity for the Indonesian population. A very significant increase in garlic prices was seen in the first quarter of 2020, this was due to a decrease in import volume by 62.27% compared to June 2020. This decline was caused because China was hit by the corona virus, China was still an importer of garlic. This price increase was not only caused by a thinning supply but also accompanied by an increase in prices due to a thinning supply while the demand remained constant.

Factors that affect inflation in East Java, the price of garlic, the real exchange rate of the previous year, real interest rates, and real interest rates of the previous year also affect inflation. The increased exchange rate of the rupiah against the dollar caused commodity prices to increase, especially imported commodities, resulting in high inflation. Garlic has not been free from imports, thus the exchange rate will affect inflation through the commodity price mechanism. High interest rates make investors not interested in investing, so that the aggregate production that can be provided (Aggregate Supply) remains constant, even though demand (Aggregate Demand) continues to increase along with population growth, therefore causing inflation from the

demand side. Inflation in general can be approached from the supply and demand side. Demand pull inflation is a type of inflation that occurs from the demand side. Cost push inflation is inflation from the supply side which can be caused by rising production costs so that supply becomes limited and causes inflation to occur.

Policy Implication

Policies to manage food prices, especially garlic so that price volatility can be minimized, must continue. The policies implemented must be in favor of producers and consumers, because both are actors in consumption as well as parties that produce commodities.

The supervisory policies before the crisis and after the crisis are quite different. This is because rice is a strategic commodity. The stability of the price of garlic is also shown from the results of the analysis of the volatility graph. Garlic only experienced an increase in price during the product crisis during the corona virus outbreak. The policy of managing the price of shallots and garlic also needs to pay attention to farmers who act not only as producers but also as consumers.

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