SUPPLY OF SUGAR IN INDONESIA: AN EMPIRICAL STUDY

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Abstract
This paper analyzes the supply of sugar in Indonesia from the revenue side. The independent variables included in the model are domestic sugar price, import sugar price, tea price, coffee price, and a government policy on the pricing of provenance sugar price. The Error Correction Model (ECM) that is used to help analyzing the data finds that all variables influence the dependent variable both in the long run and in the short run, except the price of coffee.

Keywords: Supply of sugar, sugar price, tea, coffee, provenance price
JEL classification numbers: L66, Q18

INTRODUCTION
Sugar is one of the nine basic needs in Indonesia, thus a very important commodity for the community (Minister of Industry and Commerce No. 115/mpp/kep/2/1998 dated February 27, 1998). Sugar is consumed by households to complement tea, coffee, or other beverage and food. Sugar is also used by the industry as a raw material for various types of products. Sugar has been established as a special commodity in the World Trade Organization (WTO). The sugar industry in Indonesia has experienced the heyday in the Dutch colonial era in the 19th century, which was primarily intended for export commodity (see Mubyarto, 1984, or Dachliani, 2006). However, in 2012, Indonesia is the largest sugar importer in southeast Asia.
There are two types of sugar industries in Indonesia, which is a white crystalline sugar industry that uses sugarcane as the base ingredients, and refined sugar industry that uses imported raw sugar as one of the ingredients. Minister of Trade Regulation No. 111/2009 states that the refined sugar industry may only be distributed to the food and beverage industry, and should not be sold directly to the consumer. However, in early 2012, the Minister of Agriculture asked the Minister of Commerce to allow the import of sugar as an ingredient for white crystalline sugar for several companies in Indonesia. The granted import licensing has lowered the price of white sugar from Rp 10.500 to Rp 9.300, which lowers the welfare of cane farmers while reducing their interest to cultivate sugar cane in the future. This, if it takes place in the long run, will threaten the supply of domestic sugar.

As Indonesian economy increases, the raw sugar production is projected to increase in 2013, which gives no reason to import the commodity. Ministry of Commerce predicted that the total of white crystalline sugar production in 2013 will reach 3.8 million tons, while consumption is only at around 2.4 million tonnes. For refined sugar, import quotas in 2013 is as much as 2.265 million tonnes. Ministry of Commerce plans to construct a new HPP (harga patokan petani or farmer benchmark prices) and encourages to increase local production and improve the welfare of farmers (Neraca, 2013).

Observing the importance of sugar in Indonesia as well as Indonesian dependence on import sugar for many years, it is important to examine the factors that affect the supply of sugar in Indonesia. The variables that are hypothesized to be the determinants of the supply of sugar are the price of domestic sugar, the price of imported sugar, the price of tea, the price of coffee, and government policies on fixing the provenue price of sugar. The results of this study are expected to be on of the inputs for policy makers to maintain the supply of domestic sugar in Indonesia.

**Literature Review**

Studies on the sugar industry in Indonesia has been made by several researchers. Nelson and Panggabean (1991) examine the contradictions in Indonesian sugar policy. They use a policy analysis matrix (PAM) developed by Monke and Pearson (1989) to analyze the effect of Indonesia's sugar policy toward sugar production in irrigated areas with good irrigation system and in dry areas in Java. They found different results from the situations in other countries. They
found that the price of sugar exceeds the sugar price standards in other countries, while the input prices of sugar (cane) is lower than the input prices of sugar in other countries. To that end, the farmers should be given another motivation to continue growing sugar cane.

Widiastuty and Haryadi (2001) examined the application of sugar rates in Indonesia and came to the conclusion as follows. The hypothesis proved that the rate of sugar prices led to higher than average prices, thus causing changes in consumer surplus, producer surplus and government revenue. Consumer surplus is smaller than before the tariffs, because consumers now have to pay higher price of sugar. The existence of surplus producers causing rates to be greater than before the tariffs because manufacturers can now sell sugar at a higher price. The sugar import tariff levels optimal can not be determined.

Hadi (2005) estimated the effect of tariff and nontariff policies on the economy of sugar in Indonesia at the macro-level and micro-level aggregate farms. Using a partial equilibrium approach, they found that protectionist policies could significantly reduce imports and increase domestic sugar prices. In addition, there was also an increase in production, producer surplus, and the income of farmers.

Susila and Sinaga (2005) examined the sugar industry policy in Indonesia. They found that various policies related to output prices, input prices, and distribution systems, significantly affect Indonesian sugar industry. They also found that in terms of policies related to output prices, policies that are more directly related to the price level of the farmers are more effective policies. Thus, provenue pricing policies (ensuring price) has a higher effectiveness than the policy of TRQ (tariff rate quota) and import tariffs. The policies are effective to increase acreage, production and reduce imports. Furthermore, they also found that different combinations of provenue pricing policy, import tariff, TRQ and input subsidies are effective policy instruments for developing the national sugar industry and reduce imports.

Dachliani (2006) conducted a study on sugar import demand in Indonesia in 1980-2003 and concluded as follows. First, the variables that significantly affect the volume of sugar imports in Indonesia are the domestic sugar production, income per capita a year earlier, domestic sugar stock, and domestic sugar consumption. Second, sugar production and domestic stocks negatively affect the volume of imports, while the per capita income of the previous year and the consumption of sugar in the country have positive significance effects.
Rahayuningrum et al. (2007) investigate the factors that influence retail prices of sugar, with the following conclusion. First, the analysis shows that there are four main factors that affect the retail price of sugar in Indonesia, namely imported sugar prices, the benchmark price of sugar farmers, distribution costs, and the index of market concentration. Second, they found that HPP policy set by the government will affect the retail price, but price changes of HPP is not fully transferred to the retail price. Third, the structure of the market as measured by market share showed a significant effect on retail prices.

Zaini (2008) conducted a study on the influence of imported sugar prices, domestic sugar prices and domestic sugar production to the demand for the imported sugar Indonesia and came to the conclusion as follows. First, the increase in domestic sugar production can be done by expanding sugarcane plantations outside of Java and reduce conversion of plantation on the island of Java. Second, it requires the import restriction policy to protect farmers from the price slump of cane. Third, the required review of the deregulation policy of the sugar import tariffs are proportional.

The Theory of Supply and Prices

Supply shows the desire of the seller to sell their goods. The number of items offered by a producer associated with various factors such as the price offered, the price of other goods, and so on. The elasticity of supply measures the percentage of supply of goods and services change with the percentage price changes. Elasticity of supply is affected by many things. First, the elasticity is affected by the ability of sellers or producers in changing the amount of production, which is closely related to cost and production capacity. Second, the elasticity is affected by the period of analysis, namely the time needed to increase or decrease the amount of goods produced. The effect of period of analysis on the elasticity of supply can be divided into three categories, namely, in a very short period of time, short term and long term. Third, the elasticity is affected by inventory stock. The larger the inventory, the more elastic the supply. Fourth, the supply elasticity is affected by the ease of substitution of factors of production. The higher mobility of the machine (or other capital) and labor, the more elastic the supply.

According to Swastha (1998), the price is the amount of money needed to get the number of combinations of items (please see Kotler, 2002: 550 for more discussion). Factors affecting the price level is the demand and cost of production. Demand can be analyzed from the demand
curve. Nagel (1984) has defined nine factors that influence the demand for a product, namely the influences of the unique values, awareness of the replacement product, comparisons, total expenditure, benefits, cost, embedded investment, quality and stock prices. Cost is an important factor in determining the minimum price which should be set so that the company does not incur a loss. Competition within an industry can be analyzed by a variety of factors. These factors are the number of firms in the industry, the relative size of each company in the industry, product differentiation, ease of entry to the the industry, and customers.

METHODS
The data used in this paper are secondary data consisting of supply of sugar as the dependent variable and various independent variables, namely domestic sugar prices, imported sugar price, tea price, coffee price, and government policies of provenue price fixing of sugar (Kepmenhutbun Decree No. 363/MPP/Kep/8/1999/199 dated August 5) that aims to avoid the loss of farmers and encourage increased production. Secondary data was sourced from the BPS (Central Bureau of Statistics) and others who are competent with the publication of data that are relevant to this study, the period between 1986 to 2004.

To determine the influence of domestic sugar price, imported sugar price, tea price, coffee price, and government policy on the supply of sugar, we use an ECM model. The specifications of long-term model is as follows:

\[ LY_t = \beta_0 + \beta_1 L 1 + \beta_2 L 2 + \beta_3 L 3 + \beta_4 L 4 + \beta_5 X 5 + \epsilon_t \]  

The ECM model specification is as follows:

\[ DLY_t = \theta_0 + \theta_1 D 1 + \theta_2 D 2 + \theta_3 D 3 + \theta_4 D 4 + \theta_5 X 5 + \theta_6 \epsilon_{t-1} + \theta_7 u_t \]  

where \( Y \) = supply of sugar in Indonesia, \( X1 \) = domestic sugar prices, \( X2 \) = imported sugar price, \( X3 \) = tea price, \( X4 \) = coffee price, and \( X5 \) = dummy variable on government policy, \( L \) is the natural log operator, and \( D \) is the mean first difference operator.

RESULTS
Figure 1 presents the raw data of the variables analyzed. From this figure it appears that the observed time series data are not stationary, which can be seen from the trends that appear, so it
seems that we should conduct stationarity test and, if possible, use an ECM model to avoid spurious regression.

The stationarity test on the data in level is shown in Table 1. From the table it can be seen that all variables are not stationary in level. It can be seen from the ADF test of each variable which is less than the critical value, or the probability that all values exceed 5%. Thus we can say that in the 5% significance level, the data are not stationary.

**Table 1. Unit Root Test Result: in Level**

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF</th>
<th>MacKinnon Critical Values</th>
<th>Notes</th>
</tr>
</thead>
</table>

Source: *Badan Pusat Statistik*, Various Years

**Figure 1.** Plot of Raw Data
The next step is testing stationarity at first difference over such data. The results are shown in Table 2. From the table we can see that all variables are stationary at first differences. In other words, the variables are integrated at the level of 1 or $I(1)$, at least at the 10% level. It can be seen from the ADF value of each variable which exceeds the corresponding critical value, at least at the 5% level, except DLX3 and DLX4 which are stationary at 7%.

**Table 2. Unit Root Test Result: in First Difference**

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF</th>
<th>MacKinnon Critical Values</th>
<th>Prob</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1%</td>
<td>5%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>DLY</td>
<td>-5.290443</td>
<td>-4.616209</td>
<td>-3.710482</td>
<td>-3.297799</td>
</tr>
<tr>
<td>DLX1</td>
<td>-6.297443</td>
<td>-4.616209</td>
<td>-3.710482</td>
<td>-3.297799</td>
</tr>
<tr>
<td>DLX2</td>
<td>-5.801571</td>
<td>-4.616209</td>
<td>-3.710482</td>
<td>-3.297799</td>
</tr>
<tr>
<td>DLX3</td>
<td>-2.864795</td>
<td>-3.886751</td>
<td>-3.052169</td>
<td>-2.666593</td>
</tr>
<tr>
<td>DLX4</td>
<td>-3.530971</td>
<td>-4.616209</td>
<td>-3.710482</td>
<td>-3.297799</td>
</tr>
</tbody>
</table>

* Estimated using intercept only.

Source: Data Analyzed

After getting proofs that these variables are stationary at first difference, we will perform cointegration tests. This is done to find out whether there is a long-term equilibrium between the variables. From the test results in Figure 2 it appears that there is no unit root in the residuals of the long-term equation that we can say that there is a cointegration of the estimated variables, so that we can continue to estimate ECM models. However, first we should construct the long corresponding long-term model. The estimates of the long-term results models built shown in Table 3.
Before analyzing the estimation results in Table 3, we will see whether the model meets the classical assumption, namely the assumption of no serial correlation and homoscedasticity of constant variance. From the White heteroscedasticity test results in Table 4, it appears that the probability of Chi-Square is 0.111306 which exceeds 0.05. Thus we can not reject $H_0$ that the residuals of the model over the long term has a constant variance (homoscedastic).

**Table 4. Excerpt of White Heteroskedasticity Test, Long Run Model**

<table>
<thead>
<tr>
<th></th>
<th>F-statistic</th>
<th>Prob. F(9,9)</th>
<th>0.055464</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obs*R-squared</td>
<td>14.32252</td>
<td>Prob. Chi-Square(9)</td>
<td>0.111306</td>
</tr>
</tbody>
</table>

Source: Data Analyzed
Autocorrelation shows the correlation between members of series of observations, sorted by time or space. To test such correlation, this paper uses the Lagrange Multiplier (LM) test which includes lag variable lags. From the serial correlation test results, it appears that the probability of Chi-Square is 0.633376 exceeding 0.05. Thus we can not reject $H_0$ that the residuals of the model over the long term is not serially correlated.

Table 5. Excerpt of Autocorrelaition Test Results, Long Run Model

| F-statistic | 0.277752 | Prob. F(2,11) | 0.762642 |
| Obs*R-squared | 0.913382 | Prob. Chi-Square(2) | 0.633376 |

Source: Data Analyzed

To ensure that the process of inference on the long-term models can be done properly, then the assumption of normality in the residuals should be tested. This paper used Jarque-Bera test. We find that the value of Jarque-Bera is 0.550920 with a probability of 0.759223. Because the probability is more than 0.05, we can not reject $H_0$ that the residuals are normally distributed at 5% significance level.

Having proved that the model meets the classical assumptions, we will now analyze the results. From Table 3 it appears that all variables affect $LY$ except $LX4$ (log price of coffee). The adjusted $R^2$ shows the number of 0.857910 which indicates that the variation in the dependent variable explained by variation in the independent variables are as much as 85.79%, a quite high rate. The $F$-value is 22,736 with a probability of 0.000005 indicates that, in general, the built model explains the behavior of the dependent variable quite well.

From Figure 2 it appears that the variables analyzed are cointegrated. This means that the appropriate model to explain the behavior of the dependent variable in this case is the error correction model (ECM). The ECM model estimation results are shown in Table 6.

Table 6. ECM Model, Dependent Variable DLY

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>t-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>0.034506</td>
<td>2.245272</td>
<td>0.0463</td>
</tr>
<tr>
<td>DLX1</td>
<td>-1.943822</td>
<td>-7.066555</td>
<td>0.0000</td>
</tr>
<tr>
<td>DLX2</td>
<td>1.662733</td>
<td>5.687616</td>
<td>0.0001</td>
</tr>
<tr>
<td>DLX3</td>
<td>0.463453</td>
<td>3.287313</td>
<td>0.0072</td>
</tr>
<tr>
<td>DLX4</td>
<td>-0.018629</td>
<td>-1.418042</td>
<td>0.1839</td>
</tr>
<tr>
<td>X5</td>
<td>-0.051092</td>
<td>-2.672346</td>
<td>0.0217</td>
</tr>
<tr>
<td>RES1</td>
<td>-0.696169</td>
<td>-3.950967</td>
<td>0.0023</td>
</tr>
</tbody>
</table>
Before analyzing the ECM estimation results in Table 6, we will examine whether the residuals satisfy classical assumptions, namely homoscedasticity and no-serial correlation, as well as to meet the assumptions of normality for the benefit of the inference on the regression results. From the White heteroscedasticity test results in Table 7, it appears that the probability of Chi-Square is 0.672063 exceeding 0.05. Thus we can not reject \( H_0 \) that the residuals of the model over the long term has a constant variance (homoscedastic).

| Table 7. Excerpt of White Heteroscedasticity Test Result, ECM Model |
|-------------------|-------------------|-------------------|
| F-statistic       | 0.483160          | Prob. F(11,6)     | 0.859850 |
| Obs*R-squared     | 8.454947          | Prob. Chi-Square(11) | 0.672063 |

From the Breusch-Godfrey serial correlation LM test in Table 8, it appears that the probability of Chi-Square is 0.211098 exceeding 0.05. Thus we can not reject \( H_0 \) that the residuals of the model over the long term is not serially correlated.

| Table 8. Excerpt of Breusch-Godfrey Serial Correlation LM Test, ECM Model |
|-------------------|-------------------|-------------------|
| F-statistic       | 0.940210          | Prob. F(2,9)      | 0.425781 |
| Obs*R-squared     | 3.110868          | Prob. Chi-Square(2) | 0.211098 |

To ensure that the process of inference on the model ECM can be done properly, then the assumption of normality in the residuals should be tested. This paper used Jarque-Bera test. We find that the value of Jarque-Bera probability is 0.162529 with the probability of 0.921950. Because the probability is more than 0.05, we can not reject \( H_0 \) that the residuals are normally distributed at the 5% significance level.

Having proved that the model meets the assumptions of classical ECM, we will now analyze the results. From Table 3 it appears that all variables affect \( LY \) except \( DLX4 \) (log coffee price). The adjusted \( R^2 \) is 0.857910 which indicates that the variation in the dependent variable explained by variation in the independent variables are as much as 86.37%, a
quite good rate. The \( F \)-value is 18.95122 and the probability is 0.000005 indicates that the constructed model is able to to explain the behavior of the dependent variable.

From the results of model estimation, both the long term and ECM models, it appears that all the variables affect the supply of sugar, both in the long term and short term, except the price of coffee. Coffee prices have no effect on the supply of sugar both long in the long term and short term.

Based on the long term and short terms equations, it can be seen that the domestic sugar price have a negative significant impact on the supply of sugar in Indonesia, both in the long term and short term. This is presumably because many speculators involved in the sugar industry. In order to keep prices high, it is not uncommon these speculators are hoarding sugar. So when there is a shortage of sugar and the price increases, new sugar gradually released into the market. However, with the huge amount of imported sugar price in a lower price, the speculators need to release the sugar into the market with lower prices in order not to lose money.

Price of imported sugar affects the supply of sugar in a positive fashion, both in the long term and in the short term. This is probably because when the price of imported sugar increases, the general price will also increase, so the traders will increase the amount of sugar that is offered to the market.

The tea price significantly influences the supply of sugar in a positive manner, both in the long term and short term. Theoretically, when tea prices rise, demand for tea will drop so that the price of tea will decrease. Because the tea and sugar are complementary goods, then decrease in the demand for tea will be accompanied by the decrease in the demand for sugar. Eventually, this will be followed by a decline in the supply of sugar. But the results of this study is the reverse, namely an increase in the price of tea is followed by an increase in the supply of sugar. One possible explanation could be given as follows. The increasing price of tea will not have a major impact on the demand of tea because tea is a widely consumed commodity, and the price is relatively affordable. However, the demand for tea is generally a signal that there is an inflation in the economy. This means that an increase in tea prices coincides with the increase in sugar price, which will also increase the supply of sugar.
The coffee price does not significantly influence the supply of sugar both in the long term and short term. This is presumably because the culture of drinking coffee is not as strong as the culture of drinking tea, where tea and coffee are usually consumed with sugar.

The Dummy variable has a positive impact which means that government policies such as provenance price fixing of sugar from the farmers is able to increase the supply of sugar in Indonesia. Error correction term is negative and significant as expected, indicating that the ECM was valid.

CONCLUSIONS
This paper analyzes supply of sugar in Indonesia. The independent variables included in the model are domestic sugar price, import sugar price, tea price, coffee price, and a government policy on the pricing of provenance sugar price. The Error Correction Model (ECM) is used to help analyzing the data. From the results of model estimation, both the long term and ECM models, it appears that all the variables affect the supply of sugar, both in the long term and short term, unless the price of coffee. Coffee prices have no effect on the supply of sugar both long in the long term and short term.

Domestic sugar price have a negative significant impact on the supply of sugar in Indonesia, both in the long term and short term. This is presumably because many speculators involved in the sugar industry. Price of imported sugar affects the supply of sugar in a positive fashion, both in the long term and in the short term. This is probably because when the price of imported sugar increases, the general price will also increase, so the traders will increase the amount of sugar that is offered to the market. The tea price significantly influences the supply of sugar in a positive manner, both in the long term and short term. The coffee price does not significantly influence the supply of sugar both in the long term and short term. This is presumably because the culture of drinking coffee is not as strong as the culture of drinking tea, where tea and coffee are usually consumed with sugar. The Dummy variable has a positive impact which means that government policies such as provenance price fixing of sugar from the farmers is able to increase the supply of sugar in Indonesia.

REFERENCES
Badan Pusat Statistik, *Statistik Indonesia*, Beberapa Tahun Terbitan.


