Price transmission of Arabica coffee between North Sumatra with state main export purpose (America-Europe)

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Abstract. Fluctuations in North Sumatra Arabica coffee prices can affect market efficiency and transmission prices of North Sumatra Arabica coffee with the main export destination countries. This can be used as an opportunity by market participants, especially those who have the power to influence prices to manipulate prices. This research was conducted to analyse the transmission price of North Sumatra Arabica coffee with the main destination countries of America and Europe, and analysis of the factors forming the price of Arabica coffee in North Sumatra. The method used in this study is the Asymmetric Error Correction Model (AECM) model which is used for analysis of Arabica coffee price transmission and the Error Correction Model (ECM) model which is used to analyse the factors forming coffee prices with. The results showed that there was an asymmetric relationship between the transmission price of Arabica coffee in North Sumatra and the main destination country in the short run whereas in the long run the price transmission occurred symmetrically. In the analysis of the factors forming the price of North Sumatra Arabica coffee both in the short term and long term are significantly affected by all variables used.

1. Introduction
Export activities are one of the drivers of economic growth in North Sumatra, one of North Sumatra's export commodities in the agricultural sector is Arabica coffee. Arabica coffee is one of the leading export products of North Sumatra. The volume of coffee exports in North Sumatra fluctuates every year in line with the development of world demand for coffee and competition with other large coffee exporting countries [1].

Table 1. Prices of Arabica coffee exports in North Sumatra 2014-2018

| Year | Export Price of Arabica Coffee (US $) |
|------|-------------------------------------|
| 2014 | 5.292014 |
| 2015 | 5.026551 |
| 2016 | 4.723113 |
| 2017 | 4.843559 |
| 2018 | 5.426816 |

Source: Statistics of Sumatera Utara
The price of North Sumatra Arabica coffee exports fluctuates. In Table 1, from 2014-2018 we can see the highest price of Arabica coffee in 2018 of 5.42 US$ and the lowest price in 2016 of 4.72 US$. In price theory, price fluctuations affect the efficiency of resource allocation and price transmission in integrated markets both vertically and spatially [2]. High price fluctuations can be used as opportunities by market participants, especially those who have the power to influence prices to manipulate prices. When there is an increase in prices at one market level it is not immediately forwarded to another market level. This can cause price transmission between marketing institutions to be imperfect and create market inefficiency [3].

In developing Arabica coffee exports in North Sumatra, it is necessary to create an efficient marketing system that benefits all parties. For this reason, a comprehensive understanding of price movements and transmission needs to be carried out in each marketing institution, both the North Sumatra market as an exporter and the main destination country as an importer. This needs to be done because the prices formed can be used as indicators in assessing market efficiency.

In markets which are vertically connected prices in a market or marketing institution, in addition to being determined by market conditions such as supply and marketing costs, prices are also positively influenced by prices at other marketing institutions (reference markets). Price in each level marketing organizations can be predicted by observing the conditions in one market, especially the market rate benchmark when markets run efficiently. So that the problem of Arabica coffee price fluctuations can be addressed more effectively [4]. Based on the above, it is necessary to further study the price transmission between North Sumatra and the main destination countries and the factors affecting the formation of North Sumatra Arabica coffee prices.

2. Data and methods

2.1 Location and sample
The study was conducted in North Sumatra Province by purposeful sampling that is determined intentionally by considering the objectives of the study. North Sumatra Province was chosen with the consideration that North Sumatra Province is one of the provinces that relies on Arabica coffee export with the support that North Sumatra is one of the largest Arabica coffee producers in Indonesia.

This research was conducted in 2019. The data used in this research is secondary data are time series monthly taken from the years 2014-2018. Data were analysed in the form of a data Price coffee exports North Sumatra, price of imported coffee in the coffee market the main importers, the export volume of Sumatran coffee and the exchange rate.

2.2 Data analysis

2.2.1 Analysis of transmission price. In analysing the price transmission, the method used is the Asymmetric Error Correction Model (AECM) model. This model is used to see whether price transmissions occur asymmetrically or symmetrically. This test is carried out through the Error Correction Model (ECM) approach. Before conducting this analysis, it is necessary to carry out several stages as follows: 1) Data Stationary Test, 2) Optimum Lag Test, 3) Cointegration Test, 4) Causality Test.

As for analysing the transmission price of North Sumatra Arabica coffee with the main destination country, a test using the Error Correction Model (ECM) approach is as follows:

\[
\Delta Y = \alpha_0 + \sum_{i=1}^{n} \beta_{1i} \Delta Y_{t-i} + \sum_{i=1}^{n} \beta_{12i} \Delta X_{t-i} + \pi_{1}Z_{t} - 1 + \sum_{i=1}^{n} \beta_{21i} \Delta Y_{t-i} + \sum_{i=1}^{n} \beta_{21i} \Delta X_{t-i} + \pi_{2}Z_{t-i} + \epsilon_t
\]

(1)

Where:
- \( Y \) = Export Price of North Sumatra Arabica Coffee (US$/kg)
- \( Y_{t-1} \) = Export Price of North Sumatra Arabica Coffee in the previous period (US$/kg)
X = Import Price of Arabica Coffee of Major Destination Countries (US$/kg)
Z = Error Correction Term
α = Interception
ε = Error

Price transmission is seen through the presence or absence of a real difference between a positive ECT value and a negative ECT, price transmission is symmetrical if there is no real and asymmetrical difference if there is a real difference. In this analysis to find out the real difference is done through the Wald test [5].

2.2.2 Analysis of factors in formation of North Sumatra Arabica coffee prices. In analysing the factors forming the price of North Sumatra Arabica coffee, it was carried out using the error correction model (ECM) analysis method. This analysis is divided into long term and short term.

Long-term model:

\[ \ln HES_t = \alpha_0 + \alpha_1 \ln HES_{t-1} + \alpha_2 \ln HEB_t + \alpha_3 \ln HEV_t + \alpha_4 \ln HIA_t + \alpha_5 \ln HIG_t + \alpha_6 \ln HIK_t + \alpha_7 \ln HIB_t + \alpha_8 \ln HII_t + \alpha_9 \ln Vol_t + \alpha_{10} \ln NT_t + \epsilon_t \]  

(2)

Tests on the Error Correction Term (ECT) coefficient are performed to determine whether the ECM model is a valid model. If the test results on the ECT coefficient are significant, the observed model specifications are valid. ECT is a variable that can be used as a coefficient of adjustment, which is a variable that can correct imbalances in the short term to get back to the position of long-term balance. This adjustment coefficient reflects the speed of the process of adjusting the desired value of economic actors with their actual values in the short term [6].

Short term model:

\[ \ln HES_t = \alpha_0 + \alpha_1 \ln HES_{t-1} + \alpha_2 \ln HEB_t + \alpha_3 \ln HEV_t + \alpha_4 \ln HIA_t + \alpha_5 \ln HIG_t + \alpha_6 \ln HIK_t + \alpha_7 \ln HIB_t + \alpha_8 \ln HII_t + \alpha_9 \ln Vol_t + \alpha_{10} \ln NT_t + ECT_t + \epsilon_t \]  

(3)

Where:

HES = Export Price of North Sumatra Arabica Coffee (US$/ kg)
HES-1 = Export Price of North Sumatra Arabica Coffee in the previous period (US$/ kg)
HEB = Export Price of Brazilian Arabica Coffee (US$/ kg)
HEV = Export Price of Vietnamese Arabica Coffee (US$/ kg)
HIA = Imported Price of American Arabica Coffee (US$/ kg)
HIG = Imported Price of German Arabica Coffee (US$/ kg)
HIK = Imported Price of Canadian Arabica Coffee (US$/ kg)
HIB = Imported Price of Belgian Arabica Coffee (US$/ kg)
HII = Imported Price of British Arabica Coffee (US$/ kg)
ECT = Error Correction Term
α = Interception
ε = Error

3. Results and discussion

3.1. Price transmission

From transmission analysis Arabica coffee prices between North Sumatra country of destination with America and Europe are being done with using methods asymmetric error correction model (AECM), obtained as follows.
Table 2. Price asymmetry test between north Sumatra and main destination countries

| Wald Test | Variable | F-statistics | Prob. |
|-----------|----------|--------------|-------|
| America → North Sumatra | $\Delta HES_t = \Delta HES_{t-1}$ | 4.692325 | 0.0352 * |
| | $\Delta HIA = \Delta HIA$ | 0.001682 | 0.9674 |
| | $ECT = ECT$ | 0.015739 | 0.9007 |
| | $\Delta HES_t = \Delta HES_{t-1}$ | 1.705025 | 0.1977 |
| German → North Sumatra | $\Delta HJ = \Delta HJ$ | 5.4848504 | 0.0194 * |
| | $ECT = ECT$ | 0.166084 | 0.6854 |
| | $\Delta HES_t = \Delta HES_{t-1}$ | 5.120504 | 0.0281 * |
| Canada → North Sumatra | $\Delta HI = \Delta HI$ | 5.192480 | 0.0271 * |
| | $ECT = ECT$ | 0.074317 | 0.7863 |
| | $\Delta HES_t = \Delta HES_{t-1}$ | 4.835352 | 0.0326 * |
| Belgium → North Sumatra | $\Delta HIB = \Delta HIB$ | 0.293906 | 0.5092 |
| | $ECT = ECT$ | 0.72114 | 0.3999 |
| | $\Delta HES_t = \Delta HES_{t-1}$ | 4.822173 | 0.0329 * |
| UK → North Sumatra | $\Delta HII = \Delta HII$ | 0.149913 | 0.7003 |
| | $ECT = ECT$ | 0.119843 | 0.7307 |

* 5% sig

In the Table above, the results show that the transmission of North Sumatra Arabica coffee prices with the United States, Germany, Canada, Belgium and the United Kingdom is asymmetrical in the short term. This asymmetrical relationship is seen from the significant difference between the previous month's North Sumatra export price which was positive and the previous month's North Sumatra export price which was negative. In the Canadian transaction with North Sumatra the short-term asymmetric relationship is also influenced by the import prices of Canadian Arabica coffee. This asymmetric transmission occurs because it takes time to adjust prices from the Importer market to the exporter market.

Arabica coffee price transmission in long-term North Sumatra market with America, Germany, Canada, Belgium, and the UK showed that occurs symmetrically relationship. In this case it can be concluded that there was no misuse of market power between the main destination market and the North Sumatra market.

3.2 factors affecting the formation of Arabica coffee market prices in North Sumatra

From analyse the formation of prices of Arabica coffee in North Sumatra conducted analyse by the method of Error Correction Model (ECM). This analysis is divided into long term and short term. Short-term analysis is analysed by entering the Error Correction Term (ECT) from the long-term analysis.

Long-term

The result showed that the most significant in building the price of North Sumatra Arabica coffee is the export price of North Sumatra in the previous month and the price of US imports of Arabica coffee. For all variables, in the long run all variables have a significant effect on the formation of coffee prices in North Sumatra with an F-stat value of 14.55 with a probability value of 0.000. R-square value of 0.678 can explain that all variables can explain the price of North Sumatra Arabica coffee at 67.8% and the rest are influenced by other variables not included in the model.
Table 3. Analysis of the factors that influence long-term price formation

| Variable | Coefficient | t-Statistics | Prob. |
|----------|-------------|--------------|-------|
| C        | 1.278997    | 2.414420     | 0.0195|
| H ES (-1)| 0.833409    | 5.783747     | 0.0000*|
| H EB     | -0.010425   | -0.816184    | 0.4183|
| H EV     | 0.001691    | 0.728991     | 0.4695|
| H IA     | -0.130068   | -2.544487    | 0.0141*|
| H IG     | 0.090557    | 1.460871     | 0.1504|
| H IK     | 0.040153    | 0.730403     | 0.4686|
| H IB     | -0.022655   | -0.459138    | 0.6482|
| H II     | 0.022291    | 0.729738     | 0.4690|
| NT       | -4.73E-05   | -1.547483    | 0.1282|

R-squared: 0.727831
Adjusted R-squared: 0.677840
F-statistics: 14.55944
Prob (F-statistic): 0.000000

*5% sig

Short-term

Table 4. Analysis of factors affecting the price formation short-term

| Variable | Coefficient | t-Statistics | Prob. |
|----------|-------------|--------------|-------|
| C        | 0.009877    | 0.869992     | 0.3887|
| D (HES (-1)) | 0.166940 | 2.309503     | 0.0254*|
| D (H EB)  | -0.005533   | -1.040841    | 0.3033|
| D (H EV)  | 0.000717    | 0.902553     | 0.3714|
| D (H IA)  | -0.085577   | -3.832896    | 0.0004*|
| D (H IG)  | 0.063278    | 2.729376     | 0.0089*|
| D (H IK)  | 0.021704    | 0.982230     | 0.3310|
| D (H IB)  | -0.011611   | -0.485686    | 0.6294|
| D (H II)  | -0.000228   | -0.015302    | 0.9879|
| D (NT)    | -0.000107   | -2.495558    | 0.0161*|
| ECT       | 0.976308    | 12.63537     | 0.0000|

R-squared: 0.837528
Adjusted R-squared: 0.802959
F-statistics: 24.22806
Prob (F-statistic): 0.000000

The result showed that in the short term the most significant in making price North Sumatra Arabica coffee is the export price of Sumatera Utara in the previous month, the import price of Arabica coffee the United States, the price of Arabica coffee imported German and Exchange. The whole in the short term all variables significantly influence the formation of coffee prices in northern Sumatra with an F-stat value of 24.22 with a probability value of 0.000. R-square value of 0.80 can explain that all variables can explain the price of North Sumatra Arabica coffee by 80% and the rest are influenced by other variables not included in the model.
Significant ECT values can be concluded that the specifications used are valid so that changes in the analysed factors will be responded to in North Sumatra. A value of ECT of 0.97 means that the 97% price adjustment occurred in the first month and the rest the following month.

4. Conclusions
In the short term, the transmission of prices between North Sumatra and America, Germany, Canada, Belgium and the United Kingdom is asymmetrical. This happens because it takes time to adjust prices from the Importer market to the exporter market. Whereas in the long run, the results of transmission of prices between the North Sumatra Market and the United States, Germany, Canada, Belgium and the United Kingdom are symmetrical. In short-term and long-term real effect of all variables in the formation of the North Sumatra Arabica coffee prices with a probability value of 0.00 with each F-stat value of 24.22 and 14.55

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