Coffee export insurance premium estimates from Sumatera Utara Province in international market

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Abstract. Calculation of insurance premiums can be analysed based on a area’s yield index, weather and price volatility. This study reviewed based on the movement of Sumatera Utara coffee export prices. The purpose is to calculate and review the premium insurance for Sumatera Utara coffee exports in the international market. The research location was determined purposively with snowball sampling technique. The research data consisted of primary data which was collected by questionnaire and secondary data from Association of Indonesian Coffee Exporters Regional of Sumatera Utara and province’s statistical data. The coverage amount 32,458,011.5 IDR, it is obtained from calculation of costs incurred by exporters. The Black-Scholes method is used to determine the value of coffee export insurance premiums based on the export prices. The analysis shows that the higher trigger also increases the insurance premium, because the higher risk, so the higher premium.

1. Introduction
Coffee export has positive contributed to the Gross Domestic Regional Revenue in Sumatera Utara. Although export of coffee always fluctuate, in fact coffee exports gives a positive contribution to increase the revenue of Sumatera Utara. Study [1] shows that the average contribution of coffee exports to Sumatera Utara’s revenue is positive which is values 16.94%. Though coffee productivity in Sumatera Utara generally is still around 0.6-0.8 tons/ha, its coffee still has good competitiveness in the domestic and international markets. Because the coffee has a comparative and competitive advantage [2,3].

Sumatera Utara also has a port as the gateway for international coffee trade. Certainly, these opportunities can support the increasing of coffee exports development. Indeed, Sumatera Utara’s coffee exports have shown a significant achievement. But amid the complexity of coffee export activities, there are also various things that pose a risk to exporters, both in quality, price, transaction systems, financing, policies, competitiveness in international markets and even to the understanding of exporters themselves [4]. The competitor from other countries surely bringing up a new climate of competition and risk.

Risk management needs to be implemented in Sumatera Utara coffee export activities. Interviews with exporters found that potential and unforeseeable risks varied, such as product rejection by importers, accidents, theft, product damage, price volatility, force majeures and unilaterally cancelling contracts by importers. The study [5] shows that there is a relationship between the exchange rate and the price of other countries' coffee with Vietnam coffee. May Indonesia also has the same possibility because it is involved in the international trade of coffee. The trend of the exchange rate and export
prices of Sumatera Utara coffee can be seen in Figures 1 and 2. The correlation of export prices for Sumatera Utara coffee in 2018 and the exchange rate of the rupiah against the dollar in 2018 was 0.047.

![Figure 1](exports.png)  
**Figure 1.** Price of export coffee Sumatera Utara

![Figure 2](exchange.png)  
**Figure 2.** Rupiah exchange rate

Insurance provides protection mechanisms to minimize the risks faced by exporters. In the implementation, there are rights and obligations that must be fulfilled by the exporter and insurance. Exporters as the insured must pay a premium with the provisions provided by the insurance. While the insurance company must pay the coverage against risks that faced by exporters in accordance with applicable regulations. As for the index-based insurance, it can be estimated based on area’s yield index, climate indexes, and prices [6].

2. Materials and methods

2.1 Location and sample

This study was conducted in Sumatera Utara. This location was chosen deliberately with the criteria of the region as the largest coffee plantation area, having an international port which is the gateway for coffee imports and exports. The study activities held on June until August 2019. The determination of the sample was done by snowball sampling technique. Namely by establishing communication with the
Association of Indonesian Coffee Export Regional Sumatera Utara Management Agency. By discussing with one of the exporters, then the respondent is asked for advice to inform the researcher about other exporters. The number of respondents were 10 (ten) exporters.

The data used in this study consisted of primary and secondary data. Primary data in the form of estimated costs incurred by exporters in carrying out one coffee export activity. Starting from the cost of procurement, handling documents, processing and warehouse, packaging, transportation to the port (Free on Board / FOB).

2.2 Data analysis

Primary data are collected through in-depth interviews using a questionnaire for each respondent. Secondary data are data obtained from the Association of Indonesian Coffee Exporter Regional Sumatera Utara in 2014-2018 and the website of the Central Statistics Agency (BPS) of Sumatera Utara Province. The data that has been obtained is analysed descriptively to assess the risks that arise. While in estimating coffee export insurance premiums, it is carried out using the method Black Scholes which according to [7] the equation is as follows:

\[ C(s_t, t) = S_0e^{-(T-t)}N(d_1)-Ke^{-r(T-t)}N(d_2) \]  
\[ P(s_t, t) = Ke^{-(T-t)}N(-d_2)-S_0e^{-\delta(T-t)}N(-d_1) \]

With the determination of \( d_1 \) and \( d_2 \) (derivative values) as follows:

\[ d_1 = \frac{\ln \left( \frac{S_0}{K} \right) + (r-\delta) \frac{T-t}{\sigma \sqrt{T-t}}}{\sigma \sqrt{T-t}} \]  
\[ d_2 = \frac{\ln \left( \frac{S_0}{K} \right) + (r-\delta) \frac{T-t}{\sigma \sqrt{T-t}}}{\sigma \sqrt{T-t}} \]

Cost of coverage provided depends on the realization of the export price of coffee, where coverage will be accepted as \( P \) if the price is \( S_0<K \), but the coverage will be zero if \( S_0>K \). K is taken as the benchmark price which is the average of the annual price which has the strongest correlation with the volume of Sumatera Utara coffee exports. Premium index with the value of \( P_0 \) states that the payment can be written as:

\[ P_0 = Pe^{-r(T-t)}N(-d_2) \]

3. Results and discussion

3.1 Export price of Sumatera Utara coffee

The first step taken in conducting this study is by plotting data on the export price of coffee from Sumatera Utara to the international market monthly during 2014 to 2018. This data is processed from secondary data that obtained from the Association of Indonesian Coffee Exporters Regional Sumatera Utara. The export price of Sumatera Utara coffee in 2014-2018 can be seen in Figure 3.
Figure 3. Plot of price of export coffee from Sumatera Utara

Figure 3 shows that the export price of Sumatera Utara coffee (in dollars) always experiences fluctuations in every month from year to year. Fluctuations in world coffee prices and the exchange rate of the rupiah against the dollar have an influence on the volume of coffee exports from Indonesia [8,9]. Price volatility is often a concern for stakeholders in the coffee market [10].

3.2 Sumatera Utara coffee export volume

Next, is plotting the volume of coffee exports from Sumatera Utara to the international market each month from 2014 to 2018. This data is processed from secondary data obtained from the Association of Indonesian Coffee Exporters Regional Sumatera Utara. The volume of Sumatera Utara coffee exports in 2014-2018 can be seen in the following Figure:

Figure 4. Plot of volume of export coffee from Sumatera Utara

From Figure 4, it can be seen that the volume of coffee exports from Sumatera Utara Province also experiences fluctuations every month during the period 2014 to 2018. Through the results of interviews in the field obtained information that, in fact amid increasing world demand to coffee, original coffee stocks from Sumatera Utara still cannot cover the high demand for coffee needs.
3.3 Determination of coffee price index

The coffee price index is determined by analysing the correlation data between the export prices of Sumatera Utara coffee and its volume. The cell which is the strongest correlation value will be chosen as the index to be used in this study. Almost the same thing is also used in the calculation of premium based on rainfall intensity in Denpasar [11]. By using MS. Excel 2010 found that the strongest correlation was in Sumatera Utara coffee price data in 2018 with a correlation value of 0.75. This correlation value means that the relationship is relatively strong. The greatest correlation value is also found in the price column and volume 2018 with a value of 0.43.

| Vol 2014 | Vol 2015 | Vol 2016 | Vol 2017 | Vol 2018 |
|----------|----------|----------|----------|----------|
| P 2014   | 0.17     | -0.34    | -0.45    | 0.54     |
| P 2015   | -0.07    | 0.32     | 0.71     | -0.20    |
| P 2016   | 0.46     | 0.23     | -0.31    | 0.37     |
| P 2017   | -0.27    | -0.33    | 0.12     | -0.12    |
| P 2018   | 0.75     | 0.15     | -0.03    | 0.43     |

Table 1. Price and volume correlation of coffee exports

Table 1 shows that the strongest relationship value is the export price of coffee in 2018. So, 2018 was chosen as an index.

3.4 Price normality test

Normality test needs to be carried out in the method Black Scholes to meet the assumptions needed in order to proceed with data analysis [8]. When it meets the normality assumptions, then the insurance premium to be paid can be continued [12]. Normality analysis conducted in this study uses the Kolmogorov-Smirnov value with a significance level of 5%. The significance value of Kolmogorov-Smirnov obtained from the analysis of 2018 Sumatera Utara coffee export price data is presented in the Table below:

| Uji Normalitas Harga | N | Std-Deviation | Asymp. Sig (2-tailed) |
|----------------------|---|----------------|----------------------|
| Coffee Export Price  | 12| 0.4784         | 0.200                |

Analysis is performed using software SPSS 2.0. Table 2 can be concluded that with the total data of 12 coffee export price data, a significance value of 0.200 was obtained. This value is greater than the 5% confidence level (0.05), so the price data that used is normal.

3.5 Insurance coverage price

The next step taken is to determine the amount of insurance coverage for coffee exports. The insurance price is calculated based on the costs incurred by exporters while carrying out coffee export activities from Sumatera Utara. These costs include: purchasing green beans from collectors, promotions, warehouses, processing, purchasing packaging, packing seams, marking, transportation to port, quarantine, issuing export documents and dry bags. There are at least 13 documents that must be prepared by exporters, although only around 3 documents that is sent to importers generally, such as Declaration of Exported Goods (PEB), Certificate of Origin and Bill of Loading (B/L).

From the calculation of primary data, found that the average coverage price for each ton is obtained 63,643,160 IDR. Some assumptions used in this calculation are the insurance will pay 85% of losses and the payment system is non L/C with 60% payment in advance temporarily. So, the sum insured becomes 32,458,011 IDR.
3.6 Calculation of premium price

Calculation of the premium value was carried out using the Black-Scholes method. In this case, the \( S_0 \) value for percentile 9 = \( S_{9} \), percentile 10 = \( S_{10} \), percentile 11 = \( S_{11} \), percentile 12 = \( S_{12} \), percentile 13 = \( S_{13} \), percentile 14 = \( S_{14} \), and percentile 15 = \( S_{15} \). This percentile calculation is obtained from the price index coffee export in 2018. The illustration of the calculation of coffee export insurance premiums using Black-Scholes method can be seen below:

\[
P_0 = P e^{-r(T-t)} N(-d_2)
\]

Firstly, the calculation of cumulative distribution value \( d_2 \) from percentile 9 as follows:

\[
d_2 = \frac{\ln \left( \frac{S_o}{K} \right) + (r - \delta - \delta^2 /2)(T - t)}{\sigma \sqrt{T - t}}
\]

\[
d_2 = \frac{\ln \left( \frac{4.83}{5.5825} \right) + (0.065 - 0.0 - 0.4784^2 /2)(0.08)}{0.4784 \sqrt{0.08}}
\]

\[
d_2 = -1.052,
\]

so, the value of \( N(-d_2) = 0.137857 \).

The time period per year can be written as \( T-t = 0.08 \) with the standard deviation obtained is 0.4784. It is obtained from calculations using MS. Excel 2010. Variable K becomes the basis which is defined as the average coffee export price of the selected index price. When \( S_9 \) is the percentile 9th out of 12 available data, the value of \( S_9 \) is $4.83. By using the risk-free interest assumption of 6.5%. To calculate the premium price, the value of \( N(-d2) \) is entered into formula 5. Based on the calculation of distribution function, the 9th percentile cumulative distribution is 0.137857, the premium calculation in this study when the benchmark price is 9th percentile is:

\[
P_0 = P e^{-r(T-t)} N(-d_2) = 32,458,011 \text{ IDR} \times e^{-0.065 \times 0.08} \times 0.137857 = 4,447,716.70 \text{ IDR}
\]

The coffee export insurance premium paid at the 9th percentile is 4,447,716.70 IDR. The premium prices are optional with other percentile values are presented in Table 3.

| Percentile to Triggers ($) Coverage (IDR) Premium (IDR) Percentage (%) |
|-----------------|-----------------|-----------------|-----------------|-----------------|
| 9               | 4.83            | 32,458,011.5    | 4,447,716.70    | 7.0             |
| 10              | 4.86            | 32,458,011.5    | 4,738,150.60    | 7.4             |
| 11              | 4.87            | 32,458,011.5    | 4,888,045.72    | 7.7             |
| 12              | 4.88            | 32,458,011.5    | 5,041,070.38    | 7.9             |
| 13              | 4.90            | 32,458,011.5    | 5,157,863.39    | 8.1             |
| 14              | 4.91            | 32,458,011.5    | 5,157,863.39    | 8.1             |
| 15              | 4.92            | 32,458,011.5    | 5,477,947.23    | 8.6             |

Table 3 shows the premiums to be paid based on fluctuations in the export prices of Sumatera Utara coffee in 2014 to 2018. From the estimation results, it can be seen that the higher coffee export prices identify increasing premium costs [12,13] so that the price of coffee has an influence on increasing premium payments. But furthermore, the value of the premium may change based on the country of origin of the payment, the method of payment and the term of the loan. Non L/C payment methods potentially have a greater risk [14].
4. Conclusion
Premium prices to be paid are calculated based on the price of coffee exports index from Sumatera Utara to international markets. It is chosen from the data that has the strongest correlation between the price and volume of Sumatera Utara coffee exports. The value of coffee export insurance premiums obtained varies, higher if the trigger also increases. The value of insurance premiums will be higher if the potential risk is also large. It is recommended for further researchers to use more export price and volume data and to make a comparison between the value of insurance premiums determined by the company and the estimates made in the study. It also conducts analysis using other indices.

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