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## Factors influencing the soybean import volume in North Sumatera Province

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# Factors influencing the soybean import volume in North Sumatera Province

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**Abstract.** Imports become an alternative policy to meet the domestic soybean demand. North Sumatera Province has a high dependence on soybean imports because the amount of soybean imported is greater than the amount of domestic production. The purpose of this study was to analyse the influencing factors of the soybean import volume in North Sumatera Province. The Engle-Granger Cointegration Test and the Error Correction Model (ECM) methods used to identify the factors influencing the soybean import volume in the long-term and the short-term. The results concluded that the soybean import was significantly influenced by the domestic soybean production, the exchange rate, and the soybean price ratio. In the long-term, the soybean price ratio significantly influences the soybean import volume. While in the short-term, exchange rate and soybean price ratio significantly influence the soybean import volume.

## 1. Introduction

Soybean is one of the food crops that have high economic value. The development of soybeans has been carried out intensively as it relates to various sectors. Soybean is processed into various foods such as tofu, tempe, tauco, and soy sauce. It is the main food for most people in Indonesia, including people in North Sumatera Province. However, the increase in soybean consumption is not followed by the increase in domestic soybean production. It makes North Sumatera Province has to import soybean to fulfil domestic soybean demand.

The amount of soybean production in North Sumatera Province tends to fluctuate. The production had increased in 2008 with the acceleration program of soybean production that is Program Bangkit Kedelai Nasional (PROKEMA). The program can increase domestic soybean production to touch 11 thousand tons. However, in 2012 production fell significantly to touch 5 thousand tons only. It is due to the decline in the amount of harvested area and productivity because of the farmers' lack of interest in soybean cultivation. In contrast, the consumption of soybeans in North Sumatera Province actually increased every year to touch 65 thousand tons in 2016.

Imports become one of the inevitable ways to meet domestic soybean needs. The number of soybean imports continued to increase from 2006 to 2016. It reached more than 169 thousand tons in 2016 [1]. This condition further widened the gap between soybean production and imports in North Sumatera Province. The increasing of the soybean import volume in North Sumatera Province will have an impact on food security and the farmers' interest to cultivate soybean. Therefore, this research is needed to analyse the factors influencing the soybean import volume in North Sumatera Province.



## 2. Materials and methods

### 2.1. Method for determining the research areas

This research was conducted in North Sumatera Province. The area of study was determined purposively, with the consideration that North Sumatera Province experienced an increase in the volume of imported soybeans, due to increased consumption of soybeans, and it was not able to be balanced with the amount of domestic soybean production.

### 2.2. Data analysis method

**2.2.1. Unit Root test.** Unit root test or stationary test is aimed to know stationary data. False or spurious regression will be generated if the data is not stationary. Unit root test was performed using the augmented Dickey-Fuller (ADF) method, with the following hypothesis:  $H_0$ ; there is a unit root (the data is not stationary) and  $H_a$ ; there is no root unit (the data is stationary). If the test at the level is not stationary, then re-testing is required by conducting unit root test on the first difference of the series.

**2.2.2. Ordinary Least Square test.** The regression model must show a valid relationship equation or a BLUE (Best Linear Unbiased Estimator). The model must meet the basic assumptions of the classical Ordinary Least Square (OLS) [2].

Normality Test Criteria using the Jarque-Bera method is used to see whether the data is normally distributed or not, with the following hypothesis:  $H_0$ ; residuals are normally distributed and  $H_a$ ; residuals are not normally distributed. If the probability value of Jarque-Bera > 5% then do not reject  $H_0$  which means the data is normally distributed and vice versa.

Criteria for autocorrelation test using LM method (Bruesch-Godfrey method) using hypothesis as follows:  $H_0$ ; there are no autocorrelation symptoms and  $H_a$ ; there are autocorrelation symptoms. If the critical area p-value Obs \* R-squared > 5%, then accept  $H_0$ , so there are no suspected autocorrelation symptoms.

Multicollinearity means the existence of a perfect or definitive linear relationship, among some or all of the explanatory variables of the regression model [2]. The method used to detect multicollinearity is the partial correlation between independent variables (rule of thumb) method. The method is if the value of correlation coefficient is high enough, that is above 0.8, then we can guess that the regression model has multicollinearity disorder [3].

**2.2.3. Cointegration test.** Cointegration is a long-term relationship between variables that although individually are not stationary, linear combinations between them can be stationary by transformation. Cointegration test in this research using the Engle-Granger Cointegration Test method. The Engle-Granger Cointegration Method using the following hypothesis:  $H_0$ ; ADF-statistics > MacKinnon critical value (no cointegration occurs) and  $H_a$ ; ADF-statistics < critical value of MacKinnon (cointegration occurs). The long-term equation model used in this research are:

$$\ln VI_t = \alpha_0 + \alpha_1 \ln QD_t + \alpha_2 \ln NT_t + \alpha_3 \ln RP_t + U_t \quad (1)$$

Where  $\ln VI_t$  represent the total soybean import volume of North Sumatera Province in period t;  $\ln QD_t$  represent the total domestic soybean production in period t;  $\ln NT_t$  represent the Rupiah (IDR) exchange rate against the US Dollar (USD) in period t;  $\ln RP_t$  represent the ratio of domestic soybean price to the world in period t;  $\alpha_0$  is the intercept; and  $U_t$  is the error distribution in period t.

**2.2.4. Error Correction Model (ECM).** The estimation results on unit root and cointegration testing can be used to estimate the model using ECM, as in the following equation:

$$D \ln VI_t = \alpha_0 + \alpha_1 D \ln QD_t + \alpha_2 D \ln NT_t + \alpha_3 D \ln RP_t + \lambda U_{t-1} + e_t \quad (2)$$

Where  $D$  is the first difference;  $\lambda$  represent Error Correction Term (ECT); and  $e_t$  = error distribution in period  $t$ . To find out if the model specification with ECM is a valid model then tested the coefficient of Error Correction Term (ECT). If the test results on the ECT coefficient are significant, then the model specification observed is valid.

**2.2.5. Goodness of fit.** The coefficient of determination test ( $R^2$ ) is done with the aim to see whether the new variables of the independent variables in the model able to explain its influence to the dependent variable. The coefficient of determination shows the ability of the regression line to explain the variation of the dependent variable (percent proportion) which can be explained by the independent variable.  $R^2$  values range from 0 to 1. The closer to 1, the better it is.

The F-statistic test is a test used to determine whether the independent variables simultaneously have a significant or insignificant influence on the dependent variable, with the following hypothesis;  $H_0$ : independent variables simultaneously have no significant influence on the dependent variable; and  $H_a$ : independent variables simultaneously have a significant influence on the dependent variable. If  $\beta_1, \beta_2, \beta_3 = 0$  (prob F statistically significant at  $\alpha = 5\%$  or F-statistic  $< F$ -table), so  $H_0$  is accepted; if  $\beta_1, \beta_2, \beta_3 \neq 0$  (prob F statistically insignificant at  $\alpha = 5\%$  or F-statistic  $\geq F$ -table) so  $H_a$  is accepted.

The t-statistic test is done to know the significance of each independent variable in influencing the dependent variable. The test is done by determining the value of t table then comparing t table value and t-statistics value. The criteria in t-test are:  $H_0$  accepted if t-count  $<$  t-table means that the independent variables partially have no significant influence on the dependent variable and  $H_a$  accepted if t-count  $\geq$  t-table means that the independent variables partially have a significant influence on the dependent variable.

### 3. Results and discussion

Unit root test results at the level indicate that all variables are not stationary (Table 1). It can be seen from the t-statistical value of ADF greater than the critical value of MacKinnon at the level of 1%, 5%, and 10%.

**Table 1.** The unit root test results with the augmented Dickey-Fuller at level

Variables	Value of ADFt	Critical Value of MacKinnon			Inference
		1%	5%	10%	
Ln $VI$	-1.942222	-3.788030	-3.012363	-2.646119	not stationary
Ln $QD$	-1.866922	-3.788030	-3.012363	-2.646119	not stationary
Ln $NT$	-2.809568	-3.788030	-3.012363	-2.646119	not stationary
Ln $RP$	-2.069512	-3.788030	-3.012363	-2.646119	not stationary

Since all data has not been stationary at the level, then testing should be continued by conducting unit root test at first difference. As shown in Table 2, all variables have been stationary at the first difference. It can be seen that the t-statistical value of the ADF is smaller than the critical value of MacKinnon with varying degrees of probability.

Normality: Based on the results of data processing on the model, obtained the probability value of  $0.907 > 0.05$ , then  $H_0$  accepted. Thus, it can be concluded that the residual is normally distributed. Autocorrelation: Based on the result of data processing with LM (Bruesch Godfrey) test, known the p-value Obs \* R-squared of  $0.0985 > 0.05$ , then  $H_0$  is accepted. Therefore, it is free from the problem of autocorrelation. Multicollinearity: In the regression equation model of the factors influencing the

soybean import volume in North Sumatera Province, all independent variables have a relationship value smaller than 0.8, meaning the independent variables are free from multicollinearity.

**Table 2.** The unit root test results with the augmented Dickey-Fuller at the first difference

Variables	Value of ADFt	Critical Value of MacKinnon			Inference
		1%	5%	10%	
Ln $VI$	-4.941761	-3.808546	-3.020686	-2.650413	stationary
Ln $QD$	-5.206172	-3.831511	-3.029970	-2.655194	stationary
Ln $NT$	-4.977889	-4.498307	-3.658446	-3.268973	stationary
Ln $RP$	-4.545365	-4.498307	-3.658446	-3.268973	stationary

Cointegration testing with the Engle-Granger Cointegration method on the regression equation shows that the ADF-statistic value for residual cointegration equation is less than the critical value of MacKinnon both at the level of 1%, 5%, and 10% (Table 3). The Engle-Granger cointegration test results show that the soybean import volume ( $VI$ ), the domestic soybean production ( $QD$ ), the exchange rate of IDR to USD ( $NT$ ), and the ratio of domestic soybean price to world soybean price have long-term balance.

**Table 3.** The augmented Dickey-Fuller test results on residual Error Correction Term (ECT) equation

Variable	Value of ADFt	Critical Value of MacKinnon			Inference
		1%	5%	10%	
$ECT$	-4.437371	-2.66	-1.95	-1.60	stationary

The Long-term estimation of soybean import volume factors in North Sumatera Province shows R-square ( $R^2$ ) value of 0.832 (83.2%) (Table 4). It explains that the variables used in the model can explain the diversity of factors as much as 83.2%, while the remaining 16.8% is explained by other factors not included in the model.

**Table 4.** The results of estimation of the influencing factors of the soybean import volume in North Sumatera Province in the long-term

Variables	Coefficient	Probability
C	-24.50287	0.2651
Ln $QD_t$	-0.824215	0.4658
Ln $NT_t$	-5.063756	0.1186
Ln $RP_t$	9.971803	0.0074
R-Squared	0.832851	
Adjusted R-Squared	0.804993	
F-statistic	0.000000	

The estimation results of the model of factors influencing the soybean import volume in North Sumatera Province in the long-term, are presented in Table 4, while in the long-term equation model obtained is as follows:

$$\ln VI_t = -24.5028 - 0.8242 \ln QD_t - 5.0637 \ln NT_t + 9.9718 \ln RP_t \quad (3)$$

Error Correction Model (ECM) is a technique for correcting short-term imbalances leading to long-term equilibrium. ECM results show that the ECT coefficient value of 0.9886 indicates that the short-term imbalance will be adjusted within 9 years 8 months (Table 5). The value of ECT coefficient of 0.0004 is significant at the level of 5% ( $0.0004 < 0.05$ ). It indicates that the Error Correction Model

(ECM) is valid and can illustrate the factors influencing the soybean imports volume in North Sumatera Province, which are the domestic soybean production, the exchange rate of IDR to USD, and the ratio of domestic soybean price to the world price.

$$D \ln VI_t = 0.4536 - 0.1704D \ln QD_{t-1} - 7.6216D \ln NT_{t-1} + 8.4821D \ln RP_{t-1} - 0.9886ECT_{t-1} \quad (4)$$

The estimated ECM estimation value of R-square ( $R^2$ ) is 0.64489 (64.48%) (Table 5). It indicates that 64.48% of the domestic soybean production, the exchange rate of IDR to USD, and the ratio of domestic soybean price to the world price influencing the import of soybean, while the rest of 35.52% is explained by other factors not included in the model.

**Table 5.** The results of estimation of the influencing factors of the soybean import volume in North Sumatera Province in the short-term

Variables	Coefficient	Probability
C	0.453687	0.3039
D Ln $QD_{t-1}$	-0.170467	0.8518
D Ln $NT_{t-1}$	-7.621609	0.0030
D Ln $RP_{t-1}$	8.482117	0.0041
$ECT_{t-1}$	-0.988682	0.0004
R-Squared	0.644890	
Adjusted R-Squared	0.566113	
F-statistic	0.001557	

The F-statistic test is used to know the influence of the independent variable simultaneously to the dependent variable. Based on the results of Cointegration and ECM estimation, the F value of 29.896  $7.2641 > F$  statistic at 5% significant level, then  $H_0$  is rejected. It means that the domestic soybean production, the exchange rate of IDR to USD, and the ratio of domestic soybean price to the world price simultaneously have a significant influence to the soybean import volume in North Sumatera Province.

The t-statistic test is used to determine the influence of each independent variable to the dependent variable. The t-statistical test results with a significant level of 5% indicate that in the long-term variables influencing soybean imports in North Sumatera Province is the ratio of domestic soybean price to the world price. While in the short-term the exchange rate and the ratio of domestic soybean price to the world price influence the soybean import volume in North Sumatera Province.

**Table 6.** The results of the t-statistics test

Variables	Long-term	Short-term
Total production	not significant	not significant
Rupiah exchange rate	not significant	significant
Price ratio	significant	significant

### 3.1. The influence of production amount on soybean import volume

In the long-term and short-term economy, domestic soybean production does not influence the soybean import volume in North Sumatera Province. It is allegedly due to government policies in the development of soybean agribusiness that did not show significant progress [4]. In addition, the increasing population factor implicates to the high demand for vegetable protein through higher soybean commodities [5].

### *3.2. The influence of exchange rate on soybean import volume*

The Long-term estimates show that the IDR exchange rate to the USD has no significant influence on soybean import volume in North Sumatera Province. It is expected in the long-term, the population will increase and it is supported by an increase in income and awareness of the fulfilment of proper nutrition. Thus, this depreciation of the Rupiah will not influence the soybean import volume because the cost of depreciation will be charged to the consumers through the price paid [5]. The IDR exchange rate against USD has a negative coefficient. It is in accordance with the theory that if the domestic currency depreciates, then the importer who will buy soy will require more dollars. So that importer will spend bigger cost to import soybean. It will give consequences importers will reduce the import of soybeans.

In the short-term, the IDR exchange rate against the USD in the previous period (first lag) has a consistent direction to hypotheses and theories and has a significant impact on the soybean imports volume. In contrast to the long-term conditions, where the exchange rate does not significantly influence the imports volume. It is suspected because in the short-term there is very high volatility that causes importers (economic actors) must predict the changes in exchange rate. While in the long-term, with a good understanding of economic development and rational action, importers suspect the long-term exchange rate movement is relatively stable [5].

### *3.3. The influence of price ratios on soybean import volume*

The ratio of domestic soybean price to the world price in the long-term and the short-term has a significant influence to soybean import volume in North Sumatera Province. It means that in the long-term, the ratio of soybean prices has a significant influence on the demand for soybean imports. So that if the price of local soybeans rises, the demand for soybean imports will increase, so that soybean prices are still stable. In addition, it is allegedly due to the existence of long-term contracts by exporting countries, agreement in international trade organizations, and government policies regarding the determination of import tariffs and unstable quota [5].

### *3.4. Policy implications*

Firstly, the results of short-term and long-term estimation show that the influence of domestic soybean production is not significant on the decrease of soybean import volume. Therefore, there is a need for a real strategy, program, and support to increase soybean production and productivity so that it can hamper the rate of soybean import in North Sumatera Province.

Secondly, there is the need for strong institutional strengthening and capital support for soybean agroindustry so that if the rupiah exchange rate depreciates, the soybean industry business does not need to close its business directly. The government can cooperate with financial institutions and banks to be able to provide credit or capital assistance to soybean industry business to be able to carry out its business activities. In addition, institutional strengthening through cooperation is very important as a channel to credit or technology assistance. It is expected that the group/institution will together help the industry effort so it will be easier to get input, capital, and marketing.

Thirdly, one of the incentives that farmers need to run their farms is the price. The price becomes an important signal for farmers to cultivate soybeans. It is necessary to set a "reasonable price" mechanism, to ensure domestic soybean prices can compete with imported soybean prices. The relatively lower imported soybean price becomes a disincentive for farmers, especially if it is associated with a trade-off of growing more profitable crops. If the incentive system through the price is difficult to handle by the government, then efforts to keep farmers planting soybeans will be very difficult.

Fourth, the government can maintain the protection policy (tariff setting) which has been taken, that is the implementation of import tariffs. With specific tariff rates and quotas, a price level created will not compete with local soybean prices and should be combined with non-tariff policies such as monitoring, regulation, and import restrictions.

Fifth, according to the estimation result in the short-term, the IDR exchange rate also significantly influence the soybean import volume. Therefore, the government through the monetary authority of Bank Indonesia should have the right mechanism to maintain the stability of the rupiah exchange rate in

the short and long-term. Because it will trigger domestic inflation fluctuations, and finally the domestic inflation fluctuations will trigger domestic commodity price fluctuations.

#### 4. Conclusions

The soybean imports volume in North Sumatera Province was significantly influenced by the domestic soybean production, exchange rate, and the soybean price ratio. In the long-term, the soybean price ratio has a significant influence on the soybean import volume in North Sumatera Province. While in the short-term, the IDR exchange rate to the USD and the soybean price ratio have a significant influence on soybean import volume. The amount of domestic soybean production has not been able to reduce the soybean import volume in North Sumatera Province. In order to reduce the soybean imports volume, the government need to compile strategies and programs to increase soybean production and productivity; strengthen the institutional and capital support for soybean agroindustry; arrange the incentive systems for viable soy farmers; maintain the policy of imposition of import tariffs; and maintain the stability of the rupiah exchange rate.

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