Determinants of Natural Rubber Export in North Sumatra Province

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Abstract: Rubber is a commodity that plays an important role in the Indonesian economy. Indonesia is one of the largest producing countries of natural rubber in the world. From 2000 to 2022, the export volume of natural rubber in North Sumatra experienced fluctuations, which was not in line with the increasing world's consumption of natural rubber. The export volume of natural rubber in North Sumatra is highly dependent on fluctuations in economic conditions, such as the price of natural rubber, the rupiah exchange rate, and inflation. This research aims to analyze the determinants of natural rubber exports in North Sumatra. This research uses secondary data from the period 1989-2022. Data were analyzed using a multiple linear regression model with the Ordinary Least Square (OLS) method to examine the determinants of natural rubber exports in North Sumatra. The research results show that all independent variables, namely the price of natural rubber, the rupiah exchange rate, and inflation, simultaneously or partially have a significant influence on the export volume of natural rubber in North Sumatra at a confidence level of 95 percent.

Keywords: Export, natural rubber, price, exchange rate, and inflation.

INTRODUCTION

Rubber (*Hevea brasiliensis)* is a plant species that follows the Hevea genus of the Euphorbiaceae family, a tropical wood tree originating from the Amazon forest. At least 2,500 plant species are recognized as producing latex worldwide, but *Havea brasiliensis* is currently the only commercial source of natural rubber production. Natural rubber is used in almost half of the world's total rubber production due to its unique mechanical properties, such as tear resistance, compared to synthetic rubber.

Currently, rubber plants have become one of the potential agricultural commodities in North Sumatra, which plays a role in providing a source of income for farmers, employment opportunities, a source of foreign exchange, support for the growth of new economic centers in areas around rubber plantations and in environmental conservation (Nawaz, 2022, Hermawan et al., 2023).

Natural rubber has a HS code in the goods classification list of 4001. The exported Indonesian natural rubber products consist of processed rubber in the form of smoke sheet, SIR 10, and SIR 20. Processed rubber is mostly aimed at the tire industry and its components, with the main importing countries being the United States, Japan, South Korea, and Germany (Prasetyo, 2018).

The rapid development of the automotive industry in various countries has increased the volume of rubber exports in North Sumatra. This is because 70% of the world market provides natural rubber for the tire industry, especially at three giant tire manufacturers, namely Goodyear, Bridgestone, and Michelin, which are closely related to the automotive industry. Sumatra Island provides the largest supply of rubber exports, especially in North Sumatra. Increasing demand from other countries will increase the volume of exports in North Sumatra (Indonesia Statistics, 2021).

In the current era of globalization, the natural rubber trade faces various challenges. The market is increasingly open to anyone, causing tight competition for exports of natural rubber commodities (Maksum et al, 2021). Open market conditions result in increasingly minimal market control forces, so new competitors in international trade are inevitable.

A country carries out international trade due to differences in opportunity costs. Differences in the opportunity cost of a product between one country and another can be caused by differences in the number or proportion of production factors owned (endowment factors) in each country. These differences lead to international trade. Countries with relatively more production factors and cheap production costs will specialize in producing and exporting their goods. It would be even better if each country imports certain goods if they have production factors that are relatively rare and expensive to make (Salvatore, 2014, Rahman et al., 2022).

Price is an essential factor because it will affect profits or potential risks due to price reductions. Price integration between importing and exporting countries is one of the benchmarks to see the response of exporting countries to changes occurring in importing countries. An integrated market occurs if price changes in one party can impact or be transmitted to other parties (Zahara et al., 2020).

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The price of natural rubber in international trade tends to fluctuate. This is one of the characteristics of sustainability. These price fluctuations have an impact on natural rubber trade flows and efforts to develop the natural rubber exports in North Sumatra to increase the country's foreign exchange, which has consequences for changes in the economic environment or trade policies that significantly affect income distribution (International Ruber Consortium Limited, 2018).

The rubber export destination of North Sumatra is at least 31 countries. The biggest destination countries are Japan, the United States, China, Brazil, and Canada. Even though there is a downward trend in export volume, it is reported that North Sumatra rubber export destinations are at least 31 countries. The largest export destination is Japan at 31.61%, followed by the US at 11.7%, China at 9.24%, Brazil at 9.11 %, and Canada at 6.57% of the total export volume of rubber in North Sumatra. There was a decline in export volume, driven by, among other things, reduced purchases from tire manufacturers in several countries and disruption of sales to Russia. However, the impact was not significant, and rubber production in North Sumatra Province is still less due to high rainfall (Republika, 2022). Therefore, this research aims to examine the determinants influencing the export volume of natural rubber in North Sumatra.

METODE

Method of Data Collection

The data used were secondary data for the period 1989 - 2022 or for 34 years, consisting of data on the export volume of natural rubber, natural rubber price, rupiah exchange rates, and inflation in North Sumatra. Data were obtained from the Indonesia Statistics, Provincial Agriculture Service, North Sumatra Industry and Trade Service, and other sources.

Data Analysis Model

The analytical model used to examine the influence of natural rubber prices, the rupiah exchange rate, and inflation on the volume of natural rubber exports in North Sumatra Province is a multiple linear regression equation with the following model:

$$\text{Log } (Y) = c + a_1 \text{ Log } (X_1) + a2 \text{ Log}(X_2) + a3X_3 + et$$

Where:

Y : Natural rubber export volume (thousand tons)

X_1 : Price of natural rubber (US Dollar/ton)

X_2 : Rupiah exchange rate (rupiah/$)

X_3 : Inflation (%)

Data processing in this research used the EViews 12 software program.

Coefficient of Determination

The coefficient of determination (R2) aims to see whether the independent variable provides sufficient meaning in explaining the dependent variable. In other words, the number of variations that occur in the independent variable can explain the dependent variable (Gujaraii, 2013).

Simultaneous Test (F-test)

The results of the F-test can be seen from the significance of all independent variables in influencing the dependent variable. The overall sample regression test (overall test) aims to find out whether the regression coefficient is significant or not simultaneously.

Partial Test (t-test)

The t-test aims to determine whether the regression coefficient is partially significant. This test is also called the t-test.

Classic Assumption Deviation Test

a) Normality Test

This test is to detect whether the residual is normally distributed by comparing the Jarque Bera (JB) value with the X2 table, provided that if the Jarque Bera (JB) probability is > 0.05, the residual is normally distributed. On the other hand, if the Jarque Bera (JB) probability is <0.05, the residual is not normally distributed.

b) Autocorrelation Test

The autocorrelation test uses the serial Correlation LM Test, where if the obs*R-squared probability value in the model is greater than the real level (α = 5%), the equation model does not have autocorrelation symptoms. On the other hand, if the obs*R-squared probability value in the model is smaller than the real level (α = 5%) used, then it can be concluded that the equation model has autocorrelation symptoms.

c) Heteroscedasticity Test

The Heteroscedasticity test is to test whether there is inequality of residual variance from one observation to another in a regression model. The way to detect symptoms of heteroscedasticity is to compare the Obs R-Square probability value with the specified significance level (α=5%).

d) Multicollinearity Test

The multicollinearity test is to test whether the regression model shows a strong correlation between the independent variables. This test is to examine double collinearity (multicollinearity) that can be seen from a tolerance value of less than 10.

RESULTS AND DISCUSSION

Development of the Export Volume of Natural Rubber

The development of the export volume of natural rubber in North Sumatra is presented in Fig. (**1**).

The volume of natural rubber exports in North Sumatra Province in the period 1989-2022 tended to fluctuate but generally decreased in 2021. The highest volume of natural rubber exports during 1989-2022 was achieved in 2006, namely 696,762 thousand tons.

Development of Natural Rubber Prices

The development of natural rubber prices in North Sumatra is presented in Fig. (**2**).

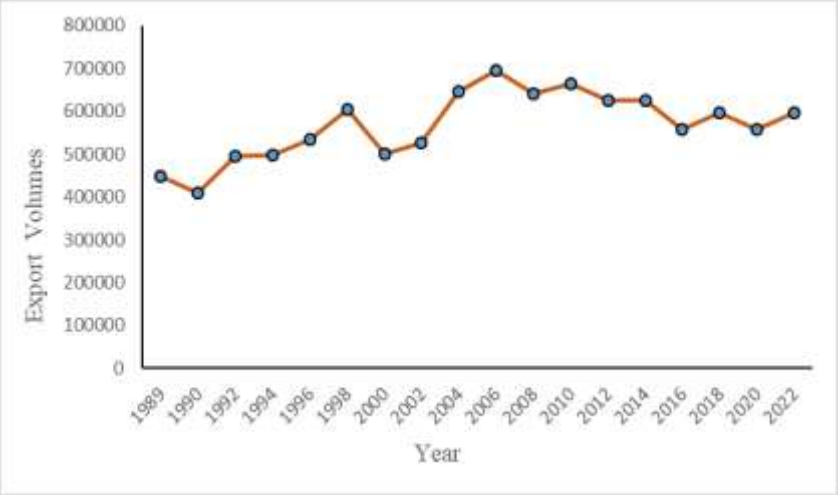

Fig. (1). Development of the export volume of natural rubber.

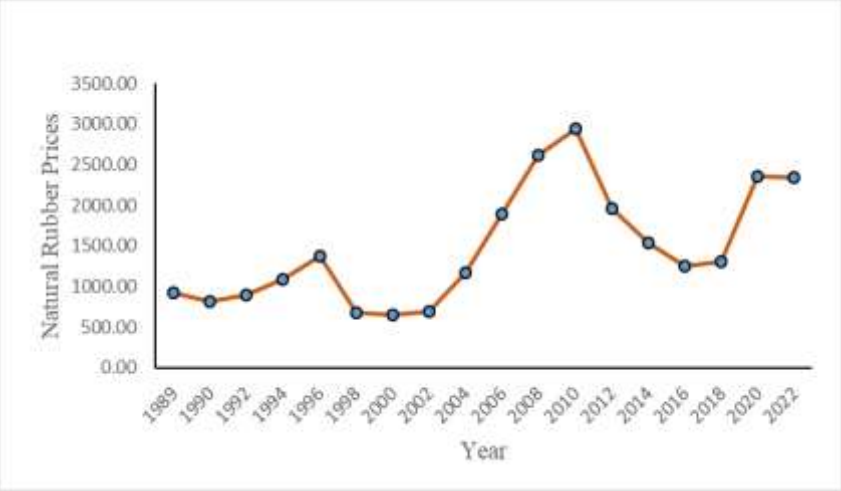

Fig. (2). Development of natural rubber prices.

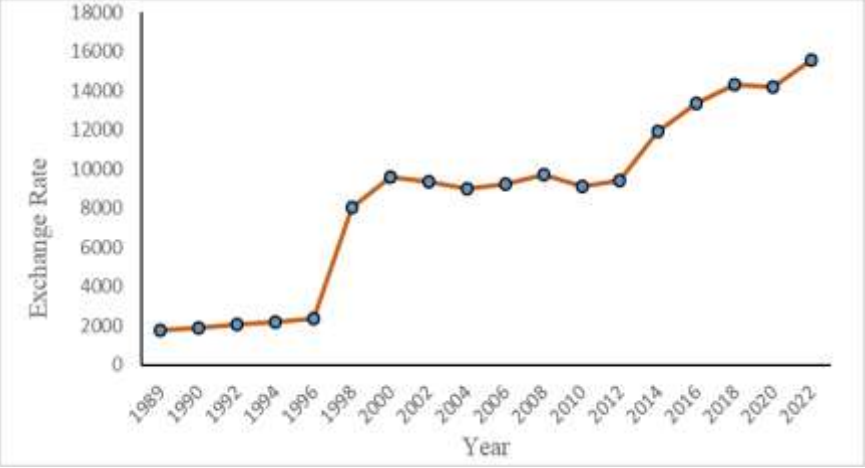

Fig. (3). development of the rupiah exchange rate.

The development of natural rubber prices in North Sumatra in the period 1989-2022 tended to fluctuate but generally increased again in 2021. The highest price of natural rubber during 1989-2022 was achieved in 2010, namely 2950 US dollars/ton.

Development of the Rupiah Exchange Rate

The development of the rupiah exchange rate in North Sumatra is presented in Fig. (**3**).

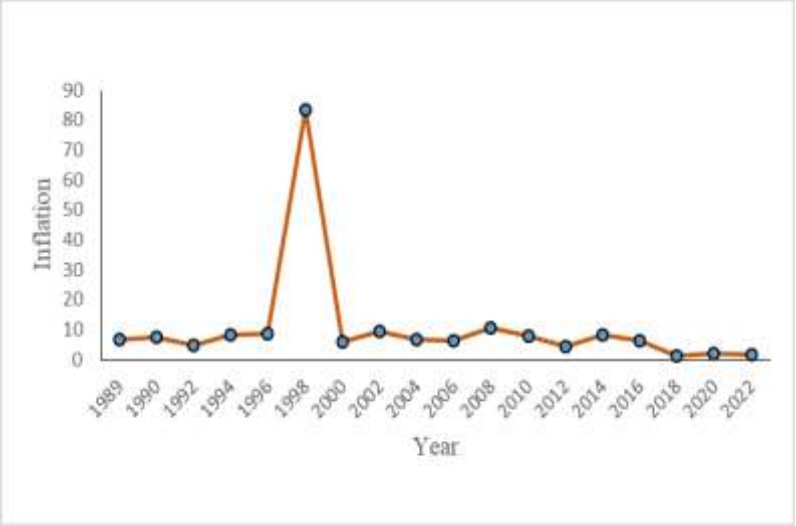

Fig. (4). Development of inflation.

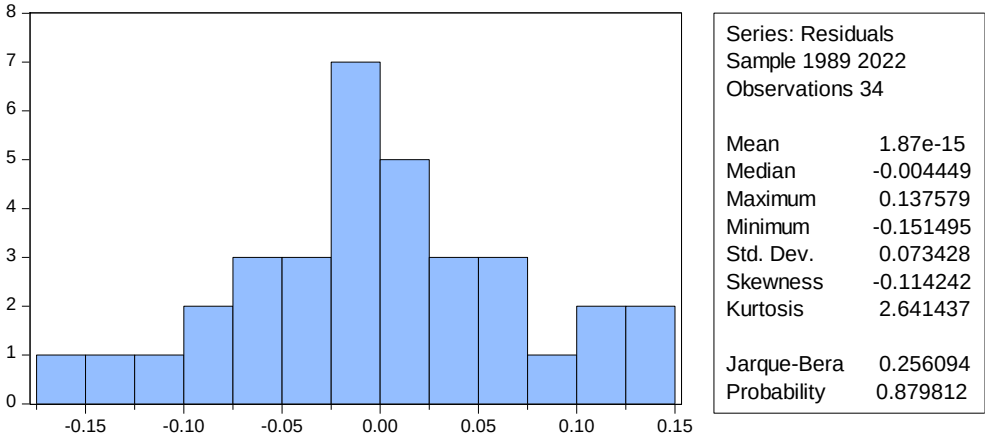

Fig. (5). Normality Test Results.

The development of the rupiah exchange rate in North Sumatra in the period 1989-2022 tended to fluctuate but generally increased. The highest rupiah exchange rate during the 1989-2022 period was achieved in 2022, namely IDR. 15,590/US dollars.

Development of Inflation

The development of inflation in North Sumatra is presented in Fig. (**4**).

The development of inflation in North Sumatra in the period 1989-2022 tended to fluctuate but generally experienced a decline. The highest inflation during 1989-2022 was in 1998, namely 83.56%. This was due to an economic crisis in North Sumatra.

Furthermore, the classical assumption test is needed to obtain a good and unbiased regression analysis and can be used as an appropriate prediction tool. The results of the classical assumption test analysis are as follows.

Normality Test

The normality test is to test the significance of the influence of the independent variable on the dependent variable through the t-test. It will only be valid if the residual has a normal distribution. The results of the normality test are shown in Fig. (**5**) above.

The test results show that if the probability value of the Jarque Bera test is greater than alpha 5% or 0.4252 > 0.05, then the null hypothesis is accepted, which means the residuals are normally distributed, or the distribution of the data analyzed is normal, since there are no extreme values in the data.

Autocorrelation/Serial Correlation Test

Autocorrelation occurs when errors or residuals of several periods are correlated. The results of the serial correlation test are shown in Table **1** below.

Table 1. Results of Serial Correlation or Autocorrelation Test.

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	**1.249595**	**Prob. F(2,28)**	**0.3021**
Obs*R-squared	**2.786057**	**Prob. Chi-Square(2)**	**0.2483**
Test Equation:			

Dependent Variable: RESID				
Method: Least Squares				
Sample: 1989 2022				
Included observations: 34				
Presample missing value lagged residuals set to zero.				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.034365	0.221834	0.154912	0.8780
LOG(X1)	-0.002693	0.031374	-0.085823	0.9322
LOG(X2)	-0.001563	0.020429	-0.076491	0.9396
X3	-0.000211	0.001033	-0.204278	0.8396
RESID(-1)	0.295443	0.194125	1.521921	0.1392
RESID(-2)	0.003226	0.196964	0.016377	0.9870
R-squared	0.081943	Mean dependent var		1.87E-15
Adjusted R-squared	-0.081996	S.D. dependent var		0.073428
S.E. of regression	0.076379	Akaike info criterion		-2.147423
Sum squared resid	0.163347	Schwarz criterion		-1.878065
Log likelihood	42.50619	Hannan-Quinn criter.		-2.055564
F-statistic	0.499838	Durbin-Watson stat		1.916265
Prob(F-statistic)	0.773681	-	-	-

The test results show that the Prob. F-statistic is greater than the alpha level of 5% or 0.05, where the prob value is 0.7031 > 0.05. Then, the null hypothesis is accepted, which means that there is no autocorrelation or no correlation between confounding errors in period t and errors in period t-1 (previous) in the regression model.

Heteroscedasticity Test

Heteroskedasticity occurs when the error or residual does not have a constant variance throughout the data value, which will affect the statistic test value at a confidence interval of 5%. The results of the heteroscedasticity test are shown in Table **2** below.

Table 2. Results of the Heteroscedasticity Test.

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	**0.324788**	**Prob. F(3,30)**	**0.8074**
Obs*R-squared	**1.069541**	**Prob. Chi-Square(3)**	**0.7844**
Scaled explained SS	**0.683402**	**Prob. Chi-Square(3)**	**0.8771**
Test Equation:			
Dependent Variable: RESID^2			
Method: Least Squares			
Sample: 1989 2022			
Included observations: 34			
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-0.008872	0.020027	-0.442981	0.6610
LOG(X1)	0.001545	0.002841	0.543702	0.5907
LOG(X2)	0.000376	0.001876	0.200378	0.8425
X3	-3.92E-05	9.35E-05	-0.419489	0.6778
R-squared	0.031457	Mean dependent var		0.005233
Adjusted R-squared	-0.065397	S.D. dependent var		0.006805
S.E. of regression	0.007024	Akaike info criterion		-6.968710
Sum squared resid	0.001480	Schwarz criterion		-6.789139
Log likelihood	122.4681	Hannan-Quinn criter.		-6.907471
F-statistic	0.324788	Durbin-Watson stat		1.874507
Prob(F-statistic)	0.807399	-		

The test results show that the Prob. F-statistic is greater than the alpha level of 5 percent or 0.05, where the prob value is 0.868 > 0.05. Then, the null hypothesis is accepted, meaning there is no heteroscedasticity or equal variance of errors for all observations of each independent variable in the regression model.

Multicollinearity Test

Multicollinearity is a condition where the independent or independent variables are strongly interconnected. The results of the multicollinearity test are presented in Table **3** below.

Table 3. Results of the Multicollinearity Test.

Variance Inflation Factors			
Sample: 1989 2022			
Included observations: 34			
-	**Coefficient**	**Uncentered**	**Centered**
Variable	**Variance**	**VIF**	**VIF**
C	0.048208	276.3626	NA
LOG(X1)	0.000970	289.8299	1.388427
LOG(X2)	0.000423	191.9745	1.254072
X3	1.05E-06	1.609946	1.121869

The test results show that the VIF values are less than 10, which indicates that there is no multicollinearity problem in the model or that a variable is not strongly correlated with other variables in the analysis model.

The estimation results of multiple linear regression on the determinants that influence the volume of natural rubber exports in North Sumatra Province are provided in Table **4** below.

Table 4. Estimation Results of Multiple Linear Regression.

Dependent Variable: LOG(Y)				
Method: Least Squares				
Sample: 1989 2022				
Included observations: 34				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	11.50269	0.219563	52.38894	0.0000
LOG(X1)	0.127530	0.031149	4.094169	0.0003
LOG(X2)	0.092486	0.020573	4.495557	0.0001
X3	0.002290	0.001025	2.233591	0.0331
R-squared	0.691379	Mean dependent var		13.26164
Adjusted R-squared	0.660517	S.D. dependent var		0.132175
S.E. of regression	0.077012	Akaike info criterion		-2.179574
Sum squared resid	0.177926	Schwarz criterion		-2.000003
Log likelihood	41.05277	Hannan-Quinn criter.		-2.118335
F-statistic	22.40219	Durbin-Watson stat		1.377380
Prob(F-statistic)	0.000000	-	-	-

The coefficient of determination (R2) value is 0.7938. This shows that 79.38% of the variation in the variable of export volume of natural rubber can be explained by the price of natural rubber, the rupiah exchange rate, and inflation, while the remaining 20.62% is explained by other variables excluded in the estimation model.

The simultaneous test results are Prob (F) is < 0.05, showing that the price of natural rubber, the rupiah exchange rate (exchange rate), and inflation simultaneously have a significant effect on the export volume of natural rubber at a confidence level of 95%.

The Influence of Natural Rubber Price on the Export Volume of Natural Rubber in North Sumatra

Based on the estimation results in Table 4, the price of natural rubber has a positive influence on the export volume of natural rubber, with a coefficient value of 0.1620, meaning that every 1 percent increase in the price of natural rubber will increase the export volume of natural rubber by 0.1620 percent. Based on the results of the prob test, namely 0.000 < 0.05, the price of natural rubber has a significant influence on the export volume of natural rubber at a confidence level of 9%. This is because if the price of rubber rises, farmers will increase inputs in the production process, meaning that production will increase, thereby increasing the supply and export volume of natural rubber.

The research results are in line with research by Suri (2020), who stated that the export price of natural rubber partially has a real influence on the export volume of natural rubber in North Sumatra. The research results by Fauzi (2021) show that price and production volume have a significant effect on the export volume of Indonesian natural rubber at a significance level or real level of 5%.

The Influence of the Rupiah Exchange Rate (Exchange Rate) on the Export Volume of Natural Rubber in North Sumatra

Based on the estimation results in Table 4, the rupiah exchange rate or exchange rate has a positive influence on the volume of rubber exports, with a value of 0.1050, meaning that every increase in the rupiah exchange rate or depreciation of the rupiah by 1 percent will increase the export volume of natural rubber by 0.1050 percent. Based on the results of the prob test, namely 0.000 < 0.05, the rupiah exchange rate has a significant influence on the export volume of natural rubber at a confidence level of 95%. This is because an increase in the rupiah exchange rate means the value of the Indonesian rupiah will weaken or depreciate, resulting in the increasing volume of natural rubber exports.

The research results are in line with research by Mawardi (2021), who stated that the variable of exchange rate or the rupiah exchange rate has a positive influence on the export volume of Indonesian natural rubber to Brazil. Research results by Busyra (2014) stated that the world rubber price and the rupiah exchange rate have a positive and significant influence on the export volume of natural rubber in Jambi. This is similar to the results of research conducted by Ginting (2013), who stated that exchange rates in the long term and short term have an influence on Indonesian exports. In other words, a stronger dollar exchange rate or a weakening rupiah or depreciation will cause an increase in Indonesian exports.

The Influence of Inflation on the Export Volume of Natural Rubber in North Sumatra

Based on the estimation results in Table 4, inflation has a positive effect on the volume of natural rubber exports, with a value of 0.0020, meaning every 1 percent increase in inflation will increase the export volume of natural rubber by 0.0020 percent. Based on the results of the prob test, namely 0.020 < 0.05, inflation has a significant influence on the export volume of natural rubber at a confidence level of 95%. This is because inflation causes domestic prices to be more expensive. However, in general, rubber export trade in North Sumatra is contractual with importing countries or futures trading. Thus, in spite of inflation, the export volume of natural rubber in North Sumatra still increases.

The research results are in line with research by Situmorang (2010), who stated that inflation and natural rubber production have a positive and significant influence on the export of natural rubber in North Sumatra. The results of Noviana's (2018) research show that inflation, the rupiah exchange rate, and the amount of production simultaneously have a significant influence on rubber exports in Indonesia.

CONCLUSION

Simultaneously and partially, the price of natural rubber, the rupiah exchange rate, and inflation have a positive and significant influence on the export volume of natural rubber in North Sumatra.

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