



## Volatility and Market Integration of Spot-Forward Corn Price in Indonesia

Octaviana Helbawanti<sup>1\*</sup>, Masyhuri<sup>2</sup>

<sup>1</sup> Master Student of Agricultural Economics, Faculty of Agriculture, Universitas Gadjah Mada

<sup>2</sup> Faculty of Agriculture, Universitas Gadjah Mada

### Informasi Artikel

Sejarah artikel:

Diterima September 2018

Disetujui November 2018

Dipublikasikan Maret

2019

Keywords:

ARCH/GARCH,

Corn,

Forward,

Spot,

Volatility

### ABSTRACT

*This study aims to determine the volatility and market integration between the price of corn in the Indonesian spot market and futures market in the international market. The data used in this research is secondary data consisting of Indonesian corn spot price and corn forward price referring commodity exchange, Chicago. Data in the form of monthly time series in 2007 until 2016. ARCH / GARCH method is used to measure the volatility at spot and forward price, whereas the market integration of spot and forward corn is used Johansen Cointegration and Engel-Granger Causality method. The results show that spot and forward prices of corn occur high volatility. The best ARCH/GARCH model for spot price is GARCH (2,0) with the volatility value of 0,91 and for forward price is GARCH (2,0) with the volatility value of 1.12. It means that volatility of spot and forward influenced by the increase and fluctuations of spot and forward price two previous periods. Between the spot and forward market, there is market integration and a one-way causal relationship. The market integration indicates there is long-run relationship, while one way indicates the spot price effect on the forward price, not vice versa.*

© 2019 MediaTrend

Penulis korespondensi:

E-mail: [tesisoctavianah@gmail.com](mailto:tesisoctavianah@gmail.com)

DOI: <http://dx.doi.org/10.21107/mediatrend.v14i1.4379>

2460-7649 © 2019 MediaTrend. All rights reserved.

## INTRODUCTION

Corn is one of the most important commodities, considering that besides being the staple food of some regions in Indonesia, corn is also a major component of feed. The proportion of corn content in feed can reach about 50% compared to other materials. Indonesia corn import greater than export because of insufficient domestic production, specifically in feed industry. According to Revania, (2014), reasons why feed industry imports corn are different types of corn needed compared with local corn and poor marketing system. Feed industries deal with exporters from other countries in large quantities of corn. However, if using local corn should gather little by little from local farmers scattered in various regions.

Volatility or price fluctuation is long-run price movement where there is a risk of price changes. Price volatility is not only changes in price levels, but also the price fluctuations and the degree of variation over a given period. Charlebois, McCormick, & Juhasz, (2016) said that commodity volatility relates to unpredictability of market fundamentals, and retail price spikes arise when these phenomena occur. Pop, Rovinaru & Rovinaru, (2013) bring arguments that the volatility of prices remains a complex phenomenon have to live with and which can moderate only up to an extent. By adjusting market structures and specifying regulatory and fiscal policies we can try to limit it, but will not remove it on the whole.

Cobweb model explains the relationship between price and quantity (in this case that is production), so this model can be used to illustrate the state of the volatility of a product seen from the price. Price and quantity are described interconnected as a continuous and recurring chain. High prices will cause high production, then a lot of supply will result in low prices, and will lead to low production, and so on. Three models of cobweb are con-

vergent, divergent, and continuous (Viana, Hartono, & Waluyati, 2017).

The existence of commodity futures trading or commodity exchange becomes one of the choices of investors as it is one of the alternatives in diversifying asset portfolio. In cash markets, commodities are traded at spot prices, whereas commodity exchange use futures or forward prices. Futures and forward prices are formed from the agreement of producers and consumers on the exchange with certain requirements. Trade liberalization can encourage the transmission of the world and domestic corn prices. Indonesia as a country that implements an open economy, in this case as a net import of corn, it is necessary to know the correlation of domestic corn commodity market with international market.

Similar research related to the volatility of corn spot price volatility in Indonesia by Bachtiar, Chang, Anindita, & Mustadjab, (2014) that corn spot price in Indonesia is experiencing volatility using EGARCH that shows significant variance equation which indicates volatility. Volatility is an important risk factor in corn supply. Increased volatility shows an increased uncertainty on future prices that may affect farmers' well-being. ARCH/GARCH method is also implemented Carolina, Mulatsih & Anggraeni, (2016), local soybean prices are more volatile than imported soybeans. Domestic price fluctuations tend to follow the movement of soybean prices abroad.

The use of Johansen Cointegration method in previous research by Akbar & Rusgiyono, (2016) on six commodity market onion in Central Java reveals long-term relationship. Market becomes leader or causality relationship can be analyzed using Engle-Granger Causality. This also applied to research by Susanawati, Jamhari, Masyhuri & Dwidjono, (2015) i.e. the price on the consumer market affects the price in the producer's market

but the producer price does not affect the consumer price, resulting in a one-way relationship. Based on previous research methods, research on spot-forward price volatility and the relationship between the two prices need to be done to determine the level of price fluctuation or price volatility and the interrelations between the corn spot price in the domestic market with the corn forward price representing international corn market level.

**METHODS**

The data type used in this research is secondary data, monthly time series data from the year 2007 until 2016. The spot price and the forward price of corn are obtained from the Commodity Futures Trading Supervisory Agency (Bappebti). The spot price of corn Bappebti refers to Indonesia corn price, while the forward price of corn refers to the state of Chicago, the major commodity exchange of grain trading in United States.

**Volatility Analysis**

Time series financial data has a tendency to fluctuate rapidly over time so that the variance of errors always changes over time, hence there is usually heteroscedasticity. The Generalized Autoregressive Herterocedasticity (ARCH/GARCH) method is one of the most appropriate methods to overcome the problem of Herterocedasticity in measuring fluctuations or price volatility.

*a. Stationarity Test*

Stationary test is used to avoid the spurious regression. A data is considered to be stationary if mean and variance value are constant over time.

$H_0$ :  $\gamma = 0$  (has unit root)

$H_1$ :  $\gamma \neq 0$  (has no unit root)

1. If  $\tau >$  absolute value of ADF statistic, then  $H_0$  is accepted, meaning it has a unit root or not stationary.

2. If  $\tau <$  absolute value of ADF statistic, then  $H_0$  is rejected, meaning it has no root unit or stationary data.

*b. ARIMA model*

Autoregressive Moving Average (ARMA) is a combination of Autoregressive (AR) and Moving Average (MA) models with a common ARMA (p,q) form, so the ARMA model (p,q) becomes:

$$X_t = \phi_1 X_{t-1} + \dots + \phi_p X_{t-p} + \theta_1 \varepsilon_{t-1} + \dots + \theta_q \varepsilon_{t-q} + \varepsilon_t$$

$X_t$  is a variable value at time  $t$ ,  $X_{t-1}$ ,  $X_{t-2}$  is the value of past time series time  $t-1$ ,  $t-p$ , is the regression coefficient ( $i = 1, 2, \dots, p$ ),  $\varepsilon_t$  is the error value at time  $t$  and  $p$  is AR order.  $\varepsilon_t$ ,  $\varepsilon_{t-1}$ ,  $\varepsilon_{t-q}$  is the error value at time  $t$ ,  $t-1$ ,  $t-q$ .  $\theta_q$  is the regression coefficient ( $i = 1, 2, \dots, q$ ), and  $q$  is the MA order.

The data that is not stationary can be differentiated or differencing to stationary data. In the ARIMA model (p,d,q), the stationarity level is indicated by d notation.

*c. ARCH/GARCH model*

Heterocedasticity can be utilized in the formation of Generalized Autoregressive Conditional Heterokedasticity (GARCH) model. Model to estimate the non-constant residual was Autoregressive Conditional Heteroscedasticity (ARCH) by (Engle, 1982) and the model was developed by (Bollerslev, 1986), which included not only the residual effects of the previous period but also using previous residual variants period.

$$\sigma^2 hspot_t = K + \alpha_1 \varepsilon_{spot-t-1}^2 + \dots + \alpha_p \varepsilon_{spot-t-p}^2 + \beta_1 \sigma_{spot-t-1}^2 + \dots + \beta_q \sigma_{spot-t-q}^2 + \varepsilon_t$$

$$\sigma^2 hfor_t = K + \alpha_1 \varepsilon_{for-t-1}^2 + \dots + \alpha_p \varepsilon_{for-t-p}^2 + \beta_1 \sigma_{for-t-1}^2 + \dots + \beta_q \sigma_{for-t-q}^2 + \varepsilon_t$$

where  $\sigma^2 hspot_t$  is dependent variable at time  $t$ /conditional variance of squared residual corn spot price at time  $t$ ,  $\sigma^2 hfor_t$  = dependent variable at time  $t$ / conditional variance of squared residual corn forward price at time  $t$ ,  $K$  = constant variance,  $\alpha_1, \dots, \alpha_p$  = estimated p-order coefficients,  $\beta_1, \dots$

$\beta_q$  = estimated q-order coefficients,  $\epsilon^2_{spott-p}$  = ARCH/squared residuals corn spot price in the previous period,  $\epsilon^2_{fort-p}$  = ARCH/squared residuals corn forward price in the previous period,  $\sigma^2_{spott-q}$  = GARCH / conditional variance spot price of corn previous period,  $\sigma^2_{fort-q}$  = GARCH/conditional variance corn forward price of previous period

**d. Heterocedasticity Test**

Heterocedasticity test is required using ARCH-LM Test. If probability of Chi-square value is not significant it means constant variance of error.

**Market Integration**

**Johansen Cointegration Test**

The method to test cointegration is Johansen-Juselius (JJ) to see the amount of cointegration. The test used to determine the number of cointegration vectors (r) is by *trace test* and *maximum eigenvalue test*. Test (*trace test*,  $\lambda_{trace}$  is a likelihood ratio test to determine the most co-integration vector c, by using cointegration matrix test;

$$\lambda_{trace}(r) = T \sum_{t=r+1}^p Ln(1 - \lambda_t)$$

The maximum eigenvalue test (*Max Eigen Test*) to test the relevance of column r + 1 in  $\Pi$  using the equation:  $\epsilon_r = -T Ln(1 - \lambda_{r+1})$

If the critical value of  $\alpha$  is greater than the Trace statistic and Max Eigen statistics it means there is cointegration.

**Granger Causality Test**

Granger Causality test can see the direction of causality relationship. Causality can be two-way (reciprocal) or unidirectional. The Granger Causality test model is:

$$\Delta Spot_t = \sum_{j=1}^m \alpha_j \Delta Spot_{t-j} + \sum_{j=1}^m b_j \Delta For_{t-j} + \epsilon_t$$

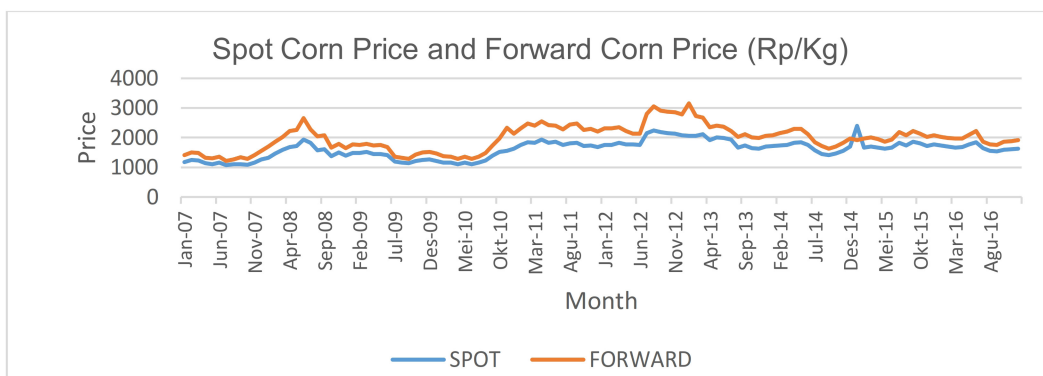
$$\Delta For_t = \sum_{j=1}^m c_j \Delta For_{t-j} + \sum_{j=1}^m d_j \Delta Spot_{t-j} + \epsilon_t$$

$Spot_{t-j}$  and  $For_{t-j}$  are the lag of the spot price variable and forward price variable, t is the time, and  $\epsilon_t$  is the error term.

**RESULTS AND DISCUSSION**

**Spot and Forward Corn Price Volatility**

Corn producers in Indonesia get benefits when corn prices at the international level increasing if domestic corn markets are integrated with the international corn market, in this case corn forward price in commodity exchange market. Spot and forward corn price fluctuation is depicted in Figure 1.



**Figure 1. Spot and Forward Corn Price Fluctuation**

Source : Bappebti, 2017

The Augmented Dickey-Fuller test (ADF) is used in this research. If the statistical value of ADF > critical value t MacKinnon at = 1%,  $\alpha = 5\%$ , and  $\alpha = 10\%$ , then the data stationary. The result Table 1, the ADF test shows the variable of spot and forward price at first difference level.

From Table 3, the ARCH/GARCH best model in Indonesian corn spot price and corn forward price in international market are GARCH (2.0) meaning there is ARCH element or squared residual as much as two previous periods that affects the price volatility.

**Table 1**  
**The Stationerity Test Results of Spot and Forward Corn Price**

Variable	ADF Statistic	
	Level	First Difference
spot_corn	-2,41	-11.94***
forward_corn	-2.17	-10.00***

Source : Secondary Data Analysis, 2017

Notes :

- \*\*\* : 1% significance level
- \*\* : 5% significance level
- \* : 10% significance level

The best model ARIMA has significance probability less than 1%. Corn spot price is obtained by ARIMA (0,1,3) or determined by Moving Average model level 3 or MA (3). There are lags of spot price three previous periods affecting the predicted spot corn price in period t. ARIMA best models for corn forward price is ARIMA (4,1,2) that consists of AR (4) and MA (2). The price prediction at time t is determined by the 4 of Autoregressive level or AR (4) i.e., there is the value of the variable forward price of corn 4 previous periods and the Moving Average of 2 or MA (2) i.e. the 2 previous periods of residual.

Selected ARCH/GARCH model must be free from autocorrelation and heteroscedasticity. If correlogram shows Prob. value > significance level  $\alpha = 0.05$  so that H0 is rejected, meaning there is no autocorrelation and heteroscedasticity. Heteroskedasticity also can be seen using ARCH LM Test. Musunuru, (2014) explains that ARCH LM test for conditional heteroscedasticity indicates strong presence of ARCH structure, which further confirms the suitability of GARCH models in examining the volatility dynamics of commodity.

**Table 2**  
**The Best ARIMA Models for Spot and Forward Corn Price**

Variable	ARIMA Model	AIC	SC	R-Squared
spot_corn	(0,1,3)***	1.0391	0.9926	0.4592
forward_corn	(4,1,2)***	1.0045	0.9333	0.5814

Source : Secondary Data Analysis, 2017

Notes :

- \*\*\* : 1% significance level
- \*\* : 5% significance level
- \* : 10% significance level

**Table 3**  
**The ARCH-LM Test Results**

Variable	GARCH Model	ARCH LM Test			
		F-Statistic	Prob. F	Obs*R-squared	Prob. Chi-Square
spot_corn	GARCH(2,0)	2.146	0.098	6.307	0.098
forward_corn	GARCH(2,0)	3.282	0.073	3.246	0.072

Source : Secondary Data Analysis, 2017

(Lepetit, 2011) classifies the level of volatility based on the number of  $\alpha + \beta$ . If  $\alpha + \beta = 1$  or  $\alpha + \beta > 1$  then volatility is classified as high volatility, whereas if  $\alpha + \beta < 1$  then it can be classified as low volatility. The results of ARCH LM Test are shown in Table 3. Chi-square probability value greater than the alpha value ( $\alpha = 5\%$ ) means that model does not contain heteroskedasticity problem, then be used to analyze volatility.

ket will be an important insight into market integration for traders. The degree of market integration will determine how large producers and consumers benefit from commodity price movements. The market integration will determine the strength or weakness of the domestic market in response to changes in the international market. The domestic market is integrated with the international market indicated by how

**Tabel 4**  
**Spot and Forward Corn Price Volatility**

Variable	Variance Equation	$\alpha + \beta$
spot_corn	$\sigma^2 h_{spot_t} = 0.004 + 0.608\varepsilon_{spot_{t-1}}^2 + 0.303\varepsilon_{spot_{t-2}}^2 + \varepsilon_t$	0.91
forward_corn	$\sigma^2 h_{for_t} = 0.003 + 1.033\varepsilon_{for_{t-1}}^2 + 0.089\varepsilon_{for_{t-2}}^2 + \varepsilon_t$	1.12

Sumber : Analisis data sekunder, 2017

The corn spot price volatility (0.91) and the forward price (1.12) tend to be high volatility causing several implications. The high volatility lead the increase of the risk and fluctuation of the price. The price can not be predicted confidently so that become problems for industry and other corn consumers. The rapid change of price causes cost for industry if can not attain affordable price of raw material. In this case, feed industry will be disrupted by price fluctuation in obtaining continuity of corn supply. Investors or traders in commodity exchange market will decrease their transaction or investment because high risk in returns. The spike in price also contributes high speculation resulting market can not be efficient because of high uncertainty.

The price volatility of corn commodities is a risk to both of producers and consumers of commodity. The international price shocks transmitted to the domestic mar-

ket will be an important insight into market integration for traders. The degree of market integration will determine how large producers and consumers benefit from commodity price movements. The market integration will determine the strength or weakness of the domestic market in response to changes in the international market. The domestic market is integrated with the international market indicated by how

much the increase in international prices is reflected in the rise of domestic price. Corn in Indonesia is mostly for feed industry obtained by imported corn. The feed industry as the biggest corn consumer requires corn raw material of horse's dent corn type (*Zea mays indentata*), while corn in Indonesia is dominated by pearl corn type (*Zea mays indurata*). According to Utomo, (2012) high imports will disrupt the corn price stability in the country as the price of corn in the country may decrease. Ministry of Trade claims that production of corn spread in almost all areas of Indonesia with a distribution system that has not been well operated and the lack of connections with farmers may be causing obstacles for industry to cover the shortage of corn supply from local production. During the harvest season (generally January-March), the feed industry warehouse is estimated to only absorb 60% of the national

production. Moreover, the quality of corn produced outside the harvest period which can not be absorbed by warehouse, may decline due to weather factor.

Volatility occurs not only in Indonesian corn commodities but also in international markets. Based on Mugera, (2015), the United States is one of the largest corn producer, besides the United States is a producer and consumer of biofuels (ethanol). In 2007 the regulation of The Energy Policy Act (EPAAct) raises the minimum standard of ethanol production. This has an impact on demand for corn, ethanol production capacity and corn for fuels. The turmoil of corn demand and supply in the U.S. for biofuels, feed, and food is one of the causes of fluctuations in the price of corn. Ethanol production in the United States is highly dependent on the availability and price of world corn.

**Market Integration**

*Johansen Cointegration Test*

From Table 5, the value of Trace Statistic and Max Eigen Statistic Value greater than Critical Value at 5% significant level. Therefore, corn spot and forward price have significant relationship.

for the analysis of long-run relationship of the prices to be plausible.

*Granger Causality Test*

The Granger Causality test results in Table 6. show one-way relationship. The null hypothesis with probability smaller than 5% significance level is corn spot price affects corn forward price.

Integration between two markets give several implications in corn trading. Indonesia needs to suffice shortage by importing corn from other countries, therefore should be aware with the price changes and be able to get the corn price information in international market completely to make right decisions. From causality test, there is availability of corn market in Indonesia giving impact to the international market. This is benefit for Indonesia as top ten world corn exporter to expand the domestic corn to international market. When the international price rise, Indonesia can expand corn export to gain benefits but when the international price low, Indonesia able to choose affordable price from certain countries so the industry can increase profit. The market integration implies that the trade should be continued in the long

**Table 5**  
**Rank Test of Trace and Maximum Eigenvalue of Johansen Cointegration Test**  
**Spot and Forward Corn Price**

Rank Test	Statistic Value	0.05	
		Critical Value	Prob.**
Trace	22.47160	15.49471	0.0038
Max- Eigenvalue	17.42882	14.26460	0.0153

Source : Secondary Data Analysis, 2017

Between Indonesia corn spot market and international commodity exchange market there is long-run integration. Cointegration between two markets indicates changes in one market will be followed by another market. Spot and forward corn price are well integrated and price fluctuation signals are transferred. Beag & Singla, (2014) states that the presence of at least one cointegrating relationship is necessary

run and each market receive benefits if the information flows very well therefore the commodity can be delivered or traded properly.

The development of prices in international markets, especially the forward prices in the commodity exchanges market is determined by corn supply from Indonesia because Indonesia is one of the largest corn producers in the world in the eighth

**Table 6**  
**Granger Causality Test Spot and Forward Corn Price**

Null Hypothesis:	F-Statistic	Prob.
FORWARD does not Granger Cause SPOT	6.76400	0.0003***
SPOT does not Granger Cause FORWARD	0.38612	0.7632 <sup>NS</sup>

Source : Secondary Data Analysis, 2017

Notes :

- \*\*\* : 1% significance level
- \*\* : 5% significance level
- \* : 10% significance level

rank and has been able to export corn products. Price in the commodity exchanges market cannot affect the price of Indonesian corn. This shows that trading in commodity exchange market in Indonesia, especially corn commodity has not developed yet. The multilateral transactions are still low, therefore the price of Indonesian corn is less competitive and not yet a reference price. The lack of knowledge on traders in commodity trading because of the risk of speculators, causing traders prefer conventional transactions in the spot market. The type of forward price in a stock is a risky price because there is no guarantee of payment at the beginning of the agreement. In other hand, futures price has lower risk because there is delivery payment at the beginning of the agreement. According to Haase, S Zimmermann & Zimmermann, (2016) which studies do find effects of speculation, they predominantly identify reinforcing price effects, but indeterminate effects on returns and volatility.

## CONCLUSIONS AND RECOMMENDATIONS

Both of spot and forward price of corn are high volatility. The high volatility spot price indicates high fluctuation in supply-demand of domestic corn market. There is usage competition of corn, for food and feed. High volatility in forward prices may indicate a risk of speculation on the exchange and the development of

ethanol in United States, therefore food, feed, and biofuel competition. From the cointegration test results, there is long-run integration of the spot and forward with one-way relationship. The spot price affects on the forward price, not vice versa.

In order to become a reference price, Indonesia needs to increase commodity transactions on commodity exchanges, especially multilateral transaction. To reduce the price risk on the exchange, futures prices better to be used in transactions. Socialization to corn farmers, traders, corn processing industries and institutions involved in corn marketing about commodity exchange to obtain favorable prices and potential customers. In addition, to reduce the dependence of corn imports, Indonesian corn farmers are expected to plant corn that is suitable with the type of corn for the feed industry. (Sumaryanto, 2009) explains to maintain price stability and keep food prices at an affordable point by consumers, government policy is needed. In order to obtain an price stabilization policy and to increase the effectiveness of the price stabilization program, complete information on food price behavior including volatility is required because it is useful for formulating more effective anticipatory measures and price volatility is closely linked to the risks and uncertainties faced in decision making.

## REFERENCES

Akbar, R. A., & Rusgiyono, A. (2016).



- Analisis Integrasi Pasar Bawang Merah Menggunakan Metode Vector Error Correction Model (VECM) (Studi Kasus: Harga Bawang Merah di Provinsi Jawa Tengah). *Jurnal Gaussian*, 5(4), 811–820.
- Bachtiar, R. R., Chang, W., Anindita, R., & Mustadjab, M. (2014). Supply Response and Corn Price Volatility in Indonesia. *Greener Journal of Business and Management Studies*, 4(3), 58–69.
- Beag, F. A., & Singla, N. (2014). Cointegration, Causality and Impulse Response Analysis in Major Apple Markets of India. *Agricultural Economics Research Review*, 27(2), 289. <https://doi.org/10.5958/0974-0279.2014.00032.9>
- Bollerslev, T. (1986). Generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics*, 31(3), 307–327.
- Carolina, R. A., Mulatsih, S., & Anggraeni, L. (2016). Analisis Volatilitas Harga dan Integrasi Pasar Kedelai Indonesia dengan Pasar Kedelai Dunia. *Jurnal Agro Ekonomi*, 34(1), 47–66.
- Charlebois, S., McCormick, M., & Juhasz, M. (2016). Meat consumption and higher prices. *British Food Journal*, 118(9), 2251–2270. Retrieved from <http://www.emeraldinsight.com/doi/10.1108/BFJ-03-2016-0121>
- Engle, R. F. (1982). Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. *Econometrica*, 50(4), 987–1008.
- Haase, M., S Zimmermann, Y., & Zimmermann, H. (2016). The impact of speculation on commodity futures markets – A review of the findings of 100 empirical studies. *Journal of Commodity Markets*, 3(1), 1–15. Retrieved from <http://dx.doi.org/10.1016/j.jcomm.2016.07.006>
- Lepetit, I. P. (2011). *Price Volatility and Price Leadership in the EU Beef and Pork Meat Market*. Spain: Springer Science.
- Mugera, H. K. (2015). *Commodity Price Volatility : Causes , Effects and Implications*. Athesina Studiorum Universitas.
- Musunuru, N. (2014). Modeling Price Volatility Linkages between Corn and Wheat: A Multivariate GARCH Estimation. *International Advances in Economic Research*, 20(3), 269–280.
- Pop, L. N., Rovinaru, F., & Rovinaru, M. (2013). Commodity price volatility during and after the economic crisis-implications for Romania. *South East European Journal of Economics and Business*, 8(1), 45–52.
- Revania, L. (2014). Analisis faktor-faktor yang mempengaruhi impor jagung di Indonesia tahun 1982 – 2012. *Journal of Economics and Policy*, 7(1), 102–112.
- Sumaryanto. (2009). Analisis Volatilitas Harga Eceran beberapa Komoditas Pangan Utama dengan Model ARCH/GARCH. *Jurnal Agro Ekonomi*, 27(2), 135–163.
- Susanawati, S., Jamhari, J., Masyhuri, M., & Dwidjono, D. (2015). Integrasi Pasar Bawang Merah di Kabupaten Nganjuk (Pendekatan Kointegrasi Engle-Granger). *AGRARIS: Journal of Agribusiness and Rural Development Research*, 1(1), 43–51. Retrieved from <http://journal.umy.ac.id/index.php/ag/article/view/1152>
- Utomo, S. (2012). Dampak Impor Dan Ekspor Jagung Terhadap Produktivitas Jagung Di Indonesia. *Jurnal Etikonomi*, 11(2), 158–179.
- Viana, C. D. N., Hartono, S., & Waluyati, L. R. (2017). Volatility Analysis on Producer Price of Price of Red Pepper and Cayenne Pepper in West Java Province Indonesia. *Jurnal Agro Ekonomi*, 28(2), 157–169.