Analysis of soybean production and import trends and its import factors in Indonesia

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Abstract. This study aims to analyze the factors affecting soybean imports in Indonesia and to know the trend and projection of Indonesian soybean production as well as the import in 2016-2020. The basic method used in this research is the description analysis method. The data used are secondary data in the form of time series data from 1979-2015. Methods of data analysis using simultaneous equations model with 2SLS (Two Stage Least Square) method and Trend analysis. The results showed that the factors affecting soybean imports in Indonesia are consumption and production. Consumption has positive effect while production is negatively affected. The percentage changed in soybean imports is greater than the percentage change in consumption and production of soybeans. Consumption is positively influenced by imports and production, while production is influenced positively by consumption and negative by imports. The production trend of soybean in 2016-2020 has a tendency to increase with a percentage of 11.18% per year. Production in 2016 is projected at 1,110,537 tons while in 2020 it will increase to 1,721,350 tons. The import trend in 2016-2020 has a tendency to increase with an average percentage of 4.13% per year. Import in 2016 is projected at 2,224,188 tons while in 2020 it will increase to 2,611,270 tons.

1. Introduction
The population and food are the two things that are related to one another. The more number of people than the need for food is also increasing, including soybean demand. Soybean is one of the food sources of protein that favored by Indonesian society. The study [1] in the event of a 1% population growth, the demand for soybeans will increase 10.6% which means the increase of population in Indonesia resulted in increased consumption of soy so that soybean demand is also increasing.

National soybean production in Indonesia decreased from 843,153 tons in 2012 to 779,992 tons in 2013. In 2014 and 2015, the national soybean production increased to 954,997 tons and 963,183 tons [2]. Meanwhile, soybean harvested area tends to decrease during the last 16 years an average of about 0.97% per year while the soybean crop productivity tends to increase by an average of 1.67% per year. As a result of the increase in productivity that is greater than the decrease in harvested area, the average production increased by 0.8% per year with an average production of 819,442 tons per year.

Indonesian soybean consumption is 2.2 million tons per year, this figure is far from the average rate of production that only 819,442 tons per year, as a result, the government should import soybeans. Domestic soybean production is currently only able to meet about 35% of consumption, and more than 65% of Indonesian soy needs to be met from imports. Indonesian soybean imports continue to rise each year with an average percentage of 7.73%. In 2013 the import volume of soybeans only reached 1,788,962 and it increased to 1,965,811 tons in 2014 and 2,256,932 tons in 2015 [3]. According to
previous study [4], the supply of soybeans both production and the import of 70% was used for
tempah and tofu while the remaining 30% to meet the needs of other food.

Dependence on imported soybean will be analyzed to determine the development in the coming
years. Based on the previous year’s data, it will be seen how the development of Indonesia’s soybean
production and imports in the next few years. This study was conducted to determine trends and
projections of production and import soybean Indonesia in 2016-2020 and also to determine what
factors affecting soybean imports in Indonesia. Analytical results from this study were expected to be
a material consideration in decisions relating to the import of soybean and others soybean policy.

2. Methods
The basic method used in this research was the description analysis method. The data used are
secondary data in the form of time series data from 1979-2015 are sourced from the publication of the
BPS, the Center for Agricultural Data and Information System (Pusdatin), Food and Agriculture
Organization (FAO), World Bank, and other agencies. Data used include import of soybean,
production and consumption of Indonesian soybean, per capita income, domestic soybean prices,
international soybean prices and the value of the real exchange rate of Rupiah against the US Dollar.
Analysis of the factors affecting soybean imports in Indonesia will be done using simultaneous
equations. However, in this study we do not conduct endogeneity test due to the unavailability data.
The analyzed models were consist of three endogenous variables, namely import of soybean (IM),
soybean consumption (K) and soybean production (PD), which will be analyzed by Two Stage Least
Square (2SLS). The equation used to analyze soybean imports in Indonesia are as follows:

\[ \ln IM = \alpha_{10} + \beta_{11} \ln K + \beta_{12} \ln PD + \beta_{13} \ln KR + \beta_{14} \ln HI + \mu \] (1)
\[ \ln K = \alpha_{20} + \beta_{21} \ln IM + \beta_{22} \ln PD + \beta_{23} \ln Y + \mu \] (2)
\[ \ln PD = \alpha_{30} + \beta_{31} \ln K + \beta_{32} \ln HD + \beta_{33} \ln IM + \mu \] (3)

Description:
A : constant
\( \beta_i \) : the degree of slope of regression to \( i \)
IM : import of soybean (tons)
K : soybean consumption (tons)
PD : soybean production (tons)
KR : exchange rate (rupiah / US $)
HI : the price of International soybeans (US$/tons)
Y : income per capita (Rupiah)
HD : the price of domestic soybean (rupiah/tons)
\( \mu \) : error

There are several steps to analyze the factors affecting soybean imports in Indonesia from the third
equation. Among them is the identification test and rank condition, econometric and statistics test.
Identification test and rank condition is done by considering the rules of identification (order
condition) as follows:

- \( K - k < m-1 \): the equation is under-identified
- \( K - k = m-1 \): it is exactly-identified
- \( K - k > m-1 \): it is over-identified

Where: \( K \) is number of variables predetermined (exogenous predetermined) in the model, \( k \) is
number of variables predetermined (exogenous predetermined) in a given equations, \( M \) is number of
endogenous variables in the models and \( m \) is number of endogenous variables in a given equations.
2SLS analysis can be done if a model can be identified (exactly-identified or over-identified). While in the adequacy requirement (rank condition), the equation model is identified if and only if at least one determinant is not equal to zero in order (M-1) [5]. The next step is the econometric tests, done to get a model that qualifies BLUE (Best Linear Unbiased Estimator) with normality, multicollinearity, heteroscedasticity, and autocorrelation test. The next is the statistical test. Tests conducted with test statistics $R^2$, $F$ test and $t$ test.

Analysis of trends and projections of production and import of soybean is done by using a model of trends in accordance with the data analyzed, to select the most suitable trend model for forecasting can evaluate trend model [6]. The most suitable model will give the approximate value close to its actual value. The difference between actual value and allegations referred to as an error or mistake.

Trends matches will provide the most minimal error, for it can be used to select the criteria that match the trend partly by the standard error of estimation (SEE) or $R$-square or square Adj. $R$. Based on the trend found, it can be used to project soybean production and import during 2016-2020. Trend value is already known, often referred normal forecasts, but better forecast would be obtained if the effect of cyclic (S) and random (R) are included, given the components of a data time series annual consist of trend ($Y'$), the variation of cyclic (S) and random variation (R). The equation will be used to project the production and import of soybean Indonesia in 2016-2020 are:

$$SR = Y \cdot Y'^{-1} \cdot 100\% \quad \text{Eq.}(4)$$

$$Y_t = Y' \cdot SR$$

Where $Y_t$ is the actual value in year t, $Y'$ is a trend and SR values are the combined effect of cyclical variation value and random/residue [7].

3. Results and Discussion

3.1. Analysis of suspected Factors Affecting Imports Soybean in Indonesia

Based on the of identification with order condition the result that all the equations are over identified while testing the adequacy requirement (rank condition) indicates that the determinant of all the equations is not equal to zero in order (M-1), which means that this equation is identified. Based on the identification test with the order condition and rank condition it can be concluded that the model can be estimated by the Two Stage Least Square (2SLS) method. All test econometrics to test the model by using the classical assumption states that the model qualifies BLUE (Best Linear Unbiased Estimator) with eligibility normality, no multicollinearity symptoms, homoscedasticity and no autocorrelation so that the estimated models can be used as a model equation.

Based on Table 1, results of the analysis with the simultaneous equations by 2SLS method show that, imports of soybean in Indonesia jointly influenced by consumption, soybean production, exchange rates and international soybean prices. Indonesian soybean imports partially influenced by the consumption and production of soybeans. While the exchange rate and international soybean prices partially no effect on soybean imports in Indonesia as shown in eq.I.

Consumption has a positive effect on soybean imports. The increase of soybean consumption will cause the imports of soybean will also increase. This equation shows that the percentage change in soybean imports is greater than the percentage change in consumption. This condition illustrates that a slight increase in consumption will result in the addition of imported proportions more. The proportion of imports increase more than the increase of consumption may be caused by the condition of Indonesian soybean imports were not restricted by the quota. Since 1979 restrictions on soybean imports through quotas no longer applied after previously applied from 1973, so this condition has triggered importers to import more. Soybean imports now are made by Registered Importers (IT) and Importers Manufacturers (IP), as well as the addition of state-owned enterprises as the importer of soybeans that participated in the Soybean Prices Stabilization Program, therefore, opened the opportunity for another state other state-owned enterprises than the Company BULOG to participate.
The number of parties that can import and unlimited imported soybeans makes import increased by a greater proportion than the increase in soybean consumption.

Table 1. Regression Analysis 2SLS

| Equation | Variable | Coefficient | Standard Error | t-statistic | Prob |
|----------|----------|-------------|----------------|-------------|------|
| I        | Constant | -2.651      | 3.145          | -           | 0.406|
|          | LnK      | 2.662***    | 0.341          | 7.801       | 0.000|
|          | LnPD     | -1.450 ***  | 0.351          | -           | 0.000|
|          | LnKR     | -0.930      | 0.092          | 4.134       | 0.000|
|          | LnHI     | -0.227      | 0.167          | -           | 0.184|
|          |          |             |                |             |      |
|          | R Square  | 0.955       |                |             |      |
|          | Adjusted R Square | 0.949 |             |             |      |
|          | F-statistic | 168.027    |                |             |      |
| II       | Constant  | 1.830       | 0.973          | 1.880       | 0.096|
|          | LnIM     | 0.304***    | 0.100          | 3.049       | 0.005|
|          | LnPD     | 0.542***    | 0.092          | 5.864       | 0.000|
|          | LnY      | 0.062       | 0.045          | 1.361       | 0.183|
|          |          |             |                |             |      |
|          | R Square  | 0.962       |                |             |      |
|          | Adjusted R Square | 0.958 |             |             |      |
|          | F-statistic | 276.571    |                |             |      |
| III      | Constant  | -3.791      | 2.369          | -1.600      | 0.119|
|          | LnK      | 2.007***    | 0.281          | 7.146       | 0.000|
|          | LnHD     | -0.132      | 0.085          | -1.553      | 0.130|
|          | LnIM     | -           | 0.193          | -3.574      | 0.001|
|          |          |             |                | 0.691***    |      |
|          | R Square  | 0.652       |                |             |      |
|          | Adjusted R Square | 0.620 |             |             |      |
|          | F-statistic | 20.586***  |                |             |      |

Source: Secondary Data analysis, 2017
Note: *** Significant at α = 1%

Consumption of soybean jointly influenced by imports of soybean, soybean production, and income per capita, while partially influenced by imports and soybean production as shown in eq.II. Consumption is positively influenced by imports and production. The change of soybean consumption is smaller than of import and production for soybeans. Although soybean imports have increased, people tend to increase their consumption is not too much because people have the alternative option to consume other foodstuffs. Similarly, the industry, their own production capacity with the availability of capital and the need for raw materials that have been adjusted. So, although soybean imports more they tend to increase the production of not more. Moreover, the addition of soy production that occurs is the result of efforts to substitute imported soybeans, so if the production increase, soybean imports will tend to be reduced. This is because the availability of soybeans in the market tends not to increase much.
Production has a negative effect on soybean imports, if the soybean production increases, soybean imports will decline. Based on the eq.I show that the percentage change in soybean imports is greater than the percentage change in production of soybeans, the increased production will result in a decrease in the proportion of imports that much more. This happens because one focus of the government is to achieve self-sufficiency soybeans so expect the level of import dependence can be reduced.

Soybean production is jointly influenced by consumption, the domestic soybean price, and soybean imports, while partial, production positive influenced by consumption and negative by imports, as presented in Eq.III. The change of soybean production is greater than that of soybean consumption, meanwhile, the change of soybean production is smaller than that of soybean imports. A lower soybean production makes cheaper prices at the farm level, as imports of soybeans occur constantly to meet domestic demand. The Increasing of soybean imports gives the effect to the decreasing of domestic soybean prices, but it does not have any effect on reducing the price of processed soybean products and animal food products from soybeans. The higher imports, the market power will be lower in determining the input prices and if import activity continues to rise, there is a possibility that the people who get in charge in the market can be functioned as the price recipients [8].

The exchange rate has no effect on soybean imports is partial because soy is the consumption needs that must be met. In addition, soy is a commodity that is highly maintained a stable supply and price, as it will greatly affect the economic conditions of consumer goods other given soy is one kind of strategic commodities, therefore strengthening or weakening rupiah would not affect the number of imported soy. Although the rupiah is down, soybean imports will remain to be done in order to meet consumption and maintaining economic stability in the country.

International soybean prices also had no effect on soybean imports partially. According to research previous study [9] the dependence on imported soybeans is one of the factors causing no effect of soybean import prices on soybean demand. The quantity of imported soybean exceeds the quantity of locally made imported soybean price has its share large enough so that the amount of soybean demand is not affected by the price of soybean itself. The most effective solution to meet the domestic soybean shortage in the short term is to import soybeans. So regardless of the prevailing price of imported soybean, the government will continue to buy soybean imports. This is done to ensure the availability of soy for households to be consumed directly and also for the industry which is used as raw materials. Therefore, it is high or low prices prevailing soybean imports have no effect on soybean demand in Indonesia.

3.2. Trends and Projections of Indonesia Soybean Production in 2016-2020

According to the analysis of production trends (in appendix), obtained the best production trends equation model is Cubic. This model will be used to look at the trend of soybean production during the years 2016-2020. Indonesian production trend chart can be seen in the following figure:
Based on Figure 1, it can be seen that the trend of Indonesia soybean production is to follow the non-linear patterns that tend to increase then decrease. The trend of soybean production in 2016-2020 has a tendency to increase with a percentage of 11.18% per year. If the consumption figures are not much increased the imports can be reduced. However, if the consumption figures also increase, could not be ascertained if the number of imports will be reduced.

About 50 countries around the world grow soybean and the total soybean production was estimated at 269 million Mg in 2012/2013. Among the 20 highest producing countries, the USA is currently the largest producer of soybean, followed by Brazil, Argentina, the People’s Republic of China and India [10]. Although as one of the most soybean producing countries in the world, the Chinese state is also the largest importer of soybeans from the United States. The increase in consumption of vegetable oils in China, resulting in dependence on soybean imports to be very high. In addition, there is competition between cereal crops such as corn to soybeans. The decision to focus more cereal crops make Chinese soybean production tends to decline [11]. Over the past five years, the trend of production in China decreased by 5.05% per year [12].

Indonesia soybean production in 2016-2020 can be sought from the trends that have gained value. Here are the results of the calculation of the projected soybean production in 2016-2020.

**Table 2. Projection of Indonesia Soybean Production in 2016-2020**

| Year | Trends Production (Y') | Average SR | Yt = Y'SR |
|------|-------------------------|------------|-----------|
| 2016 | 1,062,744.85            | 104.5      | 1,110,537 |
| 2017 | 1,175,598.62            | 104.5      | 1,228,466 |
| 2018 | 1,309,786.21            | 104.5      | 1,368,688 |
| 2019 | 1,466,584.63            | 104.5      | 1,532,538 |
| 2020 | 1,647,270.95            | 104.5      | 1,721,350 |
| **Average** |                       |            | **1,392,316** |

Source: Secondary Data Analysis, 2017

Based on projected results showed that Indonesia soybean production in 2016-2020 continued to increase. Production in 2016 is projected at 1,110,537 tons, while in 2020 it will increase to 1,721,350 tons. Increased production is affected by the consumption is increasing as well. Increased consumption of an impact on the growing demand to encourage farmers to increase production. Nevertheless, the production target of 2019 to achieve self-sufficiency of 3 million tons of soybean is not expected to be sustainable. Based on the projection, soybean production in 2019 was only able to achieve 51% of its production targets.

Based on the agricultural center of research and development, to increase soybean production in Indonesia needs to be developed five sources, namely expansion of soybean growth, increased productivity, increased yield stability, suppression, and suppression gap is the result of yield loss. Of the five sources of soybean growth is then that has the largest contribution to the increase in production is the expansion of the area [14]. Availability of farmers who want to cultivate soybeans is important, besides the availability of land [15]. Farmers were not willing to plant soybeans if they can’t profit from the farm. Farmers will suffer losses if the community prefers soybean imports because it has a cheaper price. The establishment of the purchase price the government does not help if the price of soybean imports is still cheaper than the price of local soybean. To overcome this problem, it is necessary to keep the price of imported soybeans remains under control.

### 3.3. Trends and Projections of Indonesian Soybean Imports in 2016-2020

Based on the analysis of import trends (in appendix), the model obtained the best import trend equation model is quadratic. The trend of Indonesia soybean imports chart can be seen in the following figure:
Referring to Figure 2 it can be seen that the trend of Indonesian soybean imports is to follow the nonlinear pattern that is likely to increase. The import trend in 2016-2020 has a tendency to increase with an average percentage of 4.13% per year. If you look at the trend of the previous production also tends to rise, increasing import trend may mean that soy consumption in Indonesia is also increased so that despite increased production, import figures have not been able to decline if the increase in consumption is still higher.

The development of world import volumes tends to increase in the period 2009 - 2013, with an average of 6.59% per year. The increase in import volume is quite high in China with an average increase of 10.48% per year. Indonesia’s import volume average increased by 9.33% per year. Two countries tend to decrease, namely, Japan fell by an average 4.63% per year on average and Taiwan fell 2.25% per year [12]. China, Japan, and Taiwan are included in the three soybean importing countries in East Asia, where the fourth position is South Korea. Contributions fourth are as much as 70% of the international soybean trade. Countries in East Asia has reduced soybean planting, resulting in the production of fewer, consequently, these countries have to import soybean [15].

The result of trends that have gained value can then be used to project the value of Indonesia's soybean imports in 2016-2020. Here are the results of the calculation of the projected soybean production in 2016-2020.

| Year | Trends import (Y') | Average SR | Yt = Y'SR |
|------|---------------------|------------|-----------|
| 2016 | 2,226,245.398       | 99.91      | 2,224,188 |
| 2017 | 2,320,012.762       | 99.91      | 2,317,869 |
| 2018 | 2,415,841.769       | 99.91      | 2,413,610 |
| 2019 | 2,513,732.419       | 99.91      | 2,511,410 |
| 2020 | 2,613,684.713       | 99.91      | 2,611,270 |
| Average | 2,415,669          |            |           |

Source: Secondary Data Analysis, 2017

Based on projected results can be seen that the Indonesian soybean imports in 2016-2020 continue increasing. Based on Eq.I, the increase in consumption is likely to result in import increase with a higher percentage of the increased production while potentially lead to a reduction of imports with the higher percentage, but the effect of consumption greater than production. It seems that the next five years consumption increase is very large and exceeds the increase in production, so even though production increased, imports have not been able to decline.
4. Conclusions
Factors affecting soybean imports in Indonesia is the consumption and production of soybeans. If consumption increases, import and production will also increase and if production increases, imports will be decline while consumption is increasing. The opposite relationship, if the imports increased, then consumption will also increase, but production will be decline. The production trend of soybean in 2016-2020 has a tendency to increase with a percentage of 11.18% per year. Production in 2016 is projected at 1.110.537 tons while in 2020 it will increase to 1.721.350 tons. The import trend in 2016-2020 has a tendency to increase with an average percentage of 4.13% per year. Imports in 2016 are projected at 2.224.188 tons while in 2020 it will increase to 2.611.270 tons.

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