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THE COVID-19 PANDEMIC'S EFFECT ON RUBBER PRICES AT THE FARMER LEVEL IN SOUTH SUMATRA PROVINCE

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Abstract: This study aims to analyze the influence that affects changes in rubber prices at the farmer level before and during the covid-19 pandemic. This study uses panel data for 24 (twenty-four) months, from January 2019 to December 2020. The response variable (Y) is the price of rubber at the farmer level in South Sumatra Province obtained from 28 UPPB (Rubber Processing and Marketing Units). The analysis tool used is a multiple regression of panel data with the help of RStudio software. The results of the analysis using the Random Effect Model (REM) method showed that international rubber prices, rupiah exchange rates against the US dollar, world crude oil prices and synthetic rubber prices were both real influences on rubber prices at the farmer level, both before and during the covid-19pandemic. Changes in international rubber prices during the covid-19pandemic had a much greater positive impact on rubber prices at the farmer level than before the pandemic, while the change in rupiah exchange rate against the US dollar and world crude oil and synthetic rubber prices was smaller.

Keywords: Covid-19, Price of Rubber, REM, Panel Data

1. Introduction

Natural rubber is a plantation commodity that plays an important role in the Indonesian economy. Basically, the rubber industry is divided into two types, namely natural rubber and synthetic rubber. Synthetic rubber is a factory-made rubber, while natural rubber is formed from latex obtained from the sap of rubber tree plants by injuring the rubber tree, so that the tree will respond to produce latex (Ministry of Industry, 2007). The area of smallholder-owned natural rubber plantations in Indonesia is 3.671.302 hectares (85%), state-owned large estates 231.000 hectares (6.2%), and large private plantations 326.000 hectares (8.8%). The potential of rubber in Indonesia is very significant where the total production is 3.545.693 tons with a productivity of 1.161 kg/ha. Dominated by smallholder plantations, Rubber commodities created jobs for 2,5 million families with an average ownership area of 1,25 ha, while the export volume was 2,99 million tons with a value of US$ 5,10 billion. Where synthetic rubber raw materials are becoming increasingly rare, demand for natural natural rubber is rising (2,5%/year), and Indonesian natural rubber meets the technical specifications required by the tire industry and other rubber-derived industries, therefore the rubber opportunities are very promising (Directorate General of Plantations, 2019 in (Nurfatriani et al., 2019)) .

The issue of rubber cannot be separated from the issue of price because price is one of the most important factors for the survival of farmers and society in general. According to (Maulida, 2009), rubber prices in Indonesia will continue to follow international rubber price movements. This price movement occurs because the price of rubber in Singapore is one of Indonesia's

reference prices, including the determination of FOB in Indonesia. The high price of rubber in the Singapore market is thought to be closely related to domestic rubber prices, including in South Sumatra Province.

According to the South Sumatra Province Economic Report by Bank Indonesia (2020), the performance of foreign exports in South Sumatra Province also contracted. The slowdown in export performance was caused by a sharp decline in exports of rubber, coal, and pulp & paper commodities (Sugiharti et al., 2020). The outbreak of the covid-19 in various countries has led to a decline in manufacturing activities and disruption of import-export logistics activities. This has led to a decline in demand for leading export commodities. Beside that, the low price of rubber also causes a limited supply of rubber from farmers who hold back their production until the price increases. Therefore, this has an impact on the productivity of the rubber processing industry which has also decreased. This study aims to analyze the factors that influence changes in rubber prices at the farmer level before and during the covid-19 pandemic.

2. Research Method

This study uses secondary data that is quantitative. The data used is panel data. Panel data is a combination of time series data and cross section data. The data used for 24 (twenty-four) months, namely from January 2019 to December 2020. The response variable (Y) namely the price of rubber at the farmer level was obtained from 28 (twenty-eight) UPPBs in 4 (four) regencies in South Sumatra Province. namely Banyuasin, MusiBanyuasin, OKI, and OI. In addition, the X variable data used is the international rubber price (Sicom), International crude oil (WTI) prices, the exchange rate of the rupiah against the United States dollar, and international synthetic rubber prices.

The analytical method used in this research is descriptive statistical analysis and panel data regression analysis with the help of the RStudio program.

The models used in this study are:

$$Y_{it} = \alpha_0 + \boldsymbol{\beta'_1} X_1 + \boldsymbol{\beta'_2} X_2 + \boldsymbol{\beta'_3} X_3 + \boldsymbol{\beta'_4} X_4 + e_{it}$$

Description :

Y	:Natural Rubber Prices in South Sumatra Province
X1	: International Rubber Price ($/Kg)
X2	: Rupiah exchange rate against US Dollar
X3	:WTI International Oil Price ($/Barrel)
X4	: International Price of Synthetic Rubber ($/Kg)
e_{it}	: error
i	: 1,2,…,N
t	: 1,2,…,T

In estimating the panel regression model, there are three approaches that are often used, including the common effect model, the fixed effect model, and the random effect model (Widarjono, 2007).

Common Effect Model
Common Effect Model assumes that the intercept of each variable is the same, as well as the slope coefficients for all-time series and cross section units. In estimating the parameters of the Common Effect Model, the least squares method can be used. In the Common Effect Model, it is constant or the same in each individual or in each period.

Fixed Effect Model
According to (Gujarati et al., 2004), one way to pay attention to the unit *cross-section* the panel regression model is to allow different intercept values for each cross-section unit but still assume a fixed coefficient slope. Fixed Effect Model approach determines that as a specific group or different in constant terms in the regression model. The formulation commonly used in the model assumes that the difference between units can be seen in the difference in constant terms.

Random Effect Model
This model estimates panel data in which residual variables are thought to have a relationship between time and between subjects. The Random Effect Model approach involves correlation between error terms due to changes in time and units of observation. Random Effect Model appears when there is no correlation between individual and regressor effects. This assumption causes the error components of individual effects and time to be included in the error (Firdaus, 2020).

Selection of Panel Data Regression Estimation Model
In determining the estimation of the panel regression model, several tests were carried out to choose the appropriate estimation approach method. The first step that must be done is to choose between the Fixed Effect Model or the Common Effect Model method. After it is proven that there is an individual effect, the Hausman test is carried out to determine between the Fixed Effect Model and the Random Effect Model.(Zulfikar & STp, 2019)

Hausman test
Hausman test is used to choose the better model between *Fixed Effect Model*or Random Effect Models. In the Hausman test, tests are carried out on the assumption that there is a correlation between the regressor and individual effects. If the H value of the test results is greater than the Chi Square table, then there is sufficient evidence to reject H0, so that the model used is the Fixed Effect Model, or P-Value < α, therefore there is sufficient evidence to reject H_0 and vice versa (Greene, 2000).

2.1 Hypothesis testing
Partial Regression Coefficient Significance Test (t-test)
The t-test is a test that aims to determine whether the regression coefficient is significant or not. The significance level used is α = 5%, the test steps are as follows:

1) Determine the hypothesis
   a) $H_0 : \beta_1 = 0 \quad | \beta_2 = 0$
   It means that an independent variable individually has no effect on the dependent variable.

b) $H_1 : \beta_1 \neq 0 \quad | \beta_2 \neq 0$
It means that an independent variable individually influences the dependent variable.

2) Decision-making criteria, namely:
a) If t statistic ≤ t table, then H_0 is accepted (not significant).
This means that the independent variable has no significant effect on the dependent variable.
b) If t statistic > t table, then H_0 is rejected (significant). This means that the independent variable is able to significantly influence the dependent variable.

Simultaneous Regression Coefficient Significance Test (F-Test)
The F test or the regression coefficient test simultaneously is to determine the effect of the independent variables simultaneously on the dependent variable, whether the effect is significant or not. With a significance level of $\alpha = 5\%$, the test steps are:

1) Determining the hypothesis
a) $H_0 : \beta_1 = \beta_2 = 0$
Means, all independent variables simultaneously have no effect on the dependent variable.
b) $H_a : \beta_1 \neq \beta_2 \neq 0$
It means that all independent variables simultaneously affect the dependent variable.
2) Decision-making criteria, namely:
a) If the value of F statistic < F table, then H_0 is accepted and Ha is rejected, meaning that the independent variables together have no significant effect on the dependent variable.
b) If the value of F statistic > F table, then H_0 is rejected and Ha is accepted, it means that the independent variables simultaneously affect the dependent variable significantly.

Coefficient of Determination Analysis
The coefficient of determination is a coefficient number that shows the magnitude of the variation of a variable against other variables which expressed in percentages. This test aims to determine the percentage of the dependent variable (economic growth) caused by the independent variable (labor and infrastructure). The value of the coefficient of determination is between 0 and 1 1 ($0 < R^2 < 1$). Meanwhile, if $R^2 = 0$, it means that the independent variable does not affect the dependent variable, or in other words the model shows that the variation of the dependent variable cannot be explained by the independent variable. In contrast, if R^2 is close to 1, it means that the independent variable affects the dependent variable, or in other words all observation points is right on the regression line and the variation of the dependent variable can be explained by the independent variable. Basically, the coefficient of determination for cross section data is relatively low due to the large variation between each observation.

3. Results and Discussion

3.1. Results

Regression Equation Conjecture Results

The analysis in this study is basically to test whether the independent variables in this study (TSR20 prices in Singapore, the exchange rate of the Rupiah against the US Dollar, international oil prices, and synthetic rubber prices) affect rubber prices at the farmer level in South Sumatra Province which act as the dependent variable. The independent variables simultaneously affect dependent variables using multiple linear regression analysis with RStudio software. Hence, the test was conducted using multiple linear regression analysis with RStudio software. Based on the analysis, hausman test results will be shown in Table 1.

Table 1. Hausman Test Results

Hausman Test	Before the Covid-19 Pandemic	During the Covid-19 Pandemic
chisq	0.083261	1.9013
df	4	4
p-value	0.9992	0.7539

Based on the results of the Hausman test in Table 1, it can be seen from the p-value before and during the covid-19 pandemic, namely 0.9992 and 0.7539, which means that the value is greater than alpha (0.05). This means that H_0 is accepted so that obtained the best panel data model and used in this study is the Random Effect Model (REM). The results of the regression using the Random Effect Model (REM) can be seen in Table 2.

Table 2. Estimation Results of Panel Data Regression Using Random Effect Model (REM)

Coefficients :	Before the Covid-19 Pandemic				During the Covid-19 Pandemic			
	Estimate	t-value	Pr(>|t|)		Estimate	t-value	Pr(>|t|)	
(Intercept)	-16532	-40,087	0,0000611	***	-15768	-15,482	< 2,2e-16	***
IPR	1171,8	42,805	0,0000187	***	7094,5	559,114	< 2,2e-16	***
EXCHANGE RATE	0,99	3,582	0,0003409	***	0,59	18,228	< 2,2e-16	***
HMI	25,77	23,856	0,0170532	*	11,7	45,623	0,00000714	***
HKS	4974,1	31,219	0,0017972	**	3673,6	40,317	0,0000688	***

R-Squared	0,29932				0,84869			
adj. R-Squared	0,29085				0,84687			
p-value	< 2,22e-16				< 2,22e-16			

Note: *) significance at 0.01 level of significance.
***) significance at the level of significance 0.

Evaluation of Conjecture Equations

The coefficient of determination during the Covid-19 pandemic was 0.84869. This means that the variation of the IPR, EXCHANGE RATE, HMI and HKS variables simultaneously affects 84.86% of the rubber price at the farm level, while the rest is influenced by factors not included in the model. Meanwhile, before the Covid-19 pandemic, the IPR, EXHANGE RATE, HMI and HKS variables simultaneously only affected 29.23% of the farmers' rubber prices. There is a big difference between the coefficient of determination during and before the Covid-19 pandemic.

The F test shows a significance of 0.000 which is much smaller than the significance level used in this research, which is 0.05 or 5%. Thus, it can be concluded that the hypothesis testing above rejects H0 or accepts H1. This shows that the variables IPR, EXCHANGE RATE, HMI and HKS simultaneously have a significant effect on rubber prices at the farm level. The t-test in this study aims to test whether or not there is a relationship between the independent variables IPR, EXCHANGE RATE, HMI and HKS with rubber prices at the farm level. Based on Table 2, all independent variables have a significant effect on rubber prices at the farm level. Based on the results of panel data multiple regression, the following regression equation can be formulated:

$$\mathbf{Y_{B(28,12)} = -16.532 + 1.171{,}80\ X_1 + 0{,}99\ X_2 + 25{,}77\ X_3 + 4.974{,}10\ X_4}$$
$$\mathbf{Y_{A(28,12)} = -15.768 + 7.094{,}50\ X_1 + 0{,}59\ X_2 + 11{,}70\ X_3 + 3.673{,}60\ X_4}$$

Description,

Y_B	: Farmer Rubber Prices Before the covid-19 pandemic (Rp/Kg)
Y_A	: Farmer Rubber Prices During the covid-19 pandemic (Rp/Kg)
X1	: International Rubber Price ($/Kg)
X2	: Rate of Rupiah against US Dollar
X3	: WTI International Oil Price ($/Barrel)
X4	: International Synthetic Rubber Price ($/Kg)
e_{it}	: error
i	: 1,2,…,N
t	: 1,2,…,T

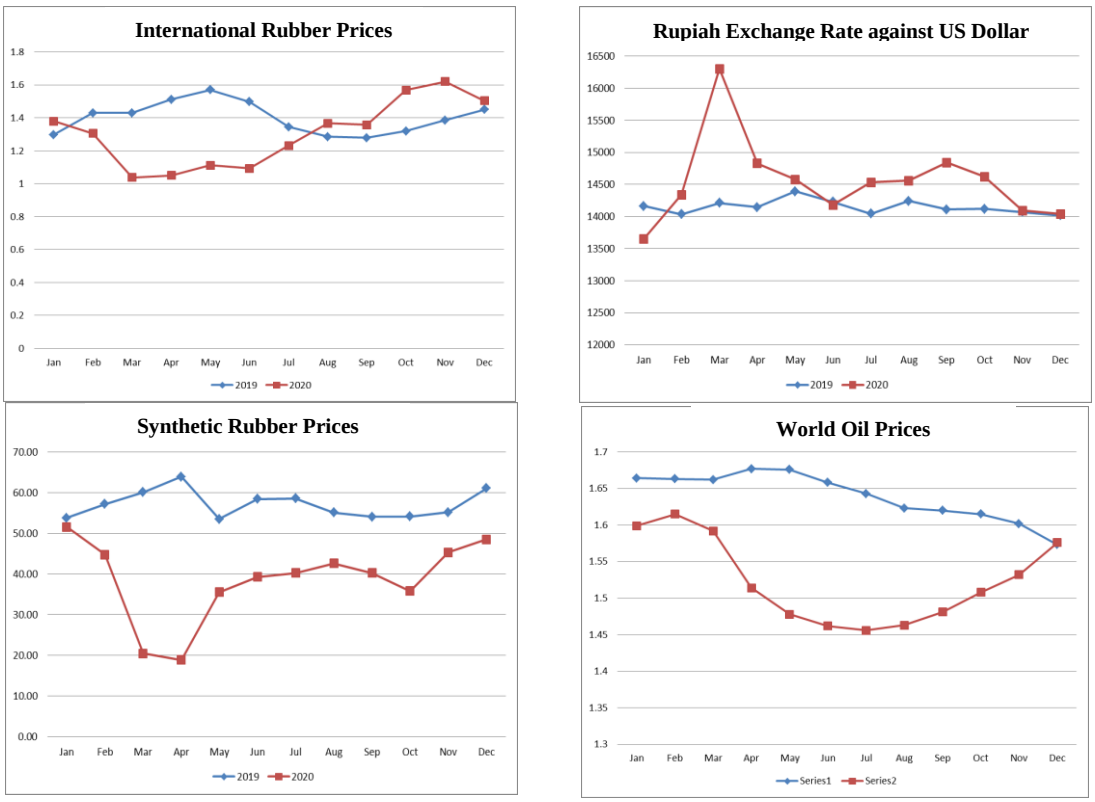

Figure 1. International Rubber Price Fluctuations, Rupiah Exchange Rate against the US Dollar, World Oil Prices and Synthetic Rubber Prices in 2019-2020

Meanwhile, in 2020, during the Covid-19 pandemic, international rubber prices experienced sharp fluctuations. In March 2020 there was a significant decline in international rubber prices, world oil and synthetic rubber. Likewise, the rupiah exchange rate against the US dollar depreciated sharply, reaching Rp 16.300 in March 2020. This decline was mainly due to limited global demand due to the Covid-19 outbreak, which caused a decline in global manufacturing activity. Rubber futures contract extended losses in the second week of November 2019 to trade below 235 yen per kg, having hit a more than 3-year high of 308 yen on October 30, 2019, due to new lockdowns and restrictions in Europe to curb the spread of Covid-19- 19 is expected to reach the automotive sector (Tragedic Economics, 2020). During the lockdown phase of the Covid-19 pandemic, all rubber plantation sectors were granted a conditional exemption, operating at 50% of the workforce. This massive economic disaster will surely have a severe impact on the plantation economy, especially small farmers and laborers (Abrahams, 2020).

The development of international rubber prices gradually increased in July 2020. International rubber prices increased even more than the average price compared to 2019. The highest price during the Covid-19 pandemic was in November 2020 which reached 1,62 SGD/Kg. Developing and low-income countries are often among the most affected, with cascades of consequences for value chains, food security, and even national economies.

However, strong demand from consumer and glove manufacturers as well as lower supply are likely to support prices. The association of natural rubber producing countries expects global production to fall by nearly 5%, with a labor shortage related to the coronavirus as well as flooding and unfavourable weather in Thailand and Vietnam (Tragedic Economics, 2020). Although there are many factors that can cause an increase in natural rubber prices, natural disasters in Thailand can cause supply disruptions that can affect prices, where Thailand is one of the main producers of rubber commodities. In line with the statement (FAO, 2021) that extreme events such as droughts, floods, storms, tsunamis, forest fires, pests and disease outbreaks take a heavy toll on agriculture and all its sectors.

3.2. Discussion

A. Factors That Affect Rubber Prices at the Farmer Level

International Rubber Price

Based on the results of panel data regression analysis, international natural rubber prices have a significant and positive effect on rubber farmer prices at the farmer level both before and during the covid-19 pandemic. This is evidenced by the statistical probability value of 0.0000 less than the 5% significance level. The positive coefficient indicates that this variable is in accordance with the hypothesis. Before the covid-19 pandemic, this variable had a coefficient weight of 1,171.80. It can be interpreted that if the international natural rubber price increases by one dollar, then the natural rubber price at the farm level will increase by 1,171.80 rupiah with the assumption of *ceteris paribus*.

The international rubber price at the time of covid-19 also had a positive effect or was in line with the natural rubber price at the farm level, supported by the significant t-test calculation results at the sig. 0.05 level so that the international rubber price partially had a significant influence on the dependent variable. The regression coefficient value at the time of covid-19 was much greater than before the covid-19 pandemic, which was 7,094.50. This means that there is a very big impact during the covid-19 pandemic. This result is in line with (Alkautsar, 2014) that world prices are the market reference price, while the global economic crisis causes demand to decline. The dependence of domestic rubber prices, including in South Sumatra Province on international rubber prices, is because Indonesia is still largely dependent on exports, especially rubber commodities. domestic prices. Likewise, during the covid-19 19 pandemic, which caused the rise and fall of natural rubber prices at the farm level in South Sumatra, it was largely determined by international rubber prices. According to (Malik et al., 2013), the dependence of Indonesian natural rubber prices on natural rubber prices in the international market is due to the fact that Indonesian natural rubber sales depend on the export market.

Rupiah Exchange Rate Against US Dollar

One of the variables that have a positive effect on the price of rubber at the farm level is the exchange rate. When the rupiah exchange rate against the dollar appreciates, it means an increase in the value of the rupiah currency. In this case, if there is an appreciation of the rupiah against the dollar by one dollar, it will increase the price of natural rubber at the farm level by 0.99 rupiah before covid-19 and 0.59 rupiah during covid-19. During the observation period, it was found that the rupiah exchange rate was relatively stable. With the appreciation and

depreciation of the exchange rate on world commodity prices and export-import activities each have their own advantages. This is supported by the statement (Nainggolan, 2014) that the slightest change in the exchange rate of the rupiah against the US Dollar will be very sensitive to affect the export value of *crumb rubber*.

World Crude Oil Price

In the table of panel data regression results using the Random Effect Model (REM), both before and during the covid-19 pandemic, the world crude oil price variable was significant at a significance level of 0.05, so H0was rejected. Therefore, the price of world crude oil spatially has a significant effect on the price of rubber farmers. The regression coefficient value of the world oil price variable before the covid-19 pandemic had a value of 25.77 and at the time of covid-19 it was 11.70. This means that every one dollar increase in world crude oil prices will cause an increase in the price of rubber at the farm level by 25.77 rupiah before vovid-19 and 11.70 rupiah at the time of covid-19. During the pandemic or before, world crude oil prices had a significant influence on natural rubber prices at the farm level. However, it can be seen from the results of the analysis that the resulting effect is not large or tends to be small. This result is supported by research results (Lubis, 2015)that world crude oil has asmall effect on domestic natural rubber prices.

Synthetic Rubber Price

The regression coefficient value of synthetic rubber prices before the covid-19 pandemic showed a value of 4,974.10. This means that, if there is an increase in the price of synthetic rubber by one dollar, it will increase the price of rubber for farmers by 4,974.10-rupiah, *ceteris paribus*. Meanwhile, during covid-19, a lower regression coefficient value was obtained, which was 3,673.60, so that if there was an increase in the price of synthetic rubber by one dollar, it would increase the price of farmers' rubber by 3,673.30-rupiah, ceteris paribus. The results of the analysis show that the price of synthetic rubber has a significant influence both before and during the covid-19 pandemic. This is supported by a probability value of 0.000, meaning that it is smaller than 0.05, so H0 is rejected. This is supported by research by (Lestari, 2010), (Putra, 2021) which states that world synthetic rubber prices have a positive and significant impact on Indonesia's natural rubber exports(Anwar, 2005). In international trade, natural rubber is mostly used as a raw material for making tires, especially radial tires, where in its manufacture it turns out that synthetic rubber is mixed with natural rubber which cannot be shifted in function.

Classical Regression Test

The heteroscedasticity test value detected by the Breusch Pagan Godfrey (BPG) test obtained a p-value of 0.1298 during the covid-19 pandemic and 0.1793 before the covid-19 pandemic, which is greater than 0.05. Thus, it can be concluded that the regression model has no indication of heteroscedasticity problems. Multicollinearity is tested by looking at the tolerance value which is not less than 0,1 and the Variance Inflation Factor (VIF) value is not more than 10, so that the model can be said to be free from multicollinearity. The method used to test the autocorrelation in this study is the Lagrange Multiplayer (LM) test. The probability value is greater than 0.05 so there is no autocorrelation. Normal distribution test with Kolmogorof Smirnov, each result is greater than α=0,05, so that the decision failed to reject H0 and it was

concluded that the residuals were normally distributed. All residual assumptions from the panel regression model with the REM approach are normally distributed.

4. Conclusion

Based on the results of the analysis using panel data regression equations through the Random Effect Model method, it can be concluded that international rubber prices, the rupiah exchange rate against the US dollar, world crude oil prices and synthetic rubber prices both have a significant effect on rubber prices at the farm level, both before and during the covid-19 pandemic. Changes in international rubber prices during the covid-19 pandemic had a much larger positive impact on rubber prices at the farm level than before the pandemic, while changes in the rupiah exchange rate against the US dollar and world crude oil and synthetic rubber prices were smaller.

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