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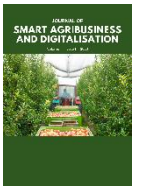

Price Volatility of Shallot Effect on Inflation in East Java

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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. The purpose of this study is to identify the existence of price volatility of shallots, 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 on inflation in East Java. The ARCH-LM test results show that price volatility occurs in changes in shallot prices.

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INTRODUCTION

In recent years, various factors have halted many community activities, causing the country's life to feel suspended (Wulandari, 2020). This situation has not only occurred in the capital city of Jakarta, but concerns about these conditions have spread to all corners of the country, including the province of East Java. The reduction in routine activities has disrupted the pace of the economy. One indicator of the decline in the economic graph can be seen from the shift in the values of inflation/deflation. Inflation, both in food and non-food sectors, is divided into two categories based on its causes: demand-side and supply-side. According to several studies, inflation tends to stem from the supply side.

The main causes of supply-side inflation in Indonesia can be attributed to disruptions in the distribution of goods and shortages of essential supplies due to disturbances in the supply chain. This condition leads to price increases, even though public demand is declining.

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. 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.

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 shallot as well as to analyze the effect of changes and volatility of shallot prices and their effect on inflation in East Java.

THEORETICAL FRAMEWORKS

This study builds on macroeconomic inflation theory, supply-side disruption theory, food price transmission, and price volatility concepts to explain how changes and volatility in shallot prices affect regional inflation in East Java. Inflation is understood as a sustained increase in the general price level of goods and services over time and is commonly distinguished into demand-pull and cost-push types (Boediono, 1995; Mankiw, 2007). In the present context, cost-push inflation is central, as disruptions to production and distribution increase costs and reduce effective supply, thereby driving prices upward even when aggregate demand is weakening.

Supply-side disruptions are typically associated with shocks to the supply chain, including obstacles in production, transportation, and distribution networks. These shocks create shortages and raise transaction and logistical costs, leading to higher and more unstable food prices (Wahyudi et al., 2013; Wulandari, 2020). Food price transmission theory emphasizes that in economies where food constitutes a large share of household expenditure, food prices play a pivotal role in shaping the Consumer Price Index (CPI) and can function as leading indicators of inflationary pressures (Braun et al., 2012). This is particularly relevant for East Java, where food commodities have substantial weight in the CPI basket and where the region serves as a major producer of strategic food commodities (BPS, 2019).

Within this framework, shallots are treated as a strategic food commodity whose price dynamics can significantly influence inflation. As a widely consumed horticultural product with regionally concentrated and seasonal production, shallot markets are prone to imbalances between supply and demand, which manifest as sharp price movements (Paskomnas, 2012; BPS, 2019). When domestic supply is insufficient relative to demand, prices rise and may trigger policy responses such as import relaxation to stabilize domestic markets, although such interventions often occur against a backdrop of already heightened volatility.

Price volatility is defined here as the degree of fluctuation in commodity prices over a given period, capturing instability rather than just the level of prices (Carolina et al., 2016).

High volatility increases uncertainty for producers, traders, and consumers, complicates planning and investment decisions, and can reduce overall market efficiency. Analyses from international organizations such as the OECD highlight that elevated volatility in food prices may restrict access to imported food and shift risk burdens onto market participants, reinforcing resource misallocation and welfare losses (OECD, n.d.). Thus, volatility itself becomes a mechanism through which inflationary pressures are amplified and made more persistent.

On this basis, the theoretical framework posits that supply-side disruptions in the shallot market generate both price increases and heightened volatility, which in turn contribute to inflation in East Java. Price changes influence the magnitude of inflation through direct effects on the CPI, while volatility affects the stability and predictability of inflation, potentially reinforcing macroeconomic uncertainty. These relationships motivate empirical analysis of (1) the extent of shallot price changes, (2) the presence and intensity of shallot price volatility, and (3) their joint effects on regional inflation dynamics.

METHOD

Participants

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 on a national scale. The type of data used is a time series with a time period from May 2018 to May 2023. In the estimation of price volatility which is the purpose of the first study, the data used is the commodity prices of shallots. 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, interest rates, exchange rates and monthly data.

Data collection and analysis

In the ARCH GARCH model, it is used to calculate the volatility of staple food prices, namely shallot. The prices of these two commodities are considered to have experienced sharp increases and decreases, so it is necessary to calculate the volatility. Volality 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

$$\sigma^2 t = \alpha_0 + \alpha_1 e^2 \quad t-$$

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:

$$h_t = K + \delta_1 h_{t-1} + \ldots + \delta_1 h_{t-p} + \alpha_1 \varepsilon^2 \quad +^{t-1} \ldots + \alpha_q \varepsilon^{2} \; {}^{t-}$$

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 sporous 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.

Instrument development and interview protocol

Describe the process of developing the research instrument, including the theoretical framework, literature, or previously validated instruments used as the basis for item development or adaptation. Explain the procedures undertaken to assess the content validity, clarity, and reliability of the instrument, such as expert review, pilot testing, or instrument revision.

If the study includes interviews, describe the interview protocol in detail. Explain the type of interview conducted (e.g., structured, semi-structured, or unstructured), the development of the interview guide, the criteria for participant selection, the interview procedures, duration, mode of administration (e.g., face-to-face or online), and the methods used to record, transcribe, and verify the interview data. If interviews were not part of the study, modify this section to describe only the instrument development process.

FINDINGS

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
DBAMER	**ARIMA (2,1,1)**	0,0012	There are ARCH *Effect*

The table above shows that the two models formed, two of which are the shallot price model (DBAMER) 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.

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) 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). 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.

DISCUSSION

ARCH/GARCH Model models

ARCH Effect testing, it has been proven that data on changes in rice prices and changes in shallot 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 This insignificance has been accommodated in the ARCH element. For both variance models, the coefficient of squared residual significantly positive effect on the variance (Shallot Price Volatility). This is evidenced by the prob value (t-stat) greater than 0.05.

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

$$DBAMER_t = 0{,}233511^* + 1{,}061772^* DBAMER_{t-2} - 0{,}451356^* DBAMER_{t-1} - 0{,}892451^* e_{t-1} + e_t$$

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

$R^2 = 0{,}308781$ R^2 adjusted = 0,293505 Prob (F-stat) = 0,000003

ARCH/GARCH Model

ARCH Effect testing, it has been proven that data on changes in rice prices and changes in shallot 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 0.05one of the autoregressive variables (DBAMERt-2) does not significantly affect the shallot price change variable (DBAPUTt) 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 (DBAMERt-2) significantly affects the change in shallot price variable (DBAMERt). This insignificance has been accommodated in the ARCH element. For both variance models, the coefficient of squared residual significantly positive effect on the variance (Shallot Price Volatility). This is evidenced by the prob value (t-stat) greater than 0.05.

Shallot PRICE (GARCH (1,0))

DBAMERt = 0,28474 + 0,56363* DBAMERt-1 + 0,056373 DBAMERt-2
- 0,319326* et-1 (0,0000) (0,0000)
(0,4746) (0,0011)

- 0,591656* et-2 -
0,337127* et-3 + et
(0,0000) (0,0006)

Variance Model: $\sigma^2 t = 2{,}923922^* + 1{,}174592^* e^2 t\text{-}1$
(0,0008) (0,0002)
R^2 = 0,191817 R^2adjusted = 0,063838 Prob (F-stat) = 0,038373

From the GARCH model that was formed, information related to price fluctuations or price volatility of rice and shallot commodities was obtained. The price volatility data series is obtained from the formed conditional variance model. The price volatility of the two commodities is as follows:

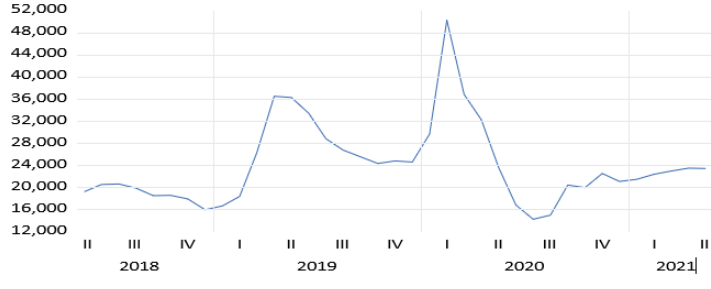

Figure 1. Shallot Volallity

Based on the picture above, the price of shallot, whose crew did not increase significantly, was seen to increase at the beginning of 2020. (BPS in Olavia 2020), imports of shallot 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) shallot imports also decreased by 29.05%. In July 2020, shallot imports had fallen by 86.12 thousand tons (Olavia, 2020).

The Effect Shallot Price Volatility on East Java Inflation

Changes and volatility of 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(BAMER)	0.603552	**0.0000**
D(EXT)	4.887230	**0.0015**
D(INT)	-0.180305	**0.0026**
(BAMER)-1	0.382587	**0.0003**
(EXT)-1	0.508051	0.0367
(INT)-1	-0.049144	0.0007
R- Squared= 0.342956 Adjusted R-Squared = 0.320679		

The volatility of shallot prices has a significant effect on the 5 percent level of significance and has a positive sign. The coefficient value of shallot price volatility is 0.6, which means that if shallot price volatility increases by 1 percent, inflation will increase by 0.6 percent ceteris paribus. The high demand for shallot is because shallot 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 shallot. This is due to the entry of imported shallot in large quantities and the price level is lower than local shallot (Hadianto et al 2019). The price of imported shallot 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 shallot 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. Shallot 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.

CONCLUSION

Shallot price volatility experienced a sharp increase at the beginning of the pandemic. This is because shallot is a strategic food commodity for the Indonesian population. A very significant increase in shallot 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 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 shallot, 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. Shallot 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.

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