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Self Sufficiency Outlook of Indonesia Soybean on the Era of Trade Liberalization

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ABSTRACT

The aim of this study is to formulate an alternative policy that can be carried out by the government to encourage the increased production of soybeans which are needed to achieve self-sufficiency in Indonesia soybean on the trade liberalization era. Econometric model of Indonesia soybean economy was built through the system of simultaneous equations and the parameter estimation used the *Two Stage Least Square* (2SLS). Alternative formulation of policies carried out by using the *ex-ante simulation.* The results showed as follow: (1) Increased soybean productivity by 1.5% together with the soybean harvested area by 3% has not been able to increase domestic soybean production in conditions of self-sufficiency. Indonesia's soybean imports still 68.69% of the total demand for soybeans Indonesia (2) Alternative policies to achieve soybean self-sufficiency in trade liberalization era was to increase the soybean productivity up to 1.60 tons/ha and increasing harvest area up to 1.89 million ha or increasing the soybean productivity up to 2.00 tons/ha and increasing harvested area up to 1.51millio ha

KEYWORDS: econometric models, trade liberalization, simulation, policy

INTRODUCTION

Soy is a *"miracle crop"* [1]. Soybeans contain ± 40% vegetable protein, 35% carbohydrate, 20% fat, and 5% mineral [2]. In Indonesia, soy is the third most important food crop after rice and maize. Soybeans are an important food that is needed to improve nutrition, safe to eat, and it's cheap [3]. Most of the soy consumed in processed forms such as tempeh, tofu, soy sauce, soy milk, tauco, and snack [4].

Indonesia is likely to increase demand for soybeans. This increase is caused by some factor. *First* is the increase of population. The population increased from 138 million (1974-1978) to 169 million (1984-1988), and then to 237 million (2009 -2010). *Second* is the increasing volume of consumption per capita in line with rising incomes. Soy consumption per capita increased from 4.69 kg (1974-1978) to 8.38 kg (1984-1988), and then be 10.01 kg (1994 to 2010). *Third* are the ever-expanding new soy consumers, who previously did not consume soy. *Fourth* is the number who said that the discovery of the processed soy products (tempeh and tofu) is a source of food that are beneficial to health.

Unfortunately, the high demand for soybeans is not able to offset the domestic soybean production [5][6][7]. As a result, more and more soybean imports to rise. Dependence on imported soybeans are higher when Indonesia began to liberalize trade. Soybean imports are initially averaged only 25% (1975-1998) rose to 61% (1999-2010). Moreover, 51% (1999-2010) Indonesia soybean imports from the United States (U.S.) in which according to Nuryanti and Kustiari [8], U.S. imports often use an instrument to pressure countries that are not integral to the politics and interests.

Dependence on soybean imports are high carry some consequences. *First,* the dangers of dependence on imports occurred at the time of price volatility. World soybean price fluctuations occur at the end of 2007. World soybean prices rose from U.S. $ 306 per ton to 520 U.S. dollars per ton in January 2008 [9]. Price paid by tempeh and tofu industry to soy imports in KOPTI, up from Rp 3.000/kg to 7.500/kg. A very high price increases are temporary stopping industrial activity of tempeh and tofu [10].

Second, the inability to produce in quantities to meet demand will be a weak point that could affect the nutritional condition of the community. The poor are already malnourished become increasingly lack of protein. In the long run, the condition can cause a decrease in the quality of Indonesian human resources. Finally, the impact is on various aspects of economic, social, and political.

In addition, the inability of self-sufficient in soybeans will spend foreign exchange. Expenditure of foreign exchange to soybeans import is opportunity cost, because of foreign exchange should be used for any other purpose that is more strategic and have a multiplier effect, for example, to developing and manufacturing infrastructure that can support the transformation of the agricultural sector to non-agricultural sector and the less favorable external conditions too. Because: i) the increase in oil prices leading to higher production costs, ii) increase in food prices in world markets; iii) decrease in world soybean production due to drought in major soybean producing countries (Brazil and Argentina) and the decline in harvested area of soybean in the U.S.; iv)

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control of the grain trade by some MNC; v) the entry of investors in commodity exchanges; vii) the occurrence of global climate change [11]; vi) The bio-energy policies in developed countries encourage the attraction between the interests of food and non-food [12].

Based on the above background, the efforts to increase domestic soybean production are absolutely necessary to reduce dependence on imported soybean, even if it may be as the self-sufficient in soybeans. Of course, policies that do must abide by the rules of the game in the context of the Agreement on Agriculture WTO. Therefore, this study aims to: i) Analyzing the impact of increased soybean productivity and or increase soybean harvested area of Indonesia soybean import dependency in the era of trade liberalization; ii) Formulate policy alternatives that can be done by the government to increase soybean production Indonesia in the era of trade liberalization.

MATERIALS AND METHODS

Sources and Data Analysis

The data used in this study is secondary data time series *(time series data)* relating to the economy of soybean in Indonesia period 1978 to 2010. Data obtained from various sources, namely Central Bureau of Statistics (BPS), Ministry of Agriculture (MoA), the Association of Indonesian Fertilizer Producers (APPI), FAOSTAT, *National Agriculture Statistics Service - United States Department of Agriculture* (NASS USDA), *Economics Research Service - United States Department of Agriculture* (ERS USDA), *Earth Policy Institute, Soy stat,* and *World food.*

Data analysis and simulation using simultaneous regression analysis with the method of Two Stage Least Square (2SLS) using SAS software 9.1 for Windows.

Model Identification, Estimation, Testing Parameters, and Model Validation

An equation will be identified if $(K - M) \geq (G - 1)$, where K is the total number of variables in the model (endogenous and predetermined); M is the number of variables (endogenous and exogenous) in the equation are identified, and G is the number of total equation (endogenous variables) on the model [13].

Economic model consists of 21 soybean equation/endogenous variable (G = 21), and 37 predetermined variables (25 variables and 12 exogenous variables endogenous lag). Total of all endogenous and predetermined variables is 58 (K = 58). The results show that the identification of each structural equation is over identified.

Testing a model using several statistical tests, among others: i) the F test (simultaneous testing), to test whether the exogenous variables are jointly significantly affect the endogenous variables, ii) t test (partial testing), to test whether a exogenous variables are individually significantly affect the endogenous variables; iii) the coefficient of determination (R^2), to determine the accuracy (goodness of fit) of the model used [14].

Indicators to determine the validity of the model using: i) *Root Mean Square Error* (RMSE) and *Root Means Square Percent Error* (RMSPE), is the deviation measures the value of variables from the actual values [15], ii) U-Theil with a value between 0 and 1. If U = 0, the model prediction is perfect and if U = 1, then the naive prediction models'; iii) U-Theil decomposition of the bias proportion (U^M), bias variance (U^S), and the bias of covariance (U^C). A model has good predictive power if the U^M and the U^S is close to zero and U^C values close to one [16].

Simulation Analysis

Model simulation was required to study the extent impact of changes in exogenous variables on endogenous variables. Simulation can be divided in half, historical simulation and ex-ante simulation.

Forecasting simulations performed on Indonesia soybean economic model. The conditions were as follows:

1. Simulation 1: increased productivity of Indonesia soybean was 1.5% (based on the actual growth rate of the average 1980 -2010),
2. Simulation 2: Indonesia increased soybean harvested area was 3% (based on the actual growth rate of the average 2006-2010),
3. Simulation 3: the combination of simulation 1 and simulation 2.
4. Simulation 4: policies to improve productivity and increase of harvested area are required to self-sufficiency in soybeans

RESULTS AND DISCUSSION

General Model of Econometrics Economic Soybean Indonesia

Model econometrics used in this study is quite representative to describe the economic phenomenon of soybean in Indonesia in the era of trade liberalization. This is evident from the evaluation criteria of economic and statistical criteria of the model. Model estimation results show that all the parameters in the model in line with expectations based on economic theory and logic.

The coefficient of determination most equations have a high value. For 16 that make up the model equations, the equation has a value of R^2 greater than 90% as much as 11 equations, R^2 values of 80-90% as much as three equations, the value of R^2 60-70 % by 1 equation, and R^2 values of 50-60% by 1 equation. This means that the explanatory variables entered into the equation could describe the behavior endogen variables.

Furthermore, F test to the whole equation shows that all explanatory variables that make up the equation is jointly significantly affecting endogen variables. F test results are confirmed by the results of the t test (partial testing) for each equation which shows that there are at least one explanatory variable that affect the real (have a high confidence level) of the variable endogen.

Test autocorrelation using *Durbin Watson test* (DW test) showed that of 16 equations that make up the model, there are only three equations that have symptoms of autocorrelation. According to Koutsoyiannis [13] as a result of the symptoms of autocorrelation, the estimators of regression coefficients obtained remains a probe-unbiased estimator, but the variance of the variable interference becomes less efficient when compared with the absence of symptoms of autocorrelation. Therefore, the estimation results of the model are still good enough to describe economic phenomena of soybean in Indonesia.

Model Validation

Econometric model validation used was statistical indicators RMSE and RMSPE. This was represented by the deviation value, namely the difference between the actual mean with the mean predicted. This shows that the lowest deviation value (regardless of sign) was 0.0003% and the highest deviation was 6.8238%. With relatively low level of prediction error, the economic model built Indonesia soybean economic model was valid, because the predictions result were able to approach the actual value.

Econometric model validation uses statistical indicators of the U-Theil decomposition, namely U^M, U^S, and U^C. The results show that the lowest U-Theil was 0.0010 and highest U-Theil was 0.1979. The lowest U^M value was 0.0000 and the highest U^M value was 0.2600. The lowest U^S value was 0.0000 and the highest U^S value was 0.3700. U^C lowest value was 0.5300 and the highest U^C value 1.0000. Because U-Theil was relatively small, U^M, and U^S values close to zero, and the U^C value close to one, then the model was said to be quite valid and can be used in the simulation analysis.

Simulation of Internal Factors

Indonesia is a country that ratified join *the World Trade Organization* (WTO), and therefore Indonesia should be submissive and obedient to the provisions of the WTO. All policies, including agricultural policy, which is made must be in harmony and not conflict with WTO provisions.

Basic pricing policies, tariffs, and subsidies are often done in the past is no longer applicable, so that policy can be carried out only broad policy of expansion of the soybean crop and increase productivity. Therefore, the simulation of internal factors and productivity of soybean harvested area was once used as an alternative policy.

The analysis of simulated internal factors (increased soybean productivity and soybean harvested area) is presented in Table 1 below.

Table 1 Simulation results of internal factors

		Change (%)		
No.	**Variable**	**Sim 1**	**Sim 2**	**Sim 3**
1.	Indonesia Soybean Harvested Area (LPIN)	-0.21	2.57	2.34
2.	Soybean Producer Price (PP)	-0.16	-0.31	-0.47
3.	Indonesia Soybean Productivity (YKIN)	1.49	-0.01	1.48
4.	Indonesia Soybean Production (QKIN)	1.28	2.55	3.86
5.	Indonesia Soybean Demand (DKIN)	0.06	0.12	0.18
6.	Soybean Demand for Tempeh (DKTP)	0.14	0.29	0.43
7.	Tempeh Price (PTP)	-0.50	-0.99	-1.50
8.	Soybean Demand for Tofu (DKTH)	0.05	0.10	0.14
9.	Tofu Price (PTH)	-0.06	-0.11	-0.17
10.	Indonesia Soybean Imports (IKIN)	-0.44	-0.89	-1.34
11.	Indonesia Price Soybean Imports (PI)	0.00	0.00	-0.02
12.	Indonesia Soybean Price (PKIN)	-0.50	-1.00	-1.50

Description:

- Sim: a simulation.
- Sim 1: simulation of increased productivity of Indonesia soybean was 1.5%.
- Sim 2: simulation of increased Indonesia soybean harvested area was 3%.
- Sim 3: the combination of simulation 1 and simulation 2.

From Table 1 it appears that the simulation by using a policy of increased productivity by 1.5% (simulation 1) and the expansion of soybean harvest by 3% (simulation 2) alone had a positive impact to

increased production and Indonesia soybean demand. Indonesia soybean production, respectively, increased by 1.28% and 2.55%, while demand for Indonesia soybean, respectively, increased by 0.06% and 0.12%. If the policy of increased productivity and harvested area is jointly carried out (simulation 3) then the impact is similar but much larger changes. Indonesia soybean production increased by 3.86% and the demand for soybean Indonesia rose by 0.18%.

Despite the increased soybean productivity and soybean harvested area increased positive impact on soybean production, but have not been able to significantly reduce imports. In the event of an increase in productivity of 1.5% soybean and soybean productivity by 3% together, Indonesia soybeans imports still 68.69% of the total demand for Indonesia soybeans so that the necessary increase in productivity and the land area is much larger. Therefore the government should focus on efforts to increase the productivity of soybean and soybean harvested area increased.

Simulation Factors Internal Factors Soybeans for self-sufficiency

Simulation of alternative policy scenarios for intensification and extensification agriculture be done to achieve self-sufficiency in soybeans, maximum import was 10%, at full trade liberalization only can be carried out policies to improve productivity and soybean harvested area in Indonesia. Guideline to increase soybean productivity was 1.60 tons/ha and 2.00 tons/ha. The land used for soybean production maximum 2 million hectares.

Simulation to increase Indonesia soybean productivity 1.60 tons/ha be done with an argument that Indonesia was able to match the productivity of maximum soybean productivity that can be achieved by countries that are both located in the tropical region of Southeast Asia (Thailand), namely 1.60 tons/ha [17]. Simulation of Indonesia soybean productivity 2.00 tons/ha be done with the argument that Indonesia soybean productivity will be able to match the level of productivity from soybean research, in which productivity was > 2 tons/ha.

Indonesia Soybean harvested area was assumed to increase to 2 million hectares. Republic of Indonesia government, through the Ministry of Agriculture, optimistic capable to make soybean extensification, so the land area increases up to 2 million hectares [3].

The results of policy simulation analysis was to increase the productivity of 1.60 tons/ha and the policy to increase soybean harvested area up to 1.89 million hectares. This occurs when there was full trade liberalization as shown in Table 2.

Table 2: Productivity rose to 1.60 tons/ha and Soybean Harvest Area rose to 1.89 million hectares

No.	Variable	Base Value	Simulation
1.	Indonesia Soybean Harvested Area (LPIN)	596467	1893477
2.	Indonesia Soybean Productivity (YKIN)	1.47	1.60
3.	Indonesia Soybean Production (QKIN)	879608	3036921
4.	Indonesia Soybean Demand (DKIN)	3015603	3320387
5.	Indonesia Soybean Imports (IKIN)	2103322	270316

Table 2 shows that the average size of productivity was 1.60 tons/ha and the harvested Indonesia soybean reached 1.89 million ha, soybean production was 3.04 million tons. When Indonesia soybean demand reached 3.32 million tons, about 91.46% soybean needs would be met from within the country, and only 8.54% was derived from imports. Therefore, if the Indonesian government could to improve the productivity of Indonesia soybean up to 1.60 tons/ha and did extensification area to 1.89 million hectares of soybean, then the self-sufficiency relative, where the import does not exceed 10%, will be achieved.

The results of simulation analysis of policies increase productivity by 2.00 tons/ha and a policy of soybean harvested area of 1.51 million hectares in the event of full trade liberalization are shown in Table 3.

Table 3: Productivity rose up to 2.00 tons/ha and Soybean Harvest Area rose to 1.51 million hectares

No.	Variable	Base value	Simulation
1.	Indonesia Soybean Harvested Area (LPIN)	596467	1514782
2.	Indonesia Soybean Productivity (YKIN)	1.47	2.00
3.	Indonesia Soybean Productivity (QKIN)	879608	3036921
4.	Indonesia Soybean Demand (DKIN)	3015603	3320387
5.	Indonesia Soybean Import (IKIN)	2103322	270316

From Table 3, it was known if the average size of productivity of 2.00 tons/ha and the harvested Indonesia soybean reached 1.51 million ha, then soybean production reached 3.04 million tons. When the demand for Indonesia soybean reached 3.32 million tons, then Indonesia has been able to meet 91.46% of the domestic soybean demand, and only 8.54% was derived from imports. Therefore, if the Indonesian government could to

improve the productivity of Indonesia soybean up to 2.00 tons/ha and did extensification area to 1.51 million hectares of soybean, the self-sufficiency relative, where the import does not exceed 10%, will be achieved.

CONCLUSION AND SUGGESTION

Conclusion

1. Increased soybean productivity by 1.5% and soybean productivity by 3% together have not been able to increase domestic soybean production in conditions of self-sufficiency. Indonesia's soybean imports still 68.69% of the total demand for Indonesia soybeans.
2. Alternative policies to achieve soybean self-sufficiency in trade liberalization era was to increase the soybean productivity up to 1.60 tons/ha and increasing harvest area up to 1.89 million ha, or increasing the soybean productivity up to 2.00 tons/ha and increasing harvested area up to 1.51 million ha.

Suggestion

1. Because the refined products made from raw soybeans are the primary food most of the people of Indonesia, the government through the Ministry of Trade shall supervise and regulate the import schedule that does not coincide with the soybean harvest.
2. Therefore the government of Indonesia through the Ministry of Agriculture should be able to encourage increased soybean productivity and soybean land area, including through the Field School, the correct cultivation techniques, the use of superior seed, and the printing of new fields.

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