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PRICE VOLATILITY AND SPILLOVER OF BIG CAYENNE (*Capsicum annuum* L.) IN MALANG DISTRICTS, INDONESIA

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Abstract: Production of big cayenne in Malang Districts has trend increase while consumption has trends decrease make excess supply. Unbalanced supply and demand causes price fluctuation between producers and consumers. Price fluctuations can pose risks and price uncertainties or price changes known as price volatility. The purpose of this research is to analyze price volatility that occurs at the level of producers and consumers of big cayenne in Malang Districts, and analyze the spillover volatility that occurs at the price of producers and consumers big cayenne in Malang Districts. The method used to analyze price volatility is ARCH/GARCH models and the method used to analyze the spillover volatility is EGARCH models. The results showed that the price volatility of big cayenne in Malang Regency at the producer and consumer level is low volatility and the results of spillover volatility showed that the price of big cayenne producers and consumers in Malang Districts occur spillover volatility.

Keywords: *Price Volatility, Spillover Volatility, ARCH/GARCH, EGARCH, Producers, Consumers*

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INTRODUCTION

Big cayenne (*Capsium annuum* L.) is a strategic horticultural commodity to be cultivated. This is reinforced by Nofita and Hadi (2015), which states that big cayenne is one of the horticultural commodities that grows well in the highlands and lowlands. Big cayenne is commonly used by the society as a spice in cooking, a mixture of ingredients in processing industries such as sauce and chili powder. So that big cayenne is important for producers as a source of income and for consumers as household needs.

Consumption of big cayenne households in Malang Districts shows a trend decrease by 30.18% from 2013 to 2017. In the same period, big cayenne production in Malang Districts did not show the same trend as its consumption. The big cayenne production in Malang Districts shows a trend increase by 2.84%, resulting in excess supply. The demand and supply of big cayenne in Malang Districts is not balanced, making prices at the producer and consumer level uncertain. This price uncertainty causes prices at the producer and consumer levels to vary or vary. Price variations can make price fluctuations that occur in producers and consumers. According to Anindita and Baladina (2017), the existence of price fluctuations can lead to risks and price uncertainties or price changes known as price volatility in the agricultural sector.

Given that big cayenne is a strategic vegetable horticultural commodity to be cultivated and there are problems regarding the uncertainty of big cayenne prices in Malang Districts at the producer and consumer level, this research needs to be done. According to Sumaryanto (2009), understanding and information about price volatility is very useful to anticipate the risks and uncertainties faced in decision making. Information about price volatility can minimize the risks faced by producers and consumers. According to Bathla (2012), price

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volatility is considered very important because it harms agricultural growth and the income of small and marginal farmers who constitute the largest part of agriculture. In addition, research on the volatility of spillover also needs to be done to determine the effect of consumer price volatility on producer price volatility. According to Barrera, Mallory and Garcia (2012), spillover volatility occurs when the volatility of prices in a market affects the volatility of prices in other markets.

The purpose of this study is to analyze price volatility that occurs at the producers level of big cayenne in Malang Districts, analyze price volatility that occurs at the consumers level of big cayenne in Malang Districts, and analyze the spillover volatility that occurs at producer and consumers price of big cayenne in Malang Districts.

RESEARCH METHODS

This research was conducted in Malang Districts. Determination of location is done purposively by considering the availability of large red pepper price data for producers and consumers in Malang Districts as well as the problems of supply and demand imbalances that cause price uncertainty. This study uses secondary data in the form of time series data, namely the monthly price of big cayenne in Malang Districts from January 2014 to December 2018. Data was obtained from the Office of Food Crops, Horticulture and Plantation in Malang Districts. The data analysis method used to analyze price volatility at the producer and consumer level is the method with the ARCH / GARCH model approach. The analytical method used to analyze the volatility of spillover is the EGARCH model. Data analysis was aided by using software E-views.

Analysis Price Volatility (ARCH / GARCH)

Stationary Test

Before analyzing price volatility with the ARCH / GARCH model, it must first do a stationary test to ensure the data used is stationary or not. Stationary tests need to be done because the time series data requirements to be analyzed are data that must be stationary. Stationary test is done by testing unit root. This test was used by Augmented Dickey Fuller (ADF) with the intersept and trend model. If the ADF probability value is <5% significant level ($\alpha = 0.05$), then the data is stationary.

The test is carried out first at the initial level. If the data is stationary, then further testing can be done. If the data at the initial level is not stationary, then the difference in non-stationery process is done by doing stationary test data in the form of first differentiation or second differentiation.

ARMA Test (Autoregresive and Moving Average)

After stationary testing, statistical tests are then carried out using the ARMA model. The best ARMA model is the model that shows the smallest Akaike Info Criterion (AIC) and Schwarz Criterion (SC) values. In testing this statistic, it can be seen how the ability and feasibility of the model. If the Fstatistic probability value is <5% significance level, then the model can be accepted as a good and feasible estimator to use.

Heteroscedasticity Test and ARCH Effect

Before testing the ARCH / GARCH model, heteroscedasticity and ARCH Effect tests are carried out first. Heteroscedasticity test is done to prove that the data used is heteroscedasticity. If the value of the Fstatistic probability is <5% significance value, then the data is heteroscedasticity. While the ARCH Effect test is used to ensure the suitability of the model for data analysis. If the Fstatistic probability value <5% significance value, then there is the ARCH Effect. If this test shows these criteria, it can be continued at the testing stage of the ARCH / GARCH model.

ARCH / GARCH Model Testing

The equation of the Autoregressive Conditional Heteroscedasticity or Generalized Autoregressive Conditional Heteroscedasticity (ARCH / GARCH) model used in this reasearch is:

$$\sigma^2 PP_t = \alpha_0 + \alpha_1 \varepsilon^2 PP_{t-1} + \beta_1 \sigma^2 PP_{t-1} \quad \text{.....(1)}$$

$$\sigma^2 CP_t = \alpha_0 + \alpha_1 \varepsilon^2 CP_{t-1} + \beta_1 \sigma^2 CP_{t-1} \quad \text{.....(2)}$$

Information:

σ_t^2 = conditional variance in time period to t (period analyzed)

α_0 = constant

α_1 = ARCH estimation coefficient

ε_{t-1}^2 = ARCH term / volatility in the previous period

β_1 = GARCH estimation coefficient

σ_{t-1}^2 = previous period GARCH / residual diversity period

PP = big cayenne producer prices
CP = big cayenne consumers price

Equation 1 is a model equation from testing producer price volatility and equation 2 is a model equation from testing consumer price volatility. In this nodel, α is an ARCH and β value is a GARCH value. Volatility can be seen by looking at the value of $\alpha_1 + \beta_1$. If $\alpha_1 + \beta_1 < 1$ then volatility is low, if $\alpha_1 + \beta_1 = 1$ then volatility is high, and if $\alpha_1 + \beta_1 > 1$ then volatility is very high.

Analysis Spillover Volatility (EGARCH)
The Exponential Generalized Autoregressive Conditional Heteroscedasticity (EGARCH) equation used in this research is:

$$\ln(\sigma_t^2) = \alpha_0 + \beta_1 \ln(\sigma_{t-1}^2) + \alpha_1 \left(\left|\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right| - \sqrt{\frac{2}{\pi}} \right) + \gamma_i \frac{\varepsilon_{t-1}}{\sigma_{t-1}}$$

Information:
$\ln(\sigma_t^2)$ = conditional variance (ln) in the time period to t (the period analyzed)
α_0 = constant
β_1 = estimation coefficient of GARCH model
$\ln(\sigma_{t-1}^2)$ = conditional variance (ln) of the GARCH model in the previous period
α_1 = estimated coefficient of ARCH model
γ_i = estimated coefficient to measure asymmetric effects
ε_{t-1} = shock

The estimation coefficient γi indicates the existence of an asymmetrical effect. If $0 < \gamma_i \leq 1$, then there is no asymmetrical effect and if $-1 > \gamma_i < 0$ then an asymmetrical effect occurs. Spillover volatility can be determined by calculating the positive changes in volatility ($\gamma_i + \alpha_i$) changes in negative volatility changes ($\gamma_i - \alpha_i$). If $\gamma_i + \alpha_i < \gamma_i - \alpha_i$, there is no spillover volatility and if $\gamma_i + \alpha_i \geq \gamma_i - \alpha_i$, there is spillover volatility.

RESULTS AND DISCUSSION

Results of Analysis Price Volatility of Big cayenne at the Producer and Consumer Level in Malang Districts

Analysis price volatility is done by using testing stages at both the producer and consumer levels. The results of the test are:

Stationary Test

At producer prices, the ADF probability value is 0.005 and at the consumer price the ADF probability value is 0.0018. The ADF probability value of the two variables shows the ADF probability value < significance level 5% (0.05), meaning that the two variables are stationary at the data level so that the next test can be carried out.

ARMA Test

At the producer price, the best ARMA model is ARMA (1,1) because it shows the smallest AIC and SC values with AIC 20,41646 and SC 20,52210 and shows the statistical probability value of the ARMA model (1,1) which is 0 which means the model can be accepted as a good and feasible estimator to use because the statistical probability value is less than the 0.05 significance level. At consumer prices, the best ARMA model is ARMA (1,1) because it shows the smallest AIC and SC values with AIC 20,48314 and SC 20,58878 and shows the probability value of the F-statistic ARMA model (1,1) which is 0 which means the model can be accepted as a good and feasible estimator to use because the statistical probability value is less than the 0.05 significance level.
The ARMA model (1,1) shows the best model so that the best model for analysis of price volatility at the producer and consumer level is GARCH (1,1). GARCH (1,1) is intended for testing software eviews containing ARCH (1) and GARCH (1).

Heteroscedasticity Test and ARCH Effect

Based on the results of heteroscedasticity testing on the ARMA model (1,1) at the producer price, it shows the statistical value of 0,000933 which means the data is heteroscedasticity because of the statistical probability value < 5% significance level (α = 0.05). The results of the ARCH Effect test on the ARMA model (1.1) indicate that the statistical probability value is 0.018733 which means there is an ARCH effect on the data because of the statistical probability value < 5% significance level (α = 0.05).

The results of heteroscedasticity testing on the ARMA model (1.1) on consumer prices indicate that the statistical probability value is 0.020493 which means the data is heteroscedasticity because of the statistical probability value < 5% significance level (α = 0.05). The results of the ARCH effect show that the statistical probability value is 0.033536 which means there is an ARCH effect on the data because of the statistical probability value < 5% significance level (α = 0.05).

Both variables indicate that the ARMA (1,1) model is heteroscedasticity and has an ARCH effect so that the next test can be carried out.

Price Volatility (ARCH / GARCH Model)

Based on the analysis of the volatility of the prices of large big cayenne at the producer and consumer level in Malang Districts, the volatility equation is obtained as follows.

Based on table 1, it is known that the price of large big cayenne at the producer level has low price volatility as evidenced by the sum of ARCH (α_1) and GARCH (β_1) which is 0.558624 < 1. Low volatility results in low risk faced by producers. it's also low. According to Maskur (2009), by understanding volatility, it will know the benefits because in economic law say high risk high return, low risk low return. In addition, according to Pertiwi, Anindita, and Dwiastuti (2013), producer price volatility is low because prices received by farmers as low-price takers and conditions when prices increase are not much felt by farmers.

Table 1. Equations of Price Volatility of Big cayenne at the Producer and Consumer Level in Malang Districts

Variable	Equation	$\alpha_1 + \beta_1$
Producer price	$\sigma^2 PP_t = 57593890 + 0{,}626172\, \varepsilon^2 PP_{t-1} + (-0{,}067548)\, \sigma^2 PP_{t-1}$	0,558624
Consumer price	$\sigma^2 CP_t = 59410319 + 0{,}536005\, \varepsilon^2 CP_{t-1} + (-0{,}062509)\, \sigma^2 CP_{t-1}$	0,473496

The price of large big cayenne at the consumer level based on table 1 shows low price volatility with the sum of ARCH (α_1) and GARCH (β_1), which is 0.473496 < 1. Low consumer price volatility indicates that consumers can meet the needs of chili with a low risk. According to Pertiwi, Anindita, and Dwiastuti (2013), consumer price volatility is low because it is influenced by the ups and downs of stocks and consumer demand. This is in line with the price changes that occur when the abundant stock in the large big cayenne consumer prices in the Malang Districts market drops and vice versa.

Results of Analysis Spillover Volatility Between Producer and Consumers Prices of Big cayenne in Malang Districts

Based on analysis spillover volatility on the price of big cayenne at the producer and consumer level in Malang Districts, the results obtained with the equation as follows:

$$\ln(\sigma_t^2) = 3{,}119171 + 1{,}671676 \ln(\sigma_{t-j}^2) + 0{,}283116 \left(\left|\frac{\varepsilon_{t-1}}{\sigma_{t-1}}\right| - \sqrt{\frac{2}{\pi}} \right) + 0{,}693203 \frac{\varepsilon_{t-1}}{\sigma_{t-1}}$$

Estimated coefficient γ_i is 0.693203. It shows that γ_i is close to 1 or positive value, which means there is no asymmetrical effect between consumer and producer prices of big cayenne in Malang Districts period January 2014 to December 2018. Positive volatility changes ($\gamma_i + \alpha_i$) are 0.976319 and negative volatility change ($\gamma_i - \alpha_i$) of 0.410087. This shows that $\gamma_i + \alpha_i > \gamma_i - \alpha_i$, then between producer and consumer price of big cayenne there is a spillover volatility.

The spillover volatility between producer prices and consumer prices explains that the volatility of big cayenne consumer prices in Malang Districts, which shows low volatility, affects producer price volatility which also indicates low volatility or vice versa. So, it can be concluded that the volatility of the prices of big cayenne consumers in Malang Districts affects the volatility of the prices of big cayenne in Malang Districts. According to Pertiwi, Anindita, and Dwiastuti (2013), the existence of spillover volatility proves that price volatility at the producer and consumer level is interrelated because there is a transmission between the two price volatility. This shows that the price information received by both is the same. When prices on consumers experience an increase or decrease, the prices of producers also experience increases or decreases with a value that is not much different.

CONCLUSION

The conclusion of this research is:

1. Producer price of big cayenne has low volatility with the number of ARCH and GARCH estimation coefficients worth 0.558624.
2. The price of big cayenne at the consumer level experiences low volatility with the number of ARCH and GARCH estimation coefficients worth 0.473496.

3. Spillover volatility occurs between the price of big cayenne at the producer and consumer level with the estimated coefficient value γ_i is 0.693203 and the value of α_1 is 0.283116, so that ($\gamma i + \alpha i$) valuable 0.976319> ($\gamma i - \alpha i$) valueable 0, 410087.

The suggestion from this research is Farmers and consumers can increase their active role and awareness to access price information that has been presented by government institutions on social media. In addition, farmers and consumers can jointly create a more up-to-date information system by updating price-related information every day in the form of websites or information systems through social media or directly on the market which makes it easier for both to get price information. This needs to be done so that farmers and consumers can maintain the information received by both of them together.

REFERENCES

Anindita, R. & Baladina, N. (2017). *Pemasaran Produk Pertanian*. Yogyakarta: Penerbit ANDI.

Barrera, A. T., Mallory, M., & Garcia, P. (2012). Volatility *Spillover* in U.S. Crude Oil, Ethanol, and Corn Futures Markets. *Journal of Agricultural and Resource Economics, 37(2), 247-262*.

Bathla, S. (2012, Februari). *Volatility in Agriculture Commodity Prices in India: Impact and Macroeconomic and Sector-Specific Policy Responses*. Paper Prepared For The 123rd EAAE Seminar, Dublin.

Maskur, A. (2009). Volatilitas Harga Saham Antara Saham Konvensional dan Syariah. *Dinamika Keuangan dan Perbankan, 1(2), 82-94*.

Nofita, I. & Hadi, S. (2015). Analisis Produktivitas Usahatani Cabai Merah besar (*Capsicum annuum* L.) di Desa Andongsari Kecamatan Ambulu kabupaten Jember. *JSEP, 8(3), 66-71*.

Pertiwi, V. A., Anindita, R., & Dwiastuti, R. (2013). Analisis Volatilitas, Transmisi Harga dan Volatilitas *Spillover* Bawang Merah (*Allium ascolanium L.*) di Jawa Timur. *Habitat, 24(3), 204-213*.

Sumaryanto. (2009). Analisis Volatilitas Harga Eceran Beberapa Komoditas Pangan Utama Dengan Model ARCH/GARCH. *Jurnal Agro Ekonomi, 27(2), 135-163*.