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THE INFLUENCE OF COCOA PRICE VOLATILITY TO INDONESIA COCOA EXPORT

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Abstract: Production or supply of domestic cocoa cannot fulfil the demand for cocoa in domestic and international markets. Furthermore, there were many old cocoa plants, damaged, unproductive and attacked by pests and diseases with mild, medium to serious condition in 2008. Cocoa production still depends on the weather, which can result in the undetermined change of cocoa price. This problem will fluctuate and if this happens continuously then volatility of cocoa price tends to be high. This research uses historical volatility method to measure the price volatility of cocoa in 2007 until 2016. It indicates that volatility of Indonesia cocoa price is high. In order to determine whether or not volatility of cocoa price affects Indonesian cocoa's exports, stationary tests, cointegration tests and Error Correction Model (ECM) are used. Its result shows that cocoa price volatility and cocoa exports variable are cointegrated and they have negative relation both in the short term and long term. In addition, the variables of volatility cocoa and cocoa exports in Indonesia are out of equilibrium.

Keywords*: Fluctuation, Price Volatility, Export, Historical Volatility, ECM*

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INTRODUCTION

The economic development in Indonesia is influenced by the contribution of the various sectors, one of them is agriculture sector. Based on data obtained from the Central Bureau of Statistics (2016), the agricultural sector contributes 13.41% in the average distribution of the Gross Domestic Product (GDP) in 2012-2015. The contribution value of the agricultural sector can be increased if there is an increase in the production of agricultural commodity and an increase in export demand for agricultural commodities.

The increasing of agricultural commodity demand caused by population growth has increased over time. The demand occurs at domestic and foreign. Agricultural commodities are mainstay in export demand is plantation sub-sector. The upward trend in the demand of plantation commodities occur in both quantity and quality. One of main plantations for the economic is cocoa plants. Cocoa business can help increase the job opportunities, as a source of national income, as well improving the welfare of cocoa farmers. In addition, cocoa also serves to encourage the development of agro-industry area in Indonesia. Currently, Indonesia is the third of world's largest supplier of cocoa products after Pantai Gading and Ghana (Rukmana and Herdi, 2016). However, the value of cocoa exports is still dominated by raw cocoa beans, so that the cocoa commodity added value should be increased.

The growth of world cocoa demand is currently around 4 million tonnes per year. Data International Cocoa and Coffee Organization (ICCO) in Rukmana and Herdi (2016), during the five years (2008-2012), cocoa demand grew at an average 5% per year. Based on these data cocoa is still great potential to be developed. On the export trade lanes such as cocoa export activity is

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influenced by world cocoa demand and cocoa prices in the international market. Market shift toward a free market will provide impact on the mechanisms of agricultural commodity markets, particularly in the domestic market. The impact is the fluctuating price dynamics and direction of trade policy (Rachman, 2003).

Aklimawati and Wahyudi (2013), explains that the price fluctuations is a result of upward and downward prices caused by demand and supply. Meanwhile, the price volatility is a statistical measurement of the degree of price variation in one period to the next. It is also in linewith the explanation of Anindita and Baladina (2017) that the price volatility is change in price or price variations giving risks and uncertainties. The volatility indicates how much and how quickly a value changes over time. Sumaryanto (2009), explains that the price of cocoa tends to have a high volatility with a relative incisive price fluctuations from time to time.

This research aims are to determine the price volatility of cocoa and the influence price volatility of cocoa to cocoa exports in Indonesia.

RESEARCH METHODS

Data collection method in this research is using secondary data time series of monthly cocoa price data and the annual data of cocoa export Indonesia in 2007-2016. Sources of data in this research are the Directorate General of Plantation, Commodity Futures Trading Regulatory Agency (BAPPEBTI).

1. Measurement of Cacao Price Volatility

The measurement of volatility in this research uses historical volatility method that measures price fluctuations over time. Historical volatility is calculating the mean and standard deviation of time series data research. Junaidi (2013), the greater the standard deviation value means higher price volatility so that prices tend to fluctuate. Ilmiyono (2017), high volatility indicates that prices change (up and down) with a wide range variation. Meanwhile, low volatility happens if prices rarely change or tend to be constant. This is a model for measuring the mean and standard deviation of price movements:

Mean: $m = \left(\frac{1}{n}\right) \sum_{i=1}^{n} X$ (1)

Standard Deviation:

$$\sigma = \sqrt{\frac{1}{n-1} \sum_{i=0}^{n} (m - X)^2} \quad (2)$$

Description:
σ = standard deviation or Historical Volatility
n = specified period of time
m = mean (rata-rata)
Xi = changes of price

2. The Influence of Cocoa Price Volatility to Cocoa Exports in Indonesia

A. Stationary Test (*Unit Root Test*)

Stationary test is used to determine the time series data has an average and variance are constant or not. If the time series data on average and variance are not constant, so the data is not stationary and like the other ways. Stationary test data in this research use the Augmented Dicky Fuller (ADF), which can be showed in the following equation:

$$Q_t = b_0 + b_1 P_v + U_t \quad (3)$$

Description:
Q_t = variable of cocoa exports at a time to t
b_0 = constant
b_1 = coefficient of regression
P_v = variable of cocoa price volatility
U_t = error regression

Hypothesis used is:

a. If H_0: $b_1 = 0$,(time series is not stationary)
b. If H_a: $b_1 < 0$,(time series is stationary)

Criteria Testing:

a. If the probability values > alpha value or $DF_{statistics} < DF_{table}$, so the time series data is not stationary
b. If a probability value < value alpha or $DF_{statistics} > DF_{table}$, so the time series data is stationary

B. Cointegration Test

Cointegration test was conducted to test if there is a long-term relationship between the variables of cocoa price volatility and cocoa exports in Indonesia. Cointegration test can be regressed residual volatility variable of cocoa price and cocoa exports. Regression model used is as follows:

$$S_t = \alpha + \alpha_1 P_t + e_t \quad (4)$$

Description:
S_t = the dependent variable (exports) at time to t
α = constant
α_1 = regression coefficient

P_t = independent variables (price volatility) at a time to t

e_t = Error term

Hypothesis used is:

a. If $H_{0:}$ $\alpha_1 = 0$, (not cointegrated)

b. If $H_{a:}$ $\alpha_1 < 0$, (cointegrated)

Criteria for decision-making are as following:

a. If the value of probability > alpha value or $ADF_{statistic} < ADF_{table}$, so the variable of cocoa price volatility and cocoa export are not cointegrated

If a probability value < value alpha or $ADF_{statistics} > ADF_{table}$, so the variable of cocoa price volatility and cocoa export are cointegrated.

C. Error Correction Model (ECM)

Error correction Model (ECM) is a technique for correcting short-term imbalance towards long-term equilibrium which explain the relationship between the dependent variable with the independent variable at the present time and past time. Equation of Error Correction Model is as follows:

$$\Delta PQ_t = b_0 + b_1 \Delta P_{vt} + b2EC_{t-1} \quad (5)$$

Description:

ΔPQ_t = Change of cocoa export

ΔP_{vt} = Change of cocoa price volatility

b_0 = Constant

b_1, b_2 = Coefficient

EC_{t-1} = Error Correction Term

Statistically, ECT is significant with probability value which is less than 5%, then the model specification used will be significant. The coefficient of short term and ECM model equations are presented by coefficient b_1.

RESULTS AND DISCUSSION

1. Overview

Cocoa is one of plants that can be used for various products of economic value. The many benefits of cocoa cause increased demand for cocoa, to fulfil these needs must be followed by an increase in the amount of cocoa production. However, the amount of cocoa production in Indonesia in 2001-2016 tends to increase as many as 1.82% in average per year. An increase in the development of production cocoa id not as many as the increases of cocoa's cultivation area. Although in 2001-2016, the average growth of cocoa area was increased by 5.11% per year.

The largest increase of cocoa area occurred in 2012 which was 1.774.463 hectares. It happened because because in 2009-2011 the Ministry of Agriculture through the Directorate General of Plantation Program launched the National Movement Cocoa Production and Quality Improvement (GERNAS). The program referred to the identification results in 2008 that there were a lot of cocoa plants were old cocoa plants, damaged, unproductive and attacked by pests and diseases with mild, medium to serious condition requiring renovation, rehabilitation and intensification (Ministry of Agriculture, 2012).

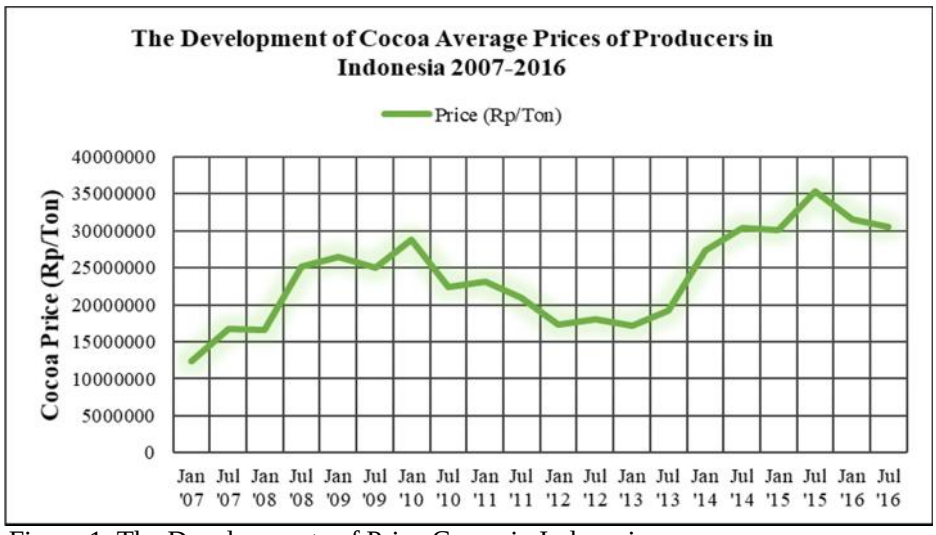

Figure 1. The Developments of Price Cocoa in Indonesia
Source: Commodity Futures Trading Regulatory Agency (BAPPEBTI) 2018

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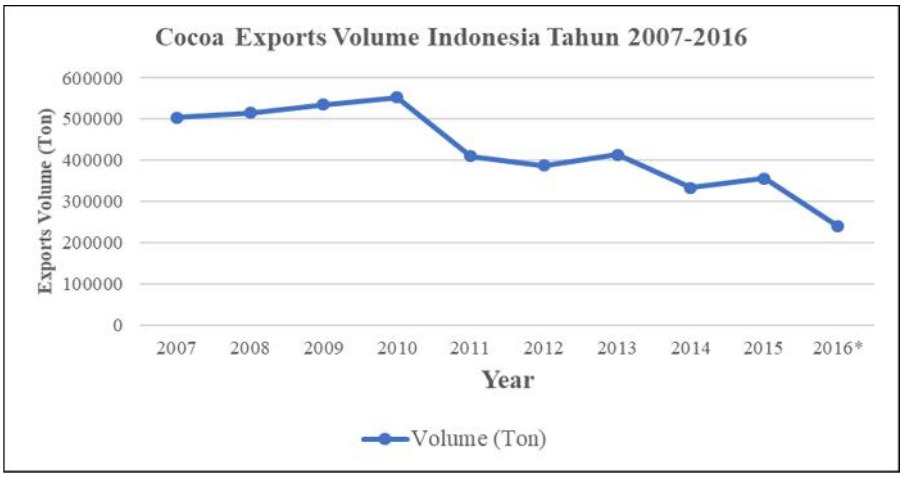
The development of the average price of cocoa in the beans cocoa in Indonesia in the period 2007-2016 at the producer level also fluctuated. Cocoa price developments can be seen in Figure 1.

Movement cocoa prices at the producer level always fluctuate or price changes up and down every month. Anindita (2004) indicates that price fluctuations are usually influenced by the imbalance between supply and demand, imports, and the number of the previous supplies harvest. This can occur because of the nature of agricultural products influenced by climate. Agricultural products such as fruits and vegetables, seasonal variation is also influenced by the state of perishable and rotten (perishable) agricultural product. Besides influenced by supply and demand factors, domestic commodity prices can also be influenced by commodity prices in the international market. On the free trade regime, domestic commodity prices will move to follow the international price. Therefore, the development of the cocoa export volume becomes volatile. The development of the export volume of dry cocoa beans in Indonesia in 2007-2016 can be seen in Figure 2, as follows.



Description: *) Temporary Figures
Figure 2. The developments of Cocoa Exports Volume in Indonesia
Source: Directorate General of Plantation 2017 (Processed Data)

The development of the domestic cocoa export volume in the period 2007-2016 shows the fluctuated pattern and tended to decrease. Fluctuated movement of export volume can occur as the level of production, cultivation area and cocoa prices are also fluctuated. On the other hand, they have a close relationship and possibly affect each other.

2. Analysis of Price Volatility

Cocoa prices are used to measure the volatility of the price of cocoa is the monthly price during the ten years from 2007 - 2016 at the producer level of dry seeds in Indonesia. The development of the 2007 - 2016 cocoa price volatility can be seen in Figure 3.

According to the graph, it can be seen that the volatility of the price of cocoa Indonesia at the

producer level since 2007 to 2016 has fluctuated or volatile price. In consequence, farmers need to face high risks in doing business. In 2008 the percentage of cocoa price volatility is highest at the level of cocoa producers in Indonesian. It is caused by a lot of old cocoa plants, damaged, unproductive and exposed to pests and diseases with an attack rate of mild, medium to serious condition. So, it will impact on the production of cocoa which may impact on the domestic cocoa price volatility. This allows domestic cocoa price volatility is high.

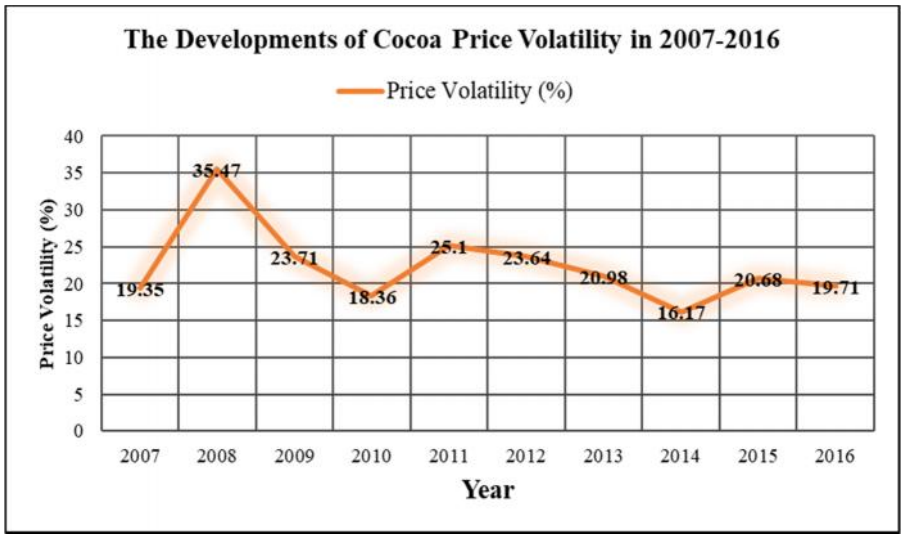


Figure 3. The developments of Indonesian Cocoa Price Volatility in Producer Level

Based on the explanation, the development of the volatility, continues to change in the period of 2007-2016. Hence, it can be categorized as high price volatility and will impact not only to consumers and producers but also will affect both the Micro and macro level.

3. Analyse of Influence of Cocoa Price Volatility to Cocoa Exports in Indonesia

A. Stationary Test (Unit Root Test)

Stationary testing results in this research can be seen through the summary in Table 1, as follows.

Table 1. The Result of Stasionary Test Data on Level (0)

Variable	t-Statistic	*Probability*
Cocoa Export	-0.612923	0.9780
Cocoa Price Volatility	-2.771488	0.1000

Source: Data analyzed

Based on stationary test results cocoa export variables by stationary test data at level (0) resulting in probability value of 0.9780 > 0.05 (alpha value), so that the export of cocoa is not stationary at the level (0). Similarly, the variable volatility of cocoa price at the known level (0) that the stationary data with probability value of 0.1000 > 0.05 (alpha value), so that the volatility variable of cocoa price is not stationary at the level (0).

The variable is unstable at the level (0) can describe that there is a close correlation between price volatility variables and cocoa exports at some point of time with other times. The main cause of non-stationary data is the presence of autocorrelation. A non-stationary time series must be converted into stationary data by differentiating, by means of difference is to calculate the change or the difference in observation value (Nurjannah, 2017).

Non-stationary data at the level (0) is also suspected that the volatility variable data of cocoa price at a given point in time affects cocoa export data at another point. The estimation can be known through cointegration testing, but in the cointegration test the both variables must be equally stationary at the same order level. Therefore, both variables must be tested stationary at the level of First Difference (1). The result of stationary test of data at level First Difference (1) can be seen in table 2, as follows.

Tabel 2. The Result of Stasionary Test Data on First Difference (1)

Variable	t-Statistic	Probability
Cocoa Export	-3.361439	0.0474
Cocoa Price Volatility	-4.793412	0.0101

Source: Data analyzed

Based on table 2 shows that the two variables, cocoa price volatility and cocoa exports are stationary at the same order that is at the level of First Difference (1). This is based on the cocoa export variables that result in a probability value of 0.0474 < 0.05 (alpha value) and for the variable of cocoa price volatility to obtain a probability value of 0.0101 < 0.05 (alpha value).

B. Cointegration Test

The cointegration result of residual regression between cocoa export and cocoa price volatility can be seen Tn table 3, as follows.

Tabel 3. The Result of Residual Cointegration of Cocoa Export Variables and Volatility Cocoa Price at Level (0)

Dependent Variable: DRESID01				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID02	-0.385	0.452	-0.853	0.422
C	-0.062	0.080	-0.769	0.467

Source: Data analyzed

Based on the table, the probability value resulting from the residual test between the volatility variables of cocoa price and cocoa exports in Indonesia are not stationary at the level (0). It is caused by the probability value of resid02 is 0.4218 > 0.05 (alpha value). So, the relationship between the both variables are not cointegrated at level (0), so it is necessary to test the residual values between volatility variables and cocoa exports in Indonesia at the level of First Difference (1) which results can be seen in Table 4, as follows.

Tabel 4. The Result of Residual Cointegration of Cocoa Export Variables and Volatility Cocoa Price at First Difference (1)

Dependent Variable: DRESID03				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID04	-1.353	0.386	-3.506	0.0099
C	-0.025	0.038	0.665	0.5275

Source: Data analyzed

Based on table 4, statistically by looking at the value of coefficient of variable resid04 with negative value indicates that between variable of volatility of cocoa price to cacao export variable in Indonesia have negative or inverse relation in long term. This long term relationship could mean that in case of long-term uncertainty of cocoa price, the export volume can decrease. In addition, by looking at the probability value resulting from the residual test between the

volatility variables of cocoa exports and the cocoa prices volatility in Indonesia are stationary in the same order of First Difference (1) and significant at 5% level. It is caused by the probability value is 0.0099 < 0.05 (alpha value). Therefore, the relationship between the variables of cocoa exports and the cocoa prices volatility in Indonesia are cointegrated.

C. Error Correction Model (ECM)

The results of ECM can be seen in Table 5, as follows.

Tabel 5. Estimated Results of Error Correction Model (ECM) between Cocoa Price Volatility Variables and Cocoa Exports in Indonesia

Dependent Variable: D(LEKS)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LVOL) (ΔP_{vt})	-0.190	0.132	-1.437	0.201
RESID04 (EC_{t-1})	-1.498	0.416	-3.601	0.011
C	-0.049	0.039	-1.267	0.252

Source: Data analyzed

Based on estimates in Table 5, can be obtained the model is:

$$\Delta PQ_t = -0.049051 – 0.189642\ \Delta P_{vt} – 1.498471\ EC_{t-1}$$

Statistically, the estimation of ECM models shown in table 4, the probability of EC_{t-1} amounted to 0.011 > 0.05 (alpha value), so the model used in this research that the cocoa price volatility has significant effect to cocoa exports in Indonesia. The value of coefficient EC_{t-1} negative indicates that the volatility variable of cocoa price and cocoa exports away from balance. The value of EC_{t-1} coefficient of -1.498 indicates that to achieve balance in the short term it takes correction factor of 1.498%. In addition, the value of cocoa price volatility coefficient variable (ΔP_{vt}) which is also negative value indicates that in the short term the relationship between variables of cocoa prices volatility to cocoa export variables in Indonesia has a negative or inverse relationship, so it can be interpreted that if the cocoa price volatility in Indonesia increased by 1%, the export volume of cocoa in Indonesia will decrease by 0.190 tons. Short term elastic value of cocoa price volatility in Indonesia is 0.190.

CONCLUSION

Cocoa price volatility in Indonesia since 2007-2016 had been unstable. So, it can be categorized as having high price volatility. Cocoa business actors need to pay attention to cocoa price volatility in decision making in order to avoid risk of loss or to find business opportunity. The volatility of cocoa prices with cocoa exports in Indonesia has an inverse relationship in the long term and in the short term. In the short term, the variables of cocoa volatility and cocoa exports in Indonesia move away from balance.

Based on the research results, research recommendations can be seen as follows:

1. Increasing the cocoa production with the use of hybrid seeds which have high production, quality products, resistant to major pest and disease, tolerance to marginal conditions such as varieties AB3, S795, USDA762, and Andungsari.
2. Optimizing cocoa production by rejuvenating old cocoa plants, rehabilitating cacao plants which have been damaged or their productivity has decreased and intensified the cocoa plants.
3. Improving the quality of cocoa according to market demand by applying post-harvest processing such as sorting, seed fermentation, washing and cleaning, seed drying, packaging, storage, quality standardization and transportation of results in accordance with Good Agriculture Practices (GAP) and Good Handling Practices (GHP).

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