



# Indonesian Crude Palm Oil (CPO) Exports Through the Gravity Model Approach

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**Abstract:** Oil palm is one of the plantation crops that provides the largest contribution to Indonesia's foreign exchange with its derivative products in the form of crude palm oil (CPO). The development of CPO consumption as a source of vegetable oil has pushed Indonesia as the largest producer to export CPO to 179 export destination countries in the world and the 10 largest export countries include India, China, Pakistan, the Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain and Singapore. Indonesia's CPO export volume fluctuates which can disrupt the country's economy. The objectives of this study are: (1) to identify the countries that positively impact Indonesian crude palm oil (CPO) exports among 10 destination countries, namely India, China, Pakistan, the Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore, (2) to analyse the factors influencing Indonesia's CPO exports to these 10 destination countries, and (3) to examine the impact of geographical distance on Indonesia's CPO exports to these countries. The research was conducted from April to September 2021, using panel data that combines time series and cross-sectional data from 2011 to 2020. The findings indicate that India, China, the Netherlands, and Italy had positive constants, while the remaining six countries had negative constants in terms of Indonesia's CPO exports. The combined effect of Indonesia's gross domestic product (GDP) (X1), geographical distance (X2), and the rupiah exchange rate (X3) significantly increased Indonesia's CPO exports to these 10 destination countries by 73.77%. Geographical distance (X2) had a significant and positive effect, whereas Indonesia's GDP (X1) and the rupiah exchange rate (X3) did not show significant effects and had a negative impact on increasing Indonesia's CPO exports to these destinations.

**Keywords:** Crude Palm Oil; Export; Gravity Model; Palm Oil

## Introduction

Plantation crops that are quite potential and have prospects that boost the Indonesian economy, one of which is oil palm plantations which make a large contribution to the country's foreign exchange. Palm oil has a derivative product known as crude palm oil (CPO) which contributes quite a lot and has economic advantages compared to other commodities. Palm oil production is mostly produced by large private companies (PBS), followed by smallholder plantations (PR) and large state-owned companies (PBN). (Azahari, 2018).

The production and consumption of crude palm oil (CPO) in Indonesia have shown significant growth rates

over the years. From 2005 to 2017, the average annual growth rate for production was 14.46%, while for consumption it was 9.24%. In 2017, Indonesia's palm oil production reached 35.35 million tons, while the consumption amounted to 11.06 million tons (Directorate General of Plantation, 2017).

Oil World Database, (2020) reports that the total volume of world palm oil imports in 2019 was around 55.26 million tons. The main importing countries for world palm oil include India, the European Union, China, Pakistan, Bangladesh, Nigeria, the United States, Malaysia and other countries that are consumers of palm oil. (Mba, 2017) reports that Indonesia's share of palm oil area is 55.5% of the total area of world oil palm plantations and 48.27% of the world's total CPO

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production. About 77% of the CPO production is destined for export.

According to the data from the Directorate General of Plantation (2019), Indonesia's CPO export volume has experienced fluctuations over a 10-year period from 2009 to 2018, with the highest decrease occurring in 2016 dari 7.788.550 ton pada tahun 2015 menjadi 5.283.953 ton (-32.16 %). Pada tahun 2017 volume eksport naik sebesar 7.076.061 ton (33.92%) dan pada tahun 2018 kembali turun 7.37 % dalam angka 6.554.495 ton. The International Trade Center (2020) has reported that there are 179 countries that serve as export destinations for Indonesian CPO, with the top 10 countries being India, China, Pakistan, the Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore.

The fluctuating condition of CPO exports is a concern as it can potentially disrupt the economy of a country. According to Ewaldo (2015), export prices, exchange rates, and palm oil production in the period of 2000-2013 had a significant combined effect on the value of palm oil exports, although the exchange rate alone did not show a significant effect. Alatas (2015) further reported that the factors influencing Indonesia's CPO exports to India include CPO prices, international CPO prices, the exchange rate of the Indonesian rupiah, per capita income, population, and substitution prices. Indonesian CPO exports to China are influenced by international prices, national income, population, and substitution prices. Meanwhile, Indonesian CPO exports to the Netherlands are affected by domestic prices, national income, population, trends, and substitution prices.

While there have been numerous research reports on the factors influencing Indonesia's CPO exports to various countries, there is limited information on the factors affecting Indonesia's CPO exports to the 10 largest export destination countries over the past 10 years (2011-2020) using gravity models. Gravity models provide a more empirical analysis of trading patterns compared to other theoretical models. Therefore, there is a need for research utilizing the gravity model to analyse the factors that influence Indonesian CPO exports to these 10 major destination countries.

## Method

### Location and Time of Research

The study encompasses planning, problem formulation, data collection from relevant agencies, data processing, analysis, interpretation, and conclusion (Fellows & Liu, 2021). It is conducted in Indonesia using both national and international data. The selection of the study location is purposive, aligning with the research objectives. The study was conducted from April to September 2021.

Sample Determination Method: The sample is determined based on the largest CPO coconut palm exports from Indonesia to the target countries over the past 10 years (2011-2020). According to data from the International Trade Centre, the top 10 destination countries for Indonesian CPO exports are India, China, Pakistan, the Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore. These countries have accounted for the highest total CPO exports from Indonesia out of 179 destination countries.

Data Analysis Method: Teknik analisis data yang digunakan adalah regresi data panel dengan Model gravity. Data panel yaitu gabungan data runtut waktu (*time series*) dan data *cross section* dari tahun 2011-2020. The study will employ an analysis of the factors that influence Indonesian CPO exports to the main destination countries. It will also assess the value and significance of the independent variables, including Gross Domestic Product (GDP) and geographic distance, in influencing the exports. Top of Form country destination, and the rupiah exchange rate to the destination country through the gravity model equation (Krugman and Obstfeld, 2003). Data first in the natural logarithm (ln) Then processed use software Eviews 10 SV. Equality base of models gravity is:

$$T_{ij} = A \times Y_i^a \times Y_j^b // D_{ij}^c \tag{1}$$

Information:

- T<sub>ij</sub> = trade value between country i and country j.
- A = constant
- Y<sub>i</sub> = GDP country i
- Y<sub>j</sub> = GDP country j
- D<sub>ij</sub> = distance between both countries.

As for model that used in study this is:

$$\ln CPO^t_i = \beta_0 + \beta_1 \ln (PDB^t_i \times PDB^t_j) + \beta_2 \ln JG^t + \beta_3 \ln NTR^t + \mu_b \tag{2}$$

Information:

- β<sub>0</sub> = constant
- β<sub>0</sub> ,..., β<sub>3</sub> = parameters of each variable
- t = (1,...,t) ; 2011-2020
- j = (1,...,N) ; country objective main export CPO coconut palm Indonesia
- I = Indonesia
- CPO<sup>t</sup><sub>i</sub> = mark export CPO Indonesia to j-country on t-year (US\$)
- GDP<sup>t</sup><sub>i</sub> = mark Indonesia's GDP in t-year (US\$)
- GDP<sup>t</sup><sub>j</sub> = GDP value country importer-j against t-year (US\$)
- JG<sup>t</sup> = geographic distance Indonesian to

NTR<sub>tj</sub> = country j-purpose on t-year (km)  
 = rupiah exchange rate to destination  
 country-j in year-t  
 μ = term error

*Common Effects Models (CEM)*

The Common Effect Model (CEM) is an estimating regression method data panel with method *Ordinary Least Square* (OLS). Method This No notice dimensions individual nor time so that assumed that behavior between individual The same in various period time. Model This just combine data *time series* And *cross section* in form *pool* , estimate it using the least squares approach (*pooled least squares*) (Gujarati, 2007).

*Fixed effects Models (FEM)*

One of the estimation methods that can be used in the data regression model panel is *fixed effect model* (FEMS). Index i on intercept show that the intercept of each unit *cross section* is different. Difference this is due to the use of dummy variables to explain the differences intercept that arises between individuals. The term *Fixed Effect Model* (FEM) originates from the fact that although the intercept α<sub>i</sub> differs between individuals, the intercept the same over time (*time invariant*). The use of this dummy variable make estimation on FEM called Least Square Dummy Variable (LSDV) model. (Gujarati, 2007).

*Random effects Model (BRAKE)*

Random Effect Model (REM) is a regression method that estimates data panel with count error from model regression with method *Generalized Least Square* (GLS). Different with *fixed effect* ct model, effect specification from respectively - respectively individual treated as part from error component that is random and not correlated with explanatory variables Which observed (Gujarati, 2007).

*Test suitability Model*

1. Test Chow

The Chow test is a test to determine the CEM or FEM model the most appropriate to use in estimating panel data. When obtained mark probability > 0.05 so chosen CEM, whereas If obtained mark probability < 0.05 \_ so selected FEM. (Cahyani et al., 2020)

2. Test Hausman

Hausman test aims to determine whether the model is FEM orBRAKE. *The fixed effect model* assumes that the independent variables are correlated with error while *the random effect* is the other way around. Panel data model with *fixed effect* is estimated by OLS, while *random effect* is estimated by GLS (*Generalized Least Square* ). If obtained mark probability > 0.05 so REM is selected, whereas if a

probability value <0.05 is obtained, then FEM is selected. (Ghozali, 2007)

3. Test Lagrange Multipliers

Lagrange Multipliers (LM) is test For know is model REM or CEM is the most appropriate to use. Test the significance of this *Random Effect* developed by Breusch Pagan. If the probability value is > 0.05 then CEM is chosen, whereas if a probability value <0.05 is obtained, then REM is selected. (Ghozali, 2007).

*Testing Assumption Classic*

A variable used in a study requires existence testing the assumptions contained in the OLS analysis method. As for the assumption test Which done between other test normality, test multicollinearity, test heteroscedasticity, and autocorrelation test (Ariefianto, 2012).

1. Test Multicollinearity

Model regression Which covers more from two variable free often found exists collinear double (multicollinear). There are multicollinear resulting in an unrealistic estimate of the regression coefficient even though the value of r<sup>2</sup> is high, the sign of the coefficient is not in accordance with the theory and OLS method, the coefficient estimator own deviation raw Which very big. Model regression Which Good show No happen multicollinearity Which can seen with mark matrix *Pearson Correlation* < 0.9 (Ghozali, 2009).

2. Test Autocorrelation

Test autocorrelation function for know is *error* on something equations are independent or dependent. Probability testing autocorrelation is done by looking at the *Durbin-Watson* (DW) value. Model a good regression is a regression that is free from autocorrelation. Autocorrelation occurs or not on this research can see Table 1

**Table 1.** Interpretation test autocorrelation

Mark Durbin-Watson	Information
1.65 < DW < 2.35	No happen autocorrelation
1.21 < DW < 1.65 or 2.35 < DW < 2.79	No can concluded
DW < 1.21 or DW > 2.79	Happen autocorrelation

Source: Trihendradi, (2007).

3. Test Heteroscedasticity

Heteroscedasticity can be seen by comparing the probability values with mark significant 5%. If probability <0.05 categorized as happen heteroscedasticity, whereas probability >0.05 categorized as No happen heteroscedasticity (Trihendradi, 2007).

#### 4. Test Normality

The normality test is used to see whether the residual value (*error term*) from the normally distributed regression model or not. The normality test is useful for find out whether the confounding or residual variables have a normal distribution. Normality can be tested by looking at the probability value on the *Jarque-Bera graph* (Trihendradi, 2007). If the probability > 0.05 is categorized as normally distributed, However, probability < 0.05 is categorized as not normally distributed.

#### Testing Statistics

Testing statistics were fore for test variable independent Whichused impact real or no to variable bound, through test F, test t, and the coefficient of determination.

##### 1. Test F

Test F enabled for now is variables freeimpact on variable bound (Gujarati, 2007). Testing held with compare between mark critical F with mark F-count Which There is on results analysis. The basis for determining acceptance or rejection of the F test is as follows:  $F_{count} < F_{table}$  : accept  $H_1$   
 $F_{count} > F_{table}$  : reject  $H_1$ .

If the decision obtained is to reject  $H_0$  so can conclude that all variables independent in a manner together can influence the dependent variable. (Gujarati, 2007).

##### 2. Test t

The t-test was carried out to test the estimated coefficients of each variable free in a manner with Partial impact significant to variable bound or No (Gujarati, 2007). Criteria testing Partial (test t) as follows:

$t_{count} < t_{table}$ : accept  $H_1$

$t_{count} > t_{table}$ : reject  $H_1$

The decision is made based on the location of the t-count value of each regression coefficient. If the location of the t-count a regression coefficient is at acceptance area  $H_0$ , meaning that the regression coefficient is not different from zero. In other words, these variables have no significant effect on the value of the variable dependent so are on the contrary.

##### 3. Coefficient Determination ( $R^2$ )

According to Gujarati, (2007) coefficient determination is size descriptive the degree of concordance between the actual data and the forecast. Hose  $R^2$  a used is  $0 < R^2 < 1$ . If the coefficient of determination is close to 1 (one), so the model is considered good.

## Result and Discussion

### Condition Export Crude Palm Oil (CPO) Indonesia (Million US\$)

Export data of Indonesia's Crude Palm Oil (CPO) to 10 main destination countries during the last 10 years (2011-2020) can be seen in Figure 1.

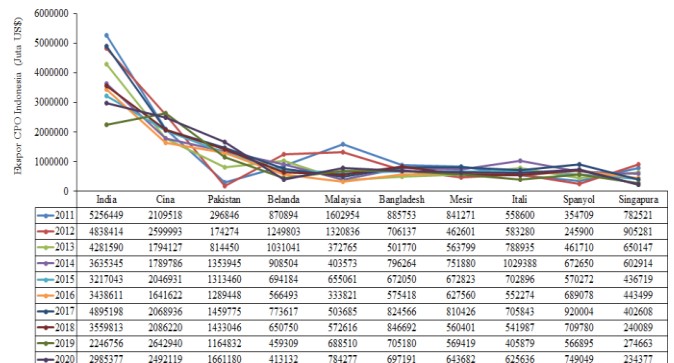


Figure 1. Indonesia's Crude Palm Oil (CPO) exports to 10 main destination countries during last 10 years (2011-2020)

Figure 1 explained that Indonesia's crude palm oil (CPO) exports to 10 destination countries (India, China, Pakistan, Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spanish, And Singapore) during 10 year final experience fluctuating with average highest there is on country India is big 3,835,459.60 million US\$.

### Rate Growth Product Domestic Gross (GDP) Indonesia (%)

Rate growth Product domestic gross (GDP) Indonesia during 10 the last year (2011-2020) can be seen in Figure 5.4. You can see a decrease in speed growth GDP Indonesia from year 2011 until 2015 And experience enhancement until year 2018, then speed down until year 2020.

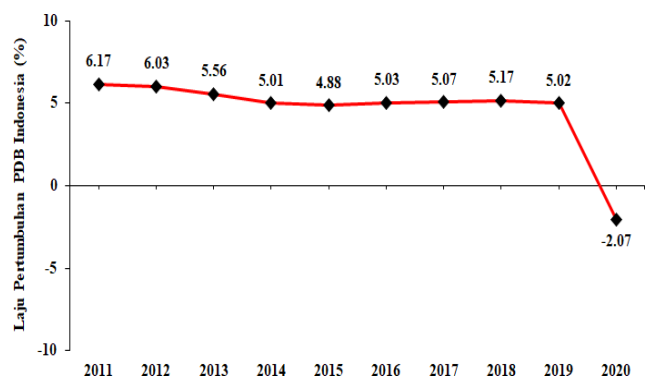


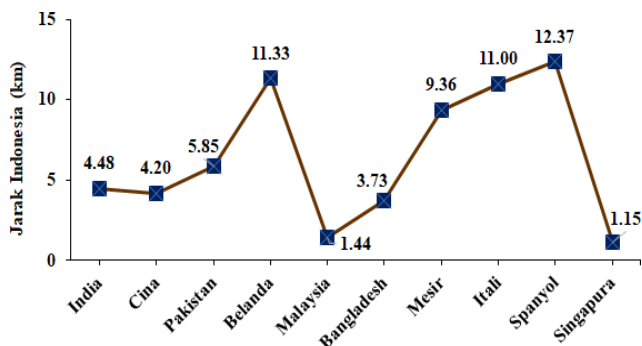
Figure 2. Rate growth Product Domestic Gross (GDP) Indonesia on 2011-2020

### Distance Geographical (km)

The distance between Indonesia and the 10 destination countries for crude palm oil (CPO) exports (India, China, Pakistani, Dutch, Malaysia, Bangladesh,



Egypt, Italy, Spanish, And Singapore) can be seen on Figure 3.

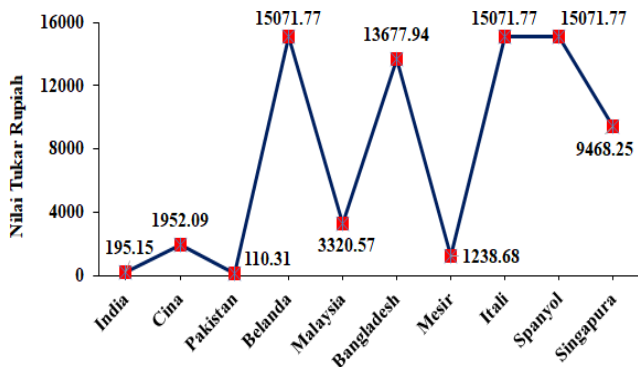


**Figure 3.** Distance between Indonesia and 10 export destination countries for crude palm oil (CPO) (India, China, Pakistan, Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spanish, and Singapore).

Figure 3. shows that Indonesia's crude palm oil (CPO) exports for the last 10 years (2011-2020) farthest to the countries of Spain and the Netherlands, whereas closest to country Singapore And Malaysia. If distance getting further, possibility cost Which needed For transportation will increase And influence crude export value palm oil (CPO) Indonesia.

*Mark Swap Rupiah*

Average mark swap rupiah Indonesia to 10 country objective export crude palmoil (CPO) (India, China, pakistani, Dutch, Malaysia, Bangladesh, Egypt, Italy, Spain, And Singapore) can be seen on Figure 4.



**Figure 4.** The average rupiah exchange rate Indonesian to 10 destination countries export crude palm oil (CPO) (India, China, pakistani, Dutch, Malaysia, Bangladesh, Egypt, Italy, Spain and Singapore)

Figure 4 shows that the average rupiah exchange rate to 10 countries Indonesia's crude palm oil (CPO) export destination for the last 10 years (2011- 2020) highest there is on country Dutch, Italy, And Spanish. Matter This because these three countries are classified as developed countries so there are opportunities to increase the export of crude palm oil (CPO) in Indonesia.

*Testing Estimation Model*

The most appropriate test model estimation methods for analysing the factors influencing Indonesia's crude palm oil (CPO) exports to the 10 destination countries (India, China, Pakistan, Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore) involve three approaches. Firstly, the Chow test is conducted to determine whether the Common Effect Model (CEM) or the Fixed Effect Model (FEM) is more suitable. If the probability value is greater than 0.05, the CEM is chosen; otherwise, the FEM is selected. Secondly, the Hausman test is performed to decide between the Random Effect Model (REM) and the appropriate FEM. If the probability value is greater than 0.05, the REM is chosen; if it is less than 0.05, the FEM is selected. Finally, the Lagrange test is conducted to determine whether the suitable model is CEM or REM. If the probability value is greater than 0.05, the CEM is chosen; if it is less than 0.05, the REM is selected. The results of the Chow and Hausman tests for the analysis of the factors affecting Indonesian CPO exports to the 10 destination countries during the 10-year period (2011-2020) are presented in Table 1.

**Table 1.** The results of the Chow and Hausman tests for the analysis of the factors affecting Indonesian CPO exports to the 10 destination countries during the 10-year period (2011-2020)

Testing	Effects test	Statistics	df	Prob.	Model
Test Chow	Cross-section F	16.6427	(9,87)	0.0000	FEM
Test Hausman	Summary Cross-section random	Chi-Sq. Statistics 0.0000	Chi-Sq. df 0	Prob. 0.0000	FEM

Table 1 explains that the probability value on the Chow test and Hausman analysis factor export crude palm oil (CPO) Indonesia to 10 destination countries (India, China, Pakistan, Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore) for the last 10 years of 0.0000 < 5% probability so selected models FEM.

Based on the results of the views 10 analysis, the best model is obtained on the factor analysis of Indonesia's crude palm oil (CPO) exports to 10 destination countries (India, China, Pakistan, Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore) namely the FEM model. The FEM model analyzes the export factor of crude palm oil (CPO) in Indonesia to 10 destination countries (India, China, Pakistan, Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spanish, And Singapore) can see in Table 2.

**Table 2.** The FEM model analyzes the export factor of Indonesian crude palm oil (CPO). 10 destination countries (India, China, Pakistan, Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore) for the last 10 years (2011- 2020)

No	Variables	coefficient	std. Error	t-Statistics	Prob.
1	Constant (C)	20.49871	7.215992	2.840733	0.0056
2	GDP Indonesia (X1)	-0.149776	0.243585	-0.614879	0.5402
3	Indonesian distance (X2)	-0.224422	0.184197	-1.218384	0.2264
4	Mark swap rupiah (X3)	-0.096372	0.258561	-0.372725	0.7103
5	Fixed Effects (Cross)				
	India	1.164518			
	China	0.799311			
	Pakistan	-0.240120			
	Dutch	0.150090			
	Malaysia	-0.532981			
	Bangladesh	-0.122412			
	Egypt	-0.258651			
	Italy	0.009038			
	Spanish	-0.086317			
	Singapore	-0.882476			
6	Effects Specifications				
	Cross-section fixed (dummy variables)				
	R-squared	0.737699	Means dependent var		13.67
	adjusted R-squared	0.701520	S,D, dependent var		0.733
	SE of regression	0.400744	Akaike info criteria		1.129
	sum squared resid	13.97185	Schwarz criteria		1.468
	Logs likelihood	-43.48757	Hannan-Quinn criter		1.266
	F-statistics	20.39003	Durbin-Watson stat		0.881
	Prob(F-statistic)	0.000000			

*Equality Regression Data Panel*

The regression results of the Fixed Effect Model (FEM) analysis of the factors influencing Indonesia's crude palm oil (CPO) exports to the 10 destination countries (India, China, Pakistan, the Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore) for the last 10 years (2011-2020) are shown in Table 2.

The results indicate that four destination countries, namely India, China, the Netherlands, and Italy, have positive constants. This suggests that Indonesia's exports of crude palm oil (CPO) to these countries are relatively high compared to other countries. On the other hand, the remaining six countries (Pakistan, Malaysia, Bangladesh, Egypt, Spain, and Singapore) have negative constants, indicating that Indonesia's exports of crude palm oil (CPO) to these countries are relatively low.

Table 2 provides further details and numerical values of the regression coefficients for each destination country, allowing for a comprehensive analysis of the factors influencing Indonesia's CPO exports to these countries. Panel data regression equation of the gross domestic product (GDP) factor Indonesia's gross domestic product (GDP), geographic distance (JG), and exchange rate rupiah (NTR) which affects Indonesia's crude palm oil (CPO) exports palm oil (CPO) to 10

destination countries (India, China, Pakistan, Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore) for the last 10 years (2011-2020) can be seen in Table 3

**Table 3.** The panel data regression equation of the influencing factors Indonesia's crude palm oil (CPO) exports to 10 destination countries for 10 year last (2011-2020

Country objective	Equality regression data panel
Ln(CPO)_India	21.663228 - 0.149776 Ln(GDP) - 0.224422 Ln(JG) - 0.096372 Ln(NTR)
Ln(CPO)_China	21.298021 - 0.149776 Ln(GDP) - 0.224422 Ln(JG) - 0.096372 Ln(NTR)
Ln(CPO)_Pakistan	20.253751 - 0.149776 Ln(GDP) - 0.224422 Ln(JG) - 0.096372 Ln(NTR)
Ln(CPO)_Netherlands	20.643961 - 0.149776 Ln(GDP) - 0.224422 Ln(JG) - 0.096372 Ln(NTR)
Ln(CPO)_Malaysia	19,960890 - 0.149776 Ln(GDP) - 0.224422 Ln(JG) - 0.096372 Ln(NTR)
Ln(CPO)_Bangladesh	20.371459 - 0.149776 Ln(GDP) - 0.224422 Ln(JG) - 0.096372 Ln(NTR)
Ln(CPO)_Egypt	20.235220 - 0.149776 Ln(GDP) - 0.224422

Country objective	Equality regression data panel
Ln(CPO)_Italy	Ln(JG)
	- 0.096372 Ln(NTR)
	20.584251 - 0.149776 Ln(GDP) - 0.224422
Ln(CPO)_Spain	Ln(JG)
	- 0.096372 Ln(NTR)
	20.407554 - 0.149776 Ln(GDP) - 0.224422
Ln(CPO)_Singapo re	Ln(JG)
	- 0.096372 Ln(NTR)
	19,611395 - 0,149776 Ln(PDB) - 0,224422 Ln(JG) - 0,096372 Ln(NTR)

Based on equality regression data panel on, obtained 3 country with the highest constant value found in India followed by China and Dutch. Besides That, obtained Also 3 country with mark constant Lowestthere is on country Singapore, Malaysia, And Pakistan. Constant on The panel data regression equation above shows that the number of crude exports palm oil (CPO) Indonesia to each country.

The constant value of Indonesia's crude palm oil (CPO) exports to India of 21.663228. This means that if Indonesia's GDP, geographical distance, and exchange rates If the rupiah is considered constant, then Indonesia's crude palm oil (CPO) exports to the country India experience enhancement as big 21.663228 million US\$. Mark constant Indonesian crude palm oil (CPO) exports to China amounted to 21.298021. It means if Indonesia's gross domestic product (GDP), geographic distance, and the rupiah exchange rate considered constant, Indonesia's crude palm oil (CPO) exports to China increased by 21.298021 million US\$. Crude export constant value Indonesian palm oil (CPO) to the Netherlands amounted to 20.643961. It means If Indonesia's GDP, geographic distance, and the rupiah exchange rate are assumed to be constant, then export crude palm oil (CPO) Indonesia to country Dutch

**Table 5.** Autocorrelation test factor analysis of Indonesia's CPO exports to 10 countries objective (India, China, pakistani, Dutch, Malaysia, Bangladesh, Egypt,Italy, Spain, and Singapore) during 10 years last (2011-2020)

Variables	coefficient	std. Error	t-Statistics	Prob.
Constant	0.772294	4.315944	0.178940	0.8584
GDP Indonesia (X1)	0.002345	0.155671	0.015064	0.9880
Distance Geographical (X2)	-0.041156	0.032410	-1.269842	0.2072
Mark Swap Rupiah (X3)	-0.026915	0.014604	-1.843031	0.0684
R-squared	0.053303		Means dependent var	0.269723
adjusted R-squared	0.023719		SD dependent var	0.260085
SE of regression	0.256982		Akaike info criteria	0.159557
sum squared resid	6.339819		Schwarz criteria	0.263764
Logs likelihood	-3.977854		Hannan-Quinn criter	0.201731
F-statistics	1.801747		Durbin-Watson stat	1.757949
Prob (F-statistics)	0.152033			

The results show that the *Durbin-Watson value* in this study is equal to 1.757949. This indicates that the factor analysis of crude palm oil exports (CPO)

experience enhancement of 20.643961 million US\$.

*Results Assumption Classic*

1. Test Multicollinearity

Results testing multicollinearity analysis factor export crude palm oil(CPO) Indonesia to 10 destination countries (India, China, Pakistan, Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore) for the last 10 years (2011-2020) can be seen on Table 4.

Table 4 shows that the analysis of crude palm oil (CPO) export factorsIndonesia to 10 country objective (India, China, pakistani, Dutch, Malaysia, Bangladesh, Egypt, Italy, Spanish, And Singapore) during 10 year final (2011-2020) own mark matrix *Pearsons Correlation* < 0.9. Matter this indicates that Indonesia's GDP factors, geographical distance, and exchange rates rupiah not experiencing multicollinearity.

**Table 4.** Test multicollinearity analysis factor export crude palm oil (CPO) Indonesia to 10 country objective (India, China, pakistani, Dutch, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore) for 10 year last (2011-2020)

Variable	GDP	Distance Geographica	Mark swap rupiah
GDP	1		
Distance	-	1	
Geographical	0.01992		
Mark swap rupiah	0.00356	0.07734	1

2. Test Autocorrelation

Autocorrelation test results analysis of crude palm oil (CPO) export factors Indonesia to 10 country objective (India, China, pakistani, Dutch, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore) for the last 10 years (2011-2020) can be done by looking at the value *Durbin-Watson* on Table 5.

Indonesia to 10 destination countries (India, China, Pakistan, Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain and Singapore) for the last 10 years not

experience autocorrelation due to value  $1.65 < Durbin-Watson < 2.35$ .

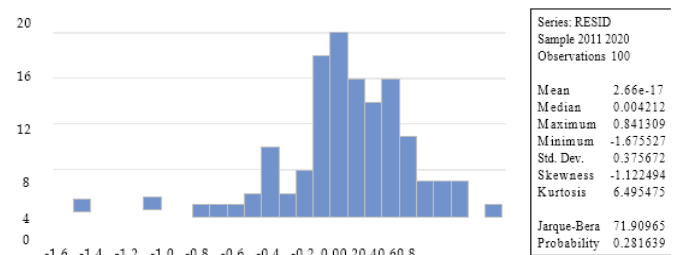
### 3. Test Heteroscedasticity

The results of the heteroscedasticity test analysis of the factors influencing Indonesia's crude palm oil (CPO) exports to the 10 destination countries (India, China, Pakistan, the Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore) for the last 10 years (2011-2020) are shown in Table 5.5. The probability values for the factors of Indonesia's domestic gross product (GDP), geographical distance, and the rupiah exchange rate against crude palm oil (CPO) exports range from 0.0684 to 0.9880. These values indicate that there is no heteroscedasticity present in the factors influencing Indonesia's CPO exports to these 10 destination countries during the 10-year period, as the probability values are greater than 0.05.

The normality test analysis of the crude palm oil (CPO) export factors for Indonesia to the 10 destination countries (India, China, Pakistan, the Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore) for the last 10 years (2011-2020) is presented in Figure 3. The figure provides insights into the normality distribution of the data, which is an important assumption in regression analysis.

Figure 3 show that mark probability on test normality *Jarque-Bera* analyzes the export factor of Indonesia's crude palm oil (CPO) to 10 countries objective (India, China, pakistani, Dutch, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore) for the last 10 years (2011-2020) of 0.2816. Indonesia's crude palm oil (CPO) exports variable to 10 destination

countries for 10 the last year (2011-2020) normally distributed, because the probability value  $> 0.05$ .



**Figure 3.** Test normality analysis factor export crude palm oil (CPO) Indonesia to 10 country objective (India, China, pakistani, Dutch, Malaysia, Bangladesh, Egypt, Italy, Spain and Singapore) during 10 last year (2011-2020)

The results of testing the classical assumptions show that the data are domestic products Indonesia's gross domestic product (GDP), geographical distance, and the rupiah's exchange rate against exports Indonesia's crude palm oil (CPO |) to the 10 destination countries has met the requirements namely No happen multicollinearity, No happen autocorrelation, No happen heteroscedasticity And data distributed normal. With thereby cannex on testing regression and statistics (test F, test t, coefficient determination).

#### Results Testing Statistics (Test F, Test t And Coefficient determination)

Results testing statistics analysis factor export crude palm oil (CPO) Indonesia to 10 country objective (India, China, pakistani, Dutch, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore) for the last 10 years (2011-2020) can be seen in Table 6.

**Table 6.** Testing statistics analysis factor export crude palm oil (CPO |) Indonesia to 10 destination countries (India, China, Pakistan, Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spanish, And Singapore) during 10 year final (2011-2020)

Variable	F-statistics		t-statistics		R <sup>2</sup>
	Mark F	Probability	Mark t	Probability	
GDP Indonesia (X1)			-0.6149	0.5402 <sup>tn</sup>	
Distance geographical (X2)	20.3900	0.0000 *	1.2184	0.0264 *	73.77%
Mark swap rupiah (X3)			-0.3727	0.7103 <sup>mr</sup>	

Information: \*= significant on on probability 5%; tn = No significant on probability 5%.

Table 6 show that mark probability on test F from factor Indonesia's gross domestic product (GDP) (X1), geographical distance (X2), exchange rate rupiah (X3) as a whole significantly increased crude palm oil exports (CPO) Indonesia to 10 destination countries (India, China, Pakistan, Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spanish, And Singapore) during 10 year final because mark probability  $< 0.05$ .

Table 6 presents the results of the t-test, indicating the probability values for the factors influencing

Indonesia's crude palm oil (CPO) exports to the 10 destination countries (India, China, Pakistan, the Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore) over the last 10 years. The results show that the geographical distance factor (X2) is partially significant with a positive effect (probability  $< 0.05$ ). On the other hand, Indonesia's gross domestic product (GDP) (X1) and the rupiah exchange rate (X3) have no significant effect and exhibit negative values in increasing Indonesia's crude palm oil (CPO) exports.



These findings suggest that as the geographical distance for crude palm oil (CPO) exports increases, the exports from Indonesia to these 10 destination countries also increase. However, higher values of Indonesia's gross domestic product (GDP) and the rupiah exchange rate are associated with lower exports of crude palm oil (CPO). This can be attributed to various factors such as global CPO price fluctuations, competition from other countries in the CPO market, demand for derivative products of palm oil, and other relevant factors.

Furthermore, the coefficient of determination (R<sup>2</sup>) for the factors influencing Indonesia's crude palm oil (CPO) exports to the 10 destination countries is 0.7377. This means that Indonesia's GDP (X1), geographical distance (X2), and the rupiah exchange rate (X3) account for 73.77% of the variation in Indonesia's crude palm oil (CPO) exports to these countries during the 10-year period. The remaining 26.23% is influenced by other factors not included in the analysis.

#### *Effect of Indonesia's Gross Domestic Product (GDP) on Exports Crude Palm Oil (CPO) Indonesia*

Factor product domestic gross (GDP) Indonesia (X1) in a manner Partial no significant effect (0.5402) and negative (-0.6149) on exports crude palm oil (CPO) Indonesia to 10 country objective (India, China, pakistani, Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore) for 10 last year. This is supported by the coefficient value of the FEM model of Indonesia's GDP factor worth -0.149776 (Table 5.5). This can be due to price crude palm oil (CPO) world experience enhancement and there is countries other producer of crude palm oil (CPO). Indonesian like Malaysia, as well as impairment rupiah currency. These results are supported by Aprina's research, (2014) that changes world price crude palm oil (CPO) is suspected to have an influence on the sector monetary policy in Indonesia, which will result in changes in value behavior real exchange. The diversity of changes in money growth is a temporary 99.68%. 0.32% other influenced by factor other outside model. Growth Money has a significant effect on money growth at the 5% level positively of 0.875031. This means that if the growth of the first lag money increases by ten percent then the current money growth will increase by 8.75% assuming other variables are constant. Purwandi et al., (2015) reported that the regression coefficient value of international crude palm oil (CPO) prices is -0.607, meaning that if there is an increase in international crude palm oil (CPO) prices by 1% so lower volume export crude palm oil (CPO) Indonesia to India of 60.70%. Khairunisa and Novianti, (2017) also reported the results of the analysis *export Product dynamic* (EPD) show that commodity oil palm Indonesia is exported to England, Italy, Germany, Spain and Greece in the

position of *rising star*. In the Netherlands, palm oil Indonesia is in position *retreat* Which indicate that happen decline share market export oil palm Indonesia in country the And followed with decline demand for Indonesian palm oil products resulting in market growth And commodity product Palm oil Indonesia No dynamic Again.

#### *The Effect of Geographic Distance on Crude Palm Oil (CPO) Exports Indonesia*

The geographical distance factor (X2) is partially significant (0.0264) and has value positive (1.2184) on Indonesia's crude palm oil (CPO) exports to 10 countries objective (India, China, pakistani, Dutch, Malaysia, Bangladesh, Egypt, Italy, Spain, and Singapore) for the past 10 years. This is due to the export distance which is too far will affect the price of crude palm oil (CPO), the closer the distance between crude palm oil (CPO) exporting countries, the purchase value of crude palm oil (CPO) is getting cheaper/lower. The same result was also reported by Sunardi et al., (2014) that *palm oil & its fraction*, and industrial *monocarboxylic fatty acids* significantly affected. Every is increasing economic distance by 1 percent will increase transportation costs so that it will decrease mark export commodity *palm oil* as big 0.84% And commodity industrial *monocarboxylic fatty acid* of 1.30%. Sari et al., (2014) showed results estimate Which obtained model show that variable *distances* significant effect on exports with a significant level of 1% and the magnitude of the value the coefficient is -1.60. This indicates that if the distance with the country If the export goal is 1% further, there will be a decline in crude palm oil exports (CPO) of 1.60%. Bellanawithana et al., (2009) explains that distance significant and the coefficient is negative indicating the greater the distance between countries will increase the cost of transportation so it can decrease trading.

#### *Effect of the Rupiah Exchange Rate on Crude Palm Oil (CPO) Exports Indonesia*

Factor mark swap rupiah (X3) in a manner Partial influential No real (0.7103) and has a negative value (-0.3727) on exports of crude palm oil (CPO) Indonesia to 10 country objective (India, China, pakistani, Dutch, Malaysia, Bangladesh, Egypt, Italy, Spain and Singapore) during the last 10 years. Results the same was also reported by Huda and Widodo, (2017) that the exchange rate rupiah against exports of crude palm oil (CPO) in the short and long term length which has a negative and significant coefficient in influencing exports Indonesian crude palm oil (CPO). This means that if the rupiah strengthens, exports of crude palm will increase oil (CPO) will down Good in period short nor period long. Prime et al., (2014) also reported that the depreciation factor had an effect significant to the variable value of Indonesia's

crude palm oil (CPO) exports, meaning significant weakening of local currency exchange rates influence happening increase in value crude export palm oil (CPO) Indonesia

## Conclusion

Based on the results of the research it can be concluded that: (1) Obtained by 4 export destination countries for Indonesian crude palm oil (CPO). positive value constants are India, China, the Netherlands, and Italy while 6 country other own value constant negative; (2) Gross domestic product (GDP) Indonesia (X1), distance geographic (X2), value the rupiah exchange rate (X3) as a whole significantly increased crude exports palm oil (CPO) Indonesia to 10 country objective (India, China, pakistani, Netherlands, Malaysia, Bangladesh, Egypt, Italy, Spain and Singapore) in the amount of 73.77%; (3) Distance geographical (X2) in a manner Partial significant And influential positive whereas product domestic gross (GDP) Indonesia (X1) And mark swap rupiah (X3) has no significant effect and has a negative value in increasing export crude Indonesian palm oil (CPO). to 10 countries objective

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## Author Contributions

The first author, Lilis S. Gultom, contributed to designing research, creating research instruments, conducting research, analyzing data, and writing research articles. The second authors, Nelly MR Sinaga contributed to conceptualization of the research, validation of research instruments, guiding data analysis, and writing of research articles. All authors have read and agree to the published version of the manuscript

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## Conflicts of Interest

The authors declare no conflict of interest.

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