Scholars Journal of Economics, Business and Management e-ISSN 2348-5302
Sch J Econ Bus Manag, 2017; 4(9):590-599 p-ISSN 2348-8875

Price Volatility of Cayenne Pepper and Red Chili Pepper in Papua and Maluku Provinces, Indonesia

Jhon Chen Van[1], Wen-Chi Huang[2], Ratya Anindita[3], Wen-I Chang[4], Shang-Ho Yang[5]

[1]Double Degree Student, International Master's Degree Program in Agribusiness Management, National Pingtung University of Science and Technology, Taiwan; Master's Degree in Agricultural Economics, Post Graduate Program, Faculty of Agricultural, University of Brawijaya, Indonesia

[2]Professor, International Master's Degree Program in Agribusiness Management, National Pingtung University of Science and Technology, Taiwan

[3]Professor, Master's Degree in Agricultural Economics, Post Graduate Program, Faculty of Agricultural, University of Brawijaya, Indonesia

[4]Assistant Professor, International Master's Degree Program in Agribusiness Management, National Pingtung University of Science and Technology, Taiwan

[5]Assistant Professor, Graduate Institute of Bio-Industry Management, National Chung Hsing University, Taiwan

***Corresponding author**
Dr. Caxton Shonhiwa

Article History
Received: 23.07.2017
Accepted: 29.07.2017
Published: 30.09.2017

DOI:
10.36347/sjebm.2017.v04i09.002

Abstract: Chili is a strategic vegetable commodity in Indonesia, especially for the cayenne pepper and red chili pepper. One of the factors contributing to the price of chili increased year by year due to the high demand of chili which the Indonesian people love and become an identity as cuisine culture of spicy distinctive. In 2010, chili was one of the top three commodities causing inflation. The chili price usually spiked quite high toward the end the year of until the beginning of the year to reach more than Rp100,000.00/kg, while at a certain price can fall below Rp10,000.00/kg. The varied and random fluctuations of chili contribute to the high volatility of prices in the market, so the price of chili is difficult to predict. This is the reason for price volatility will be a concern in recent years. Volatility refers to variations in economic variables over time. Volatility is not determined by the price level, but the level of price variations on the market. This study used the Autoregressive Conditional Heteroscedasticity (ARCH) and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model to test the price volatility and suitability as forecasting model of cayenne pepper and red chili pepper in Papua and Maluku provinces so as to know the magnitude of future volatility on producer and consumer prices with time series data which is monthly data from January 2008 to December 2015. Then analyze the price correlation between cayenne pepper and red chili pepper in both provinces to provide an additional picture in recognizing the relationship of both commodities. The results showed that the volatility appeared only on producer prices for cayenne pepper and red chili pepper in both provinces with low volatility level. The market operation (with the reference price) conducted by the government through Ministry of Trade is quite effective in suppressing price uncertainty for the consumer market, as evidenced by no case of observation that has experienced price volatility of cayenne pepper and red chili pepper in both provinces for next period in 2016. In the other side, price correlation between cayenne pepper and red chili pepper on the producer market for Maluku province show a significant correlation. Furthermore, the correlation is supported a negative and high relationship. Conversely for the producer market in Papua Province and also the consumer markets in Papua and Maluku Provinces shows no significant relationship.

Keywords: Chili Market, Future Volatility, Pearson Correlation, Reference Price

INTRODUCTION

Chili is a strategic vegetable commodity in Indonesia, especially for the cayenne pepper and red chili pepper. Furthermore, one of the factors contributing to the price of chili increased year by year due to the high demand of chili which the Indonesian people love and become an identity as cuisine culture of spicy distinctive. The price of chili usually increases sharply in certain seasons (rainy and festival seasons) to affect the inflation rate [1]. In 2010, chili was one of the top three commodities causing inflation [2].

Chili demand for large cities with a population of one million or more about 800,000 tons/year or 66,000 tons/month in 2015. In the festival season or religious holidays, the demand for chili usually increases about 10-20% of normal demand. Chili productivity rate nationally during the last 5 years about 6 tons/ha. In order to meet the monthly demand of urban communities, the area of chili harvest is about 11,000 ha/month, while on the festival season, the area of chili harvest that should be available ranges from 12,100-13,300 ha/month [3].

Inadequate infrastructure develops in the eastern Indonesia when compared with the Java Island, so the government should consider developed an effective policy and give encouragement for equitable economic growth. Eastern Indonesia often experiences high levels of inflation due to difficulties in distribution processes and inadequate supporting facilities for agricultural production. This is exacerbated by the damaged road infrastructure, and the low synergy of agricultural technology development, which often leads to delays and high costs in the distribution process for local areas and the lack of food self-sufficiency. Eastern Indonesia covering all provinces in Sulawesi, Maluku and Papua Islands in 2014 has 3.7 million people living in poverty line. The population lives on an average income of Rp360,000.00/month [4].

The chili price spiked quite high toward the end of year until the beginning of the year to reach more than Rp100,000.00/kg, while at a certain price can fall below Rp10,000.00/kg. These seasonal price fluctuations occur almost every year. The spike in chili price is due to reduced supply, while demand is constant and continuous every day, even increasing in certain seasons. Fluctuations in the chili price due to seasonal production of chili, rain factor, production cost, and length of distribution channel [5].

Meanwhile, the price disparity between chili regions occurred because the center of chili production is concentrated in Java Island and the quality of infrastructure in other island is inadequate. It will be important to develop in Papua, and Maluku, where the areas are border regions, lagging and outermost by preventing uncertainty from the impact of price volatility. This will help in maintaining price stability and better price guarantees in the future, in order to make transparent and profitable trades for all market participants [6].

The varied and random fluctuations of chili contribute to the high volatility of prices in the market, so the price of chili is difficult to predict. Then the reason for price volatility will be a concern in recent years. Volatility is not determined by the price level, but the level of price variations on the market. Therefore, the chili prices increased in the market does not necessarily indicate the chili prices in the market is volatile. This is caused price volatility creates uncertainty which may threaten the performance of agricultural and have the negative impact on the welfare of farmers [7].

This study aims to conduct research on price volatility and suitability as forecasting model of cayenne pepper and red chili pepper in Papua and Maluku. It is caused, when there are fluctuations in the uncertainty of the price increase and occurs throughout the year on chili commodities can negatively affect both producers and consumers. In order to reduce the risk, and then analyze the future price volatility will help become a reference in policy making that impacts on another important/sensitive prices, purchasing power, and welfare. In this case also an analysis of the price correlation between cayenne pepper and red chili pepper in both provinces to provide an additional picture in recognizing the relationship of both commodities.

MATERIALS AND METHODS

This study used secondary time series data which is monthly data from January 2008 to December 2015. The collected data related to management design of chilies for Indonesia in 2017 and prices at the producer and consumer levels of cayenne pepper and red chili pepper in Papua and Maluku Provinces. The analysis steps perform by stationary test, selection the best Autoregressive Integrated Moving Average (ARIMA) model, heteroscedasticity and Autoregressive Conditional Heteroscedasticity (ARCH) effect tests, and final analysis of Autoregressive Conditional Heteroscedasticity (ARCH) and Generalized Autoregressive Conditional Heteroscedasticity (GARCH) method to find the suitable forecasting model with the purpose to know magnitude of future volatility. The method application of data analysis described details are as follows:

1. Stationary Test

Critical issues related to research using time series data are stationary. Stationary test performed to determine the time series data is not affected by time. Stationary test in this research performed by using the unit root test at the producer and consumer price variables. For the purpose of this test method is used Augmented Dickey-Fuller (ADF) [8].

Here are the model used as follows:

$\Delta AB_t = {}_0 + \partial_{1t} + \delta AB_{t-1} + \varepsilon_t$ .... (1)

$\Delta CD_t = {}_0 + \partial_{1t} + \delta CD_{t-1} + \varepsilon_t$ .... (2)

Description:

ΔAB_t = The difference operator for producer price,
ΔCD_t = The difference operator for consumer price,
AB_t = Variable of producer price in period t (Rp/kg),
CD_t = Variable of consumer price in period t (Rp/kg),
AB_{t-1} = Variable of producer price in the previous period (Rp/kg),
CD_{t-1} = Variable of consumer price in the previous period (Rp/kg),
t = Time variable,
∂_0 = Intercept/constants,
∂_{1t}, δ = Estimation coefficient,
ε_t = Factors of error term in the period t.

Hypothesis:

As for testing the stationary have criteria as follows:

If H_0 : $\delta = 0$, (time series data by the unit root test that is not stationary).
If H_1 : $\delta < 0$, (time series data by the unit root test that is stationary).

Testing criteria:

If ADF $t_{statistics}$ value > ADF test critical values of 10% level then accepts H_0, which means the time series data by the unit root test that is not stationary.

If ADF $t_{statistics}$ value < ADF test critical values of 10% level then reject H_0, which means the time series data by the unit root test that is stationary.

Stationary test performed first at the beginning level. If the data is stationary, it can be conducted to perform further testing. If the data is not stationary at the current level, then the solution is to conduct with non-stationary of difference process by performing stationary test data in the form of first or second differentiations.

2. Selection the Best ARIMA Model

The stationary random process sometimes cannot be adequately explained by the model of moving average or autoregressive, because the process contains both. Therefore the combination of these two models is called model of Autoregressive-Moving Average can be more effectively used. In this model, stationary series are the function of past values, present values, and errors past [9].

The general form of the model is as follows:

$Y_t = \beta_0 + \beta_1 Y_{t-1} + \ldots + \beta_p Y_{t-p} + e_t - a_1 e_{t-1} + \ldots a_q e_{t-q}$ .... (3)

Description:

Y_t = Value of series is stationary,
Y_{t-1}, Y_{t-p} = Past value of the corresponding series,
e_{t-1}, e_{t-q} = Past error,
e_t = Forecasting error,
$\beta_0, \beta_1, \beta_p, a_1, a_q$ = Constants or model coefficients.

A necessary condition for this model stationary is:

$$\beta_1 + \beta_1 + \ldots + \beta_p < 1$$

As before, p indicates the level of the autoregressive model, and q indicates the level of moving average model, so if the model using past values of the series and mistakes in the past, the model is denoted as (Autoregressive Moving Average) ARMA (1,1) to form the following equation:

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + e_t - a_1 e_{t-1}$$

If after the stationary test on prices variable at the producer and consumer levels has been stationary at the current level, then it leads integrated on ARIMA does not need to be explained. So the prediction models adequately described using a model of ARMA.

AR, MA and ARMA models previously discussed using assumption the time series data that has been analyzed is stationary. The mean and variance of time series data are constant and covariance unaffected by time. In fact, the more time series data are not stationary, so it must go through the process as much differencing d times in order to be stationary. If we use the time series data that has to process as much differencing d times for stationary and applied to the ARMA model (p, q), then this equation will be the ARIMA model (p, d, q). The notation is used to describe the process of differencing is the backward shift operator B, whose use is as follows:

$$BY_t = Y_{t-1} \quad \text{.......... (4)}$$

In the other words, the notation B mounted on the data that has the effect of shifting one period to the rear. Two application of B will shift, that data back to the two periods as follows:

$$B(BY_t) = B^2Y_t = Y_{t-2} \quad \text{.......... (5)}$$

The backward shift operator is very appropriate to describe the process of differencing. For example, if time series is not stationary, the series can be made closer to the stationary by the first distinction of sequence data is represented by symbols as follows:

First Differentiation

$$Y'_t = Y_t - Y_{t-1} \quad \text{.......... (6)}$$

By using the backward shift operator, the equation can be rewritten into:

$$Y'_t = Y_t - BY_t \quad \text{.......... (7)}$$

The first distinction is expressed by (1 - B), so the distinction second-order (ie first distinction from the previous first distinction) can also be obtained with the following steps:

Second Order Differentiation

$$\begin{aligned} Y'_t &= Y'_t - Y'_{t-1} \\ &= (Y_t - Y_{t-1}) - (Y_{t-1} - Y_{t-2}) \\ &= Y_t - 2Y_{t-1} + Y_{t-2} \\ &= (1 - 2B + B^2)Y_t \\ &= (1 - B)^2\, Y_t \end{aligned}$$

It should be noted that the second-order differentiation notation as $(1 - B)^2$. It is important to show the second-order differentiation is not the same as the second distinction by the notation $(1 - B)^2$. The purpose of calculating the distinction is to reach stationary and generally when there is a distinction d order to achieve stationarity can be written:

$$(1 - B)^d Y_t \quad \text{.......... (8)}$$

Because the models are the mix of AR (1) and MA models (1) through the process of differencing one time, then the ARIMA model (1,1,1) can be written as follows:

$$\underbrace{(1 - B)}_{\text{First differentiation}}\underbrace{(1 - \beta_1 B)}_{\text{AR (1)}}Y_t = \mu + \underbrace{(1 - a_1 B)}_{\text{MA (1)}}e_t \quad \text{.......... (9)}$$

Following the stationary test, the data that has been stationary at the producer and consumer levels, then the estimate or prediction ARIMA using trial error method. Selection of the best ARIMA model by looking at the significance of probability value, and Akaike Info Criterion (AIC), Schwarz Criterion (SIC) and Hannan-Quinn Criter (HQIC) values are the smallest. ARIMA model in the estimation procedure performed following the Box-Jenkins method [10].

3. Heteroscedasticity and ARCH Effect Tests

Before performing the test with ARCH/GARCH method, the first tested by heteroscedasticity and ARCH effect tests. Heteroscedasticity test performs to prove that the data used is heteroscedasticity. ARCH effect test (ARCH-Lagrange Multiplier) is used to ensure that the model is suitable for the data. ARCH effect test using ARIMA model [8].

The model used in this study as follows:

$$EF_t = w_0 + w_1 EF_{t-1} + \psi_1 EF_{\varepsilon t-1} + \varepsilon_t \quad \text{.......... (10)}$$

$GH_t = w_0 + w_1 GH_{t-1} + \psi_1 GH_{\varepsilon t-1} + \varepsilon_t$ .... (11)

Description:

EF_t = Producer prices in the period t (Rp/kg),
GH_t = Consumer prices in the period t (Rp/kg),
EF_{t-1} = Producer prices in the previous period (Rp/kg),
GH_{t-1} = Consumer prices in the previous period (Rp/kg),
$EF_{\varepsilon t-1}$ = Error variable of producer prices in the previous period (Rp/kg),
$GH_{\varepsilon t-1}$ = Error variable of consumer prices in the previous period (Rp/kg),
w_0 = Intercept/constants,
w_1, ψ_1 = Estimation coefficient.

Hypothesis:
As for testing the heteroscedasticity have criteria as follows:
If H_0 : Probability value of F-statistics > Confidence level of 10%, then the data is homoscedasticity.
If H_1 : Probability value of F-statistics < Confidence level of 10%, then the data is heteroscedasticity.
As for testing the ARCH effect have criteria as follows:
If H_0 : Probability value of LM test > Confidence level of 10%, then there are no ARCH effects.
If H_1 : Probability value of LM test < Confidence level of 10%, then there has ARCH effect.

If the heteroscedasticity and ARCH effect tests indicates rejection of the null hypothesis (H_0), then continue on the next stages that are the test of ARCH/GARCH method.

4. ARCH/GARCH Method

ARIMA becomes a widely used method in econometrics. This method requires some conditions to be processed that is the first, data must be stationary, either stationary in the mean or stationary in the variant. Second, the residual must have white noise properties which mean the residual must be uniformly distributed [11]. In development, using inflation data in the UK, it was found that residuals were not uniformly distributed, so the method of ARCH was established [12]. This method is able to resolve the occurrence of heteroscedasticity in time series data. Then, the ARCH model was refined to GARCH by adding variance effects on the previous lag [13].

The ARCH model was first developed by Engle in 1982 [14]. The ARCH model was refined by Bollerslev *et. al.* in 1994. Bollerslev model is known as the GARCH model. Then for the case of the relationship between risk and return is used GARCH in the mean introduced in 1987 by Engle, Lilien, and Robins. Since proposed by Engle in 1982 and Bollerslev in 1986, ARCH/GARCH model has been widely used to describe the behavior of time series for volatility, in particular on the data about stock prices, commodity prices, and index futures.

Equation ARCH/GARCH model used in this study are:

$\sigma^2_{PPt} = \alpha_0 - \alpha_1 \varepsilon^2_{PPt-1} + \beta_1 \sigma^2_{PPt-1} + \varepsilon_t$ .... (12)

$\sigma^2_{CPt} = \alpha_0 - \alpha_1 \varepsilon^2_{CPt-1} + \beta_1 \sigma^2_{CPt-1} + \varepsilon_t$ .... (13)

Description:

σ^2 = Response variable (bound) at the time of t or residual diversity of current period,
ε^2_{t-1} = ARCH tribe/volatility of the previous period,
σ^2_{t-1} = GARCH tribe/residual diversity of the previous period,
PP = Producer price,
CP = Consumer price,
α_0 = Intercept/constants,
α_1, β_1 = Estimation coefficient.

Due to the significance of these three components in the conditional variance, where the coefficients of α_0, α_1, and β_1 in the ARCH/GARCH model in the equation are significant at the confidence level of 10%, so the apparent clustering volatility is present in this model (Gujarati, 2004). The number of estimated coefficients $\alpha_1 + \beta_1$ on each model shows the volatility level. So the volatility can be referred by looking at the values of $\alpha_1 + \beta_1$. In this case, the value of α and β is the ARCH GARCH value. If the values of $\alpha_1 + \beta_1 < 1$ indicates low volatility happen, $\alpha_1 + \beta_1 = 1$ indicates high volatility happen and $\alpha_1 + \beta_1 > 1$ indicate extremely high volatility happen. If the sum value for the estimated coefficient almost or equal to 1, this shows evidence of volatility or it can be said there is tendency of volatility lasted for a long time or show the greater degree of volatility. If the sum value for the estimated coefficients greater than 1, indicating the occurrence of explosive series (large fluctuation in the data) so that the value deviates greater than the middle value [15].

5. Pearson Correlation

The analytical method used in data analysis is Pearson correlation coefficient. The correlation coefficient (r) is used to determine whether or not there is a relationship between two or more variables used in the study. Therefore correlation technique used is Pearson correlation of product moment with the following formula [16]:

$$r = \frac{n\sum XY - (\sum X)(\sum Y)}{\sqrt{[n\sum X^2 - (\sum X)^2]\,[n\sum Y^2 - (\sum Y)^2]}} \quad (14)$$

Description:

n = Number of respondents,

X = The total score obtained from all items of the variable X,

Y = The total score obtained from all items of the variable Y.

To determine the significance level of relationship between the two variables, it can be referred from the results of significant value. If the result of significant value is smaller than the confidence level of correlation (10%). Then there is a significant relationship and vice versa, if the significant value is greater than the confidence level of correlation then there is no significant relationship.

The correlation value ranges from 1 to -1, the value closer to 1 or -1 means the relationship between two variables is getting stronger. Conversely, if the value close to 0 means the relationship between two variables is getting weaker. A positive value indicates a one-way relationship (X rises, then Y rises) while a negative value shows an inverse relationship (X rises, then Y falls).

RESULTS AND DISCUSSION

1. Price Volatility of Chilies in Papua and Maluku

Uncertainty, or risk, plays an important role in price analysis of both the producer and consumer markets which is usually measured by volatility. Obviously, the volatility of an asset is not observable so that modeling will be necessary. Based on a constructed model, the volatility can be measured as well as be predicted. The prediction of volatility is crucial to determine the best price option and risk management (estimation for value at risk). Analysis of price volatility is used to indicate variation degree from the chili prices in Papua and Maluku. The analysis results were obtained through several stages of testing that are stationary test, selection the best oder of ARIMA model, heteroscedasticity and ARCH effect tests and the last volatility analysis through produce ARCH/GARCH equation model [17].

A. Stationary Test Data

The first step must be conducted in time series data analysis is stationary test data. The purposes are to check whether the data has a constant mean and variance. The test is performed to view stationary data by ADF method. The data are said to be stationary if the $t_{statistics}$ value < test critical value or the probability value < 10%. The following Table 1 shows the stationary test data of chili prices in Papua and Maluku.

Table 1. Stationary Test Data of Chili Prices in Papua and Maluku

Price	Stage	ADF Test	
		$t_{statistics}$	Prob
Cayenne Pepper in Papua			
Producer	Level	-3.89	0.00*
Consumer	1st Difference	-9.06	0.00*
Cayenne Pepper in Maluku			
Producer	Level	-3.17	0.00*
Consumer	1st Difference	-7.53	0.00*

Table 1. Stationary Test Data of Chili Prices in Papua and Maluku (Continue)

Price	Stage	ADF Test	
		$t_{statistics}$	Prob
Red Chili Pepper in Papua			
Producer	Level	-3.03	0.03*
Consumer	1st Difference	-11.75	0.00*
Red Chili Pepper in Maluku			
Producer	Level	-2.89	0.04*
Consumer	1st Difference	-3.96	0.00*

Note: *indicates the stationary test data conducted by ADF Test Statistics is significant at the confidence level of 10%; Test Critical Values of 10% level for each model is -2.58

The result of stationary test data conducted by ADF Test Statistics with aims to test the stationary or not of the data used. Based on the Table 1 stationary test data of cayenne pepper and red chili pepper for producer prices in Papua and Maluku has been stationary by looking from $t_{statistics}$ values (-3.89; -3.17; -3.03; -2.89) respectively < test critical values of 10% level (-2.58), and probability values (0.00; 0.00; 0.03; 0.04) respectively < 0.10 at the level stage. While stationary test data of cayenne pepper and red chili pepper for consumer prices in Papua and Maluku has been stationary by looking from $t_{statistics}$ values (-9.06; -7.53; -11.75; -3.96) respectively < test critical values of 10% level (-2.58), and probability values (0.00) < 0.10 at the 1st difference stage.

B. Selection the Best ARIMA

The next step before heteroscedasticity and ARCH effect tests is to form the most appropriate ARIMA model based on the tentative model. To know the parameters used have been significant, it can be tested statistically by using least square method [8]. Test results can be conducted by looking at the significance of probability value. If the probability of AR and MA orders are smaller than the predetermined level of confidence that is 10%, then the parameters shown are significant. Thus the selection of best ARIMA model by looking at the values of Akaike Info Criterion (AIC), Schwarz Criterion (SIC) and Hannan-Quinn Criter (HQIC) are the smallest. The following Table 2 shows the best selection results of ARIMA model.

Table 2. Selection the Best ARIMA of Chili Prices in Papua and Maluku

Price	Model	AIC	SIC	HQIC	Finding
Cayenne Pepper in Papua					
Producer	ARMA (2,0,0)	-3.90	-3.86	-3.86	*
Consumer	ARIMA (3,1,1)	-3.80	-3.64	-3.73	*
Cayenne Pepper in Maluku					
Producer	ARMA (1,0,1)	-3.84	-3.74	-3.80	*
Consumer	ARIMA (0,1,1)	-3.72	-3.64	-3.68	
Red Chili Pepper in Papua					
Producer	ARMA (1,0,0)	-3.84	-3.73	-3.79	*
Consumer	ARIMA (0,1,1)	-3.71	-3.63	-3.67	*
Red Chili Pepper in Maluku					
Producer	ARMA (0,0,2)	-3.28	-3.17	-3.24	*
Consumer	ARIMA (3,1,3)	-3.59	-3.37	-3.50	

Note: *indicates selection the best ARIMA by Least Square method for constants, AR and MA used in each equation is significant at the confidence level of 10%

Based on the Table 2, the results obtained that the order of ARMA (2,0,0); ARIMA (3,1,1); ARMA (1,0,1); ARMA (1,0,0); ARIMA (0,1,1); ARMA (0,0,2) are the best models for case of of cayenne pepper and red chili pepper in Papua and Maluku. Thus the best ARIMA model is required for the next steps to conduct the heteroscedasticity and ARCH effect tests. On the other side for the consumer prices of cayenne pepper and red chili pepper in Maluku with ARIMA (0,1,1); ARIMA (3,1,3) are not significant by looking at the significance of probability value in the selection of best ARIMA model. Because in this stage the probability value indicates the result does not pass, so the model cannot be used for the further analysis.

C. Heteroscedasticity and ARCH Effect Tests

After the best ARIMA model is obtained. It is necessary to test whether the chili prices in both provinces have heteroscedasticity case and also test whether there is ARCH effect, so it can be determined the volatility level which happened. Data can be said to have an unstable variance (heteroscedasticity occurs), if it has ARCH effect based on probability value < 0.10. The ARCH effect is related to the serialization of heteroscedasticity.

This becomes clear when there is deviation or volatility from particular variable, resulting in the pattern determined by several factors. As the name implies, ARCH means estimation by modeling a conditional variance. But unlike the classical assumption of Ordinary Least Square (OLS), the ARCH model assumes that residual variance at some point of times is the function of residual variance at another time point [8].Test results of heteroscedasticity and the existence of ARCH can be referred in the following Table 3.

Table 3. Heteroscedasticity and ARCH Effect Tests of Chili Prices in Papua and Maluku

Price	Statistics Test	Prob
Cayenne Pepper in Papua		
Producer	Heteroscedasticity White Test	0.00*
	ARCH LM Test	0.00*
Consumer	Heteroscedasticity White Test	0.00*
	ARCH LM Test	0.28
Cayenne Pepper in Maluku		
Producer	Heteroscedasticity White Test	0.00*
	ARCH LM Test	0.05*
Red Chili Pepper in Papua		
Producer	Heteroscedasticity White Test	0.03*
	ARCH LM Test	0.05*
Consumer	Heteroscedasticity White Test	0.00*
	ARCH LM Test	0.75
Red Chili Pepper in Maluku		
Producer	Heteroscedasticity White Test	0.00*
	ARCH LM Test	0.00*

Note: *indicates the Heteroscedasticity White and ARCH LM tests by Least Square method is significant at the confidence level of 10%

Based on the Table 3 show that all the prices are experiencing heteroscedasticity (the variance is not constant). This is because probability value (0.00; 0.00; 0.00; 0.03; 0.00; 0.00) respectively < 0.10. Meanwhile, the result of ARCH effect test states that the cayenne pepper and red chili pepper for producer prices in Papua and Maluku have ARCH effect with probability value (0.00; 0.05; 0.05; 0.00) respectively < 0.10. Furthermore, the equations have been eligible for heteroscedasticity and ARCH effect, so it is feasible to be applied further testing that is price volatility by ARCH/GARCH method. While ARCH effect test of cayenne pepper and red chili pepper for consumer prices in Papua is not significant because in this stage the probability value (0.28; 0.75) respectively > 0.10 that indicates the result does not pass, so the model cannot be used for the further analysis.

D. Volatility Equation

The existence of heteroscedasticity in producer price data indicates the occurrence of price volatility. The volatility test is based on the values of α and β from the formation of ARCH/GARCH model. The following Table 4 shows the volatility equation of chili prices in Papua and Maluku.

Table 4. Volatility Equation of Chili Prices in Papua and Maluku

Coefficient α and β	Prob	Volatility (α+β)
Producer Price of Cayenne Pepper in Papua		
α_0= 0.00	0.00*	
α_1= -0.06	0.05*	0.36
β_1= 0.43	0.00*	
Equation: $\sigma^2_{PPt} = 0.00 - 0.06\varepsilon^2_{PPt-1} + 0.43\,\sigma^2_{PPt-1}$		
Producer Price of Cayenne Pepper in Maluku		
α_0= 1.9E05	0.00*	
α_1= -0.08	0.00*	0.94
β_1= 1.03	0.00*	
Equation: $\sigma^2_{PPt} = 1.9E05 - 0.08\varepsilon^2_{PPt-1} + 1.03\,\sigma^2_{PPt-1}$		

Table 4. Volatility Equation of Chili Prices in Papua and Maluku (Continue)

Coefficient α and β	Prob	Volatility (α+β)
Producer Price of Red Chili Pepper in Papua		
α_0= 2.6E-05	0.00*	
α_1= -0.10	0.00*	0.92
β_1= 1.02	0.00*	

Equation: $\sigma^2_{PPt} = 2.6E05 - 0.10\varepsilon^2_{PPt-1} + 1.02\ \sigma^2_{PPt-1}$		
Producer Price of Red Chili Pepper in Maluku		
α_0= 1.6E05	0.06*	
α_1= -0.10	0.00*	0.92
β_1= 1.02	0.00*	
Equation: $\sigma^2_{PPt} = 1.6E05 - 0.10\varepsilon^2_{PPt-1} + 1.02\ \sigma^2_{PPt-1}$		

Note: *indicates the volatility equation by ARCH/GARCH method is significant at the confidence level of 10%

σ^2_{PPt-1} = Conditional variance from squared residual price producer at period -t

ε^2_{PPt-1} = Squared residual price producer at period $_{t-1}$

α = ARCH Coefficient

β = GARCH Coefficient

The conditional variance equation is used to calculate the volatility of time series data. Conditional variance is the calculation of future period from variance based on relevant information in the past. If the sum of $\alpha_1 + \beta_1$ is equal or more than the value of 1, then the volatility is also increasing continuously and settle [13]; [18].

From the results of Eviews 9.0 calculation in Table 4, the conditional variance shows that the intercept value, α_0 are small and positive values that is 0.00; 1.9E05; 2.6E-05; 1.6E05 respectively, while the coefficient of α_1 show the negative values that are -0.06; -0.08; -0.10; -0.10 respectively, and coefficient of β_1 show the positive values that are 0.43; 1.03; 1.02; 1.02 respectively. Due to the significance of these three components in the conditional variance, where the coefficients of α_0, α_1, and β_1 in the ARCH/GARCH model are significant at the confidence level of 10%, so the apparent clustering volatility is present in this model [19]. Volatility clustering is a situation when there is relatively high data variability in a period, it will happen the same trend in the next period and vice versa.

The heteroscedasticity of conditional variance can be formulated as a linear function of past squared errors. From these results, it can be interpreted that the coefficients of β_1, conditional variance, and significant value show that the volatility of this period is related to the volatility of previous period and also related to the square of error term (ε^2_{PPt-1}) in the previous period. This formulation is called Autoregressive Conditional Heteroscedasticity (ARCH) model [12].

Based on the Table 4 show the values of volatility in producer price by summing the coefficient of α_1 (-0.06; -0.08; -0.10; -0.10) respectively and coefficient of β_1 (0.43; 1.03; 1.02; 1.02) respectively at the price of chilies producer in Papua and Maluku with the volatility values reaches 0.36; 0.94; 0.92; 0.92 respectively. According to the measurement benchmark described in the chapter of the research method, if the sum less than 1, shows the price volatility of chilies producer in Papua and Maluku that occurs low volatility). Therefore the ARMA equation using time series data from January of 2008 until December of 2015 is also significant at the confidence level of 10% so it can be used as forecasting for the next period.

Low volatility interpreted that price changes occur only in certain periods of relatively short time. But if the sum of $\alpha_1 + \beta_1$ is equal or more than the value of 1 used to measure the volatility persistence, then volatility shocks will become real and occur continuously. Thus the implications are relatively difficult to make forecasting because of the uncertainty relatively high [18].

In the following sections will be explained thoroughly about the results of the objective analysis. This research has eight cases of observations analyzed for forecasting over the next period in 2016, there are producer prices of cayenne pepper and red chili pepper from both provinces experienced low volatility. Low volatility interpreted that price changes occur in certain periods of relatively short time. On the other side, the market operation (with the reference price) conducted by the government through Ministry of Trade is quite effective in suppressing price uncertainty for the consumer market, as evidenced by no case of observation that has experienced price volatility of cayenne pepper and red chili pepper in both provinces for next period in 2016.

2. Pearson Correlation

Correlation analysis is a statistical method used to determine the degree of strength or linear relationship between two or more variables. If the linear relationship is more real (straight line) that occurs, so the stronger or higher degree of straight line relationship between the two variables or more. The measure for the degree of straight line relationship is called the correlation coefficient. This correlation aims only as a real situation picture of the closeness about the relationship between the both commodities using the most recent year data (2016) which just released in July, 2017. Test results of Pearson correlation between cayenne pepper and red chili pepper can be referred in the following Table 5.

Table 5. Price Correlation of Chilies in Papua and Maluku

Price Correlation of Cayenne Pepper and Red Chili Pepper				
Province	Papua		Maluku	
	Producer	Consumer	Producer	Consumer
Papua	-.26	.16	-	-
Maluku	-	-	-.73*	-.06

Note: *indicates the price correlation test conducted by Pearson Correlation is significant at the confidence level of 10%; Number of observations for the research used are 12 data

Based on Table 5 following explanation of the price correlation between cayenne pepper and red chili pepper in both provinces are as follow:

1. Price Correlation of Chilies Producer in Papua

The market of cayenne pepper and red chili pepper for producer prices in Papua, there is no significant relationship, because the p-value (0.000) of both commodities obtained is greater than the significant level of 10% where the correlation value reached -0.26.

2. Price Correlation of Chilies Consumer in Papua

The market of cayenne pepper and red chili pepper for consumer prices in Papua, there is no significant relationship, because the p-value (0.000) of both commodities obtained is greater than the significant level of 10% where the correlation value reached 0.16.

3. Price Correlation of Chilies Producer in Maluku

The market of cayenne pepper and red chili pepper for producer prices in Maluku, there is a significant relationship, because the p-value (0.000) of both commodities obtained is smaller than the significant level of 10% with a high relationship where the correlation value reached -0.73.

4. Price Correlation of Chilies Consumer in Maluku

The market of cayenne pepper and red chili pepper for consumer prices in Maluku, there is no significant relationship, because the p-value (0.000) of both commodities obtained is greater than the significant level of 10% where the correlation value reached -0.06.

According to Aron et. al. (2013) correlational method or commonly also called the explanative method is a study to test the relationship between variables hypothesized, or there is a hypothesis to be tested the truth. The hypothesis to be obtained illustrates the relationship between two or more variables, to determine whether a variable is associated or not with another variable, or whether a variable is affected or caused by another variable or not. The selected variable is based on the constructed theory first so that the expected direction of the relationship can be assumed.

The coefficient value of negative correlation shows an inverse relationship, meaning that if the cayenne pepper raises the price, while the red chili will decrease the price. In the correlation with the value approaching 1 or -1 means the relationship between both variables is getting stronger. Conversely, if the value close to 0 means the relationship between the two variables is getting weaker. On the producer market for Maluku show that the relationship between both commodities has a high correlation. Furthermore, the correlation is supported a negative and high relationship means the greater value of cayenne pepper, then the value of red chili pepper will be smaller also with a high level of change.

While for the producer market in Papua and also the consumer markets in Papua and Maluku shows no significant relationship. In the following section, it is explained that in 2016 (using the original price data) there is only a price correlation between cayenne pepper and red chili pepper on the producer market for Maluku, whereas in the other markets there is no correlation between both commodities. This simply illustrates that the price changes experienced by each commodity namely cayenne pepper and red chili pepper in Papua and Maluku mean that in general there is no correlation because 3 of 4 markets for this case has no significant relationship.

CONCLUSIONS

The volatility appeared only on producer prices for cayenne pepper and red chili pepper in Papua and Maluku provinces with low volatility level. The market operation (with the reference price) conducted by the government through Ministry of Trade is quite effective in suppressing price uncertainty for the consumer market, as evidenced by no case of observation that has experienced price volatility of cayenne pepper and red chili pepper in both provinces for next period in 2016. Price correlation between cayenne pepper and red chili pepper on the producer market for Maluku province show a significant correlation. Furthermore, the correlation is supported a negative and high relationship. Conversely for the producer market in Papua Province and also the consumer markets in Papua and Maluku Provinces shows no significant relationship. In the future decision-making, synergy and cooperation between government as policy makers and farmers are needed to be more serious and responsible so that the orientation for developing agricultural is not only measured by the number of production targets. However, it should be measured through improving the welfare and bargaining power of farmers so that it becomes better and effective in preventing the threat of volatility. This is reflected in the applied of reference price set by the government is essential for preventing the volatility and protect consumer prices in order to meet the primary needs of strategic commodities in the market.

REFERENCES

1. Saptana, Agustin N. K., and Ar-Rozi, A. M. Kinerja Produksi dan Harga Komoditas Cabai. Laporan Akhir Analisis Kebijakan, Pusat Sosial Ekonomi dan Kebijakan Pertanian, Republik Indonesia, Bogor; 2012.
2. Bank of Indonesia. Pola Pembiayaan Usaha Kecil dan Menengah. Departemen Pengembangan Unit Mikro, Kecil, dan Menengah (UMKM), Republik Indonesia, Jakarta; 2015.
3. Central Bureau of Statistics. Statistik Harga Produsen dan Konsumen Komoditas Pertanian. Badan Pusat Statistik, Republik Indonesia, Jakarta; 2015.
4. Central Bureau of Statistics. Statistik Produksi, Konsumsi, dan Aktivitas Ekspor-Impor Komoditas Pertanian, serta Kemiskinan Penduduk. Badan Pusat Statistik, Republik Indonesia, Jakarta; 2016.
5. Farid, M., and Subekti, N. A. Tinjauan terhadap Produksi, Konsumsi, Distribusi, dan Dinamika Harga Cabai. Buletin Ilmiah Penelitian dan Pengembangan Perdagangan, Jakarta; 2012.
6. Irawan, B. Fluktuasi Harga, Transmisi Harga, dan Margin Pemasaran Sayuran dan Buah. Analisis Kebijakan Pertanian. Pusat Analisis Sosial Ekonomi dan Kebijakan Pertanian, Bogor, Republik Indonesia. 2007; 5 (4): 358-373.
7. World Bank. India Managing Price Risk in India's Liberalized Agriculture : Can Future Market Help. Commodity Division, United Nations Conference on Trade and Development, India; 1996.
8. Brooks, C. Introductory Econometrics For Finance Second Edition. Cambridge University Press, New York; 2008.
9. Muis, S. Peramalan Pergerakan Saham Dengan Pendekatan Model ARIMA, Single Index, dan Markowitz. Graha Ilmu, Yogyakarta; 2008.
10. Pertiwi, V. A. Analisis Volatilitas, Transmisi Harga, dan Volatilitas Spillover Bawang Merah (Allium ascolanium L.) di Provinsi Jawa Timur. Malang: Program Pasca Sarjana, Universitas Brawijaya, Republik Indonesia, Malang; 2013.
11. Box, G. E. P., and Jenkins, G. Time Series Analysis, Forecasting and Control. Holden-Day, San Francisco; 1970.
12. Engle, R. F. Autoregressive Conditional Heteroscedasticity with Variance Estimates of United Kingdom Inflation. Journal of Econometrica. 1982; 50 (4): 987-1007.
13. Bollerslev, T. Generalized Autoregressive Conditional Heteroscedasticity. Journal of Econometrics. 1986; 31 (3): 307-327.
14. Wang, P. Financial Econometrics Methods and Models. London: Routledge, London; 2003.
15. Lepetit. Price Transmission and Price Leadership in the EU Beef and Pork Meet Market. Workshop on Methods to Analyse Price Volatility. Institute for Prospective Technological Studies (IPTS), Join Research Center (JRC), European Commission, Spain; 2011.
16. Sugiyono. Memahami Penelitian Kualitatif. ALFABETA, Bandung; 2012.
17. Yuan, M. C. Time Series Analysis: Conditional Volatility Models. Taichung: Department of Finance, National Chung Hsing University, Taiwan, Taichung; 2013.
18. Rachev, S. T., Mitnik, S., Fabozzi, F. J., and Focardi, S. M. Financial Econometrics from Basics to Advanced Modeling Techniques. John Wiley & Son, Munich; 2007.
19. Gujarati, N. D. Dasar-Dasar Ekonometrika. Erlangga, Jakarta; 2006.
20. Aron, A., Coups, E. J., and Aron, E. N. Statistics for Psychology. Sixth Edition. Pearson Education, Inc, New Jersey; 2013.