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# The influence of EU renewable energy directive policy to Indonesian palm oil exports to some EU countries

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**Abstract.** The objectives of this study are 1) to describe Indonesian palm oil export to some European Union (EU) countries and some export determinant variables, 2) to analyze the implementation of the EU renewable energy Directive (RED) as an instrument to guarantee that the traded products are environmentally friendly and sustainable, and 3) to analyze the effect of the RED on Indonesian palm oil exports. The effect of RED was estimated through the export function behavior of Indonesian palm oil to each selected EU country. The secondary data was used for period of 2000–2021. A simultaneous equation model using the 2SLS method was applied for the analysis. The research result implies that the 2003 Directive, and the rupiah real exchange rate have significant effect on Indonesian export to Spain, Italy and Germany. While the price of palm oil in the EU is significantly affected the Indonesian palm oil export to Italy and Germany, but not to Spain. The strengthening of the rupiah exchange rate caused a decrease in Indonesian palm oil exports to Spain but increased the exports of Indonesian palm oil to Italy and Germany, and also increased the palm oil prices in the EU market.

## 1. Introduction

Most of the production of Indonesian palm oil is intended for exports and the rest is intended for domestic markets. The destination country of Indonesian palm oil exports spread to five continents with the largest part aimed at the Asian markets. In 2021, the top five importing countries of Indonesian crude palm oil were India, Malaysia, Spain, Singapore and the Netherlands. The total exports to the five countries reached 94.08 percent of the total Indonesian palm oil exports. The largest destination is India with an export volume of 1.92 million tons or 75.65 percent of the total volume of Indonesian palm oil exports with a value of US \$ 14,146 million [1]. Indonesian palm oil products are treated with discrimination in the European Union because it is considered to have an impact on health, animal protection and environmental issues [2]. This caused exports of palm oil in the 2019 period to shrink 11.78 percent to 32.9 million tons compared to the same period in the previous year. The volume is equivalent to 16 percent of the total exports of Indonesian palm oil which reached 21.31 million tons. Likewise, the value of Indonesian palm oil exports to Europe dropped by 27.89 percent to 1.72 billion USD, or equivalent to 24 trillion rupiah. The European Union as the second largest Indonesian palm oil export market reached 23.63 percent after the Asian market dominated by India reached 53.88 percent [1]. EU issued the first biofuel policy known as Renewable Energy Directive (RED) where this policy will limit the import of palm oil by all EU countries.



In 2003, the EU made a policy in the form of directives or directions for all member countries of the European Union. This policy aims to reduce the impact of energy use from fossil fuels that affect global climate change. The EU targets the use of biofuel for transportation by 2 percent in 2005 and 5.75 percent in 2010. Then on April 23, 2009, the EU established a revision of the production and promotion policies related to renewable sources of energy in the EU. In 2020 the EU ensured that their transportation fuel was at least 20 percent made from renewable sources. Basically, the RED policy is aimed at reducing the impact of global warming or the contribution of greenhouse gas from the use of fossil fuels as non-renewable energy [3].

Renewable energy direction policy regulates the criteria for production and consumption of all biofuels in EU countries to guarantee that the biofuels are produced by considering sustainability aspects [2]. Furthermore, in December 2018, the EU revised the Renewable Energy Directive called RED II, where the EU sets a binding renewable energy target reaching 32 percent in 2030. Red II as part of a clean energy program for all Europeans, aims to make the European Union a global leader in renewable energy and more broadly help the EU to meet the commitment of emissions reduction based on the Paris agreement [3]. In the derivative rules issued by the EU on March 13, 2019, entitled Delegated Regulation of Supplementing Directive of the EU RED II. The EU has decided that palm oil as a high-risk and non-sustainable renewable energy raw material through the Indirect Land Use Change (ILUC) scheme [4].

In recent years, the EU RED policy has become an important problem for the Indonesian palm oil industry. Since it was set in 2009 called Red I, the RED policy has continued to improve by the EU Parliament. Where this improvement increasingly complicates exports of palm oil to the EU market. Members of the Council of Palm Oil Producing Countries (CPOPC) continue to mediate and diplomate to submit objections to this EU policy. In April 2019, CPOPC member countries visited the EU to fight the EU discrimination against oil palm products [3]. Based on this description, the main objective of this study is to analyze the influence of EU RED policy on Indonesian palm oil exports to some EU countries.

## 2. Methods

This study was conducted on Indonesian palm oil commodities to see how the impact of the EU RED policy on the demand for Indonesian palm oil by three EU countries such as Spain, Italy and Germany. A time series data from 2000-2021 was used in this study. A quantitative descriptive analysis was used to provide an explanation of how the impact of EU RED policy on Indonesian palm oil exports to three member countries of the EU. While the quantitative method is used to analyze Indonesian palm oil export data to European Union member countries. Quantitative data analysis is carried out using the simultaneous equation economic model. Each equation was predicted with a 2-stage least square (2-SLS) method using the SAS/ETS (Statistical Analysis System/Econometric Time Series) program version 9.4.

### 2.1. Model specifications

The econometric model of Indonesian palm oil export in the EU countries is formulated in 4 structural equations and 2 identity Equations. The complete model is presented as follows.

*2.1.1. Indonesian palm oil export to Spain.* Indonesian palm oil export to Spain is predicted to be influenced by the palm oil price in the EU, RED policies, and rupiah exchange rates against euros. The equation is presented in Eq. 1.

$$XIS = a_0 + a_1PEU + a_2 DRED0 + a_3 DRED1 + a_4 DRED2 + a_5 NTR + \varepsilon \quad (1)$$

where:

XIS = Indonesian palm oil export to Spain (Ton)

PEU = price of palm oil in the EU (USD/Ton)

DRED0 = dummy variable for Pre Directive 2003, D=0 for 2000-2003, D=1 for 2004-2021

DRED1 = dummy variable for Directive 2003, D=0 for 2000-2009, D=1 for 2010-2021

DRED2 = dummy variable for RED, D=0 for 2000-2018, D=1 for 2019-2021

NTR = the real exchange rate of the rupiah against the euro (IDR/EUR)

E = error

Expected estimation values:  $a_2 > 0$ ;  $a_1, a_3, a_4, a_5 < 0$

*2.1.2. Indonesian palm oil export to Italy.* Like Indonesian palm oil exports to Spain, predicted variables that affect the exports of palm oil to Italy are prices in the EU, RED policies, and rupiah exchange rates against euros. The equation is presented in Eq. 2.

$$XII = b_0 + b_1 PEU + b_2 DRED0 + b_3 DRED1 + b_4 DRED2 + b_5 NTR + \varepsilon \quad (2)$$

where:

XII = Indonesian palm oil export to Italy (ton)

Expected estimation value:  $b_2 > 0$ ;  $b_1, b_3, b_4, b_5 < 0$

*2.1.3. Indonesian palm oil export to Germany.* Indonesian palm oil exports to Germany is also predicted to be influenced by palm oil prices in the EU, renewable energy direction policies, and rupiah exchange rates against euros. The equation is presented in Eq. 3.

$$XIG = c_0 + c_1 PEU + c_2 DRED0 + c_3 DRED1 + c_4 DRED2 + c_5 NTR + \varepsilon \quad (3)$$

where:

XIJ = Indonesian palm oil export to Germany (ton)

Expected estimation value:  $c_2 > 0$ ;  $c_1, c_3, c_4, c_5 < 0$

*2.1.4. Palm oil price in the European Union.* Palm oil price in EU markets is predicted to be influenced by total palm oil export and import in EU, and by previous palm oil prices in EU. The equation is presented in Eq. 4.

$$PEU = d_0 + d_1 XEU + d_2 MEU + d_4 LPEU + \varepsilon \quad (4)$$

where:

XEU = Total palm oil export in EU (ton)

MEU = Total palm oil import in EU (ton)

LPEU = palm oil prices in the EU t-1 (tons)

Expected estimation value:  $d_1, d_2, d_4 > 0$ ;  $d_3 < 0$

*2.1.5. Total Indonesia palm oil export to European Union.* Total Indonesian palm oil exports to EU is the sum of Indonesia palm oil exports to the above mentioned countries plus Indonesian palm oil exports to the other EU countries. The equation is presented in Eq. 5.

$$XIEU = XIS + XII + XIG + XIOEU \quad (5)$$

where:

XIEU = Total Indonesian palm oil exports to EU (Ton)

XIOEU = Indonesian palm oil export to the other EU countries (Ton)

*2.1.6. Total palm oil export in European Union.* Total palm oil exports in EU is the sum of Indonesia palm oil exports to EU plus the other countries' exports to EU. The equation is presented in Eq. 6.

$$XEU = XIEU + XOEU \quad (6)$$

where:

XEU = export of palm oil to the EU (Ton)

XOEU = export of other palm producing countries to the EU (Ton)

## 2.2. Evaluation of the model analysis

The Econometric Model in this study uses time series data with a span of 22 years, between 2000 and 2021 and cross sections with three European Union member countries namely Spain, Italy and Germany. In this study used the Indonesian Crude Palm Oil (CPO) trading equation model in the European Union. This model aims to study the behavior of Indonesian palm oil exports to the EU and one of the variables that needs to be learned is whether non-tariff barriers in the form of EU RED policy will influence the demand in each EU countries for Indonesian palm oil.

## 2.3. Identification of equation models

The identification of the equation model is done by order condition, where the results of the identification of the equation in the econometrics model that have been formulated consists of 6 endogenous variables (G) and 10 predetermined variables. Thus, the number of variables contained in the model is 16 variables. The number of endogenous and exogenous variables in one particular equation four and five so that results are obtained  $(k-m) > (G-1)$ . Therefore, it can be concluded that the structural equation contained in this study is excessively identified (overidentified).

## 2.4. Model validation test

Model validation test is used to determine whether the equation model used is appropriate or not to be carried out simulation, so that it can describe the condition of demand for Indonesian palm oil in the EU market before and after the RED policy in the period of 2000 to 2021. RMSPE and U-Theil were used to validated the model. The result of the model validation is presented in Table 1.

**Table 1.** Results of the validation of the Indonesian palm oil export model, 2000-2021.

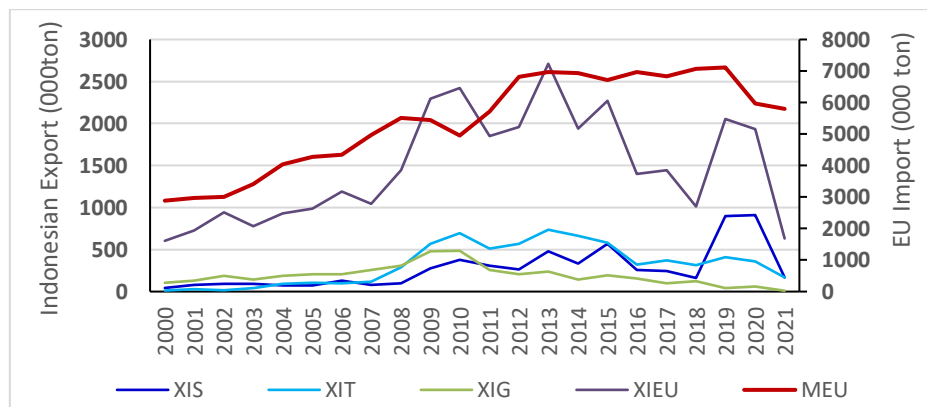
Variables	Mean % Erro	RMS % Error	Bias (UM)	Var (US)	Covar (UC)	U Theil
XIS	11.9229	66.8305	0.00	0.06	0.94	0.1322
XIIT	-0.4884	98.0806	0.00	0.02	0.98	0.1413
XIJ	-65.2300	507.0	0.00	0.02	0.98	0.3489
XEU	-3.0241	11.2867	0.08	0.01	0.92	0.0519
PEU	7.3806	27.4360	0.00	0.30	0.70	0.1293

Table 1 shows that some endogenous variables have a RMSPE value smaller than 50 percent. In addition, values of U-Theil are relatively small and can be used as estimation models.

## 3. Results and discussion

The EU is an important market for Indonesian palm oil. Three potential countries for Indonesian palm oil exports in EU are Spain, Italy and Germany. During the observation period, Indonesian palm oil exports these countries are fluctuated. During the period of 2000 to 2013 there was a consistent increase of Indonesian palm oil exports to these countries, but after 2013 there was a fluctuating development and tended to decline. The development of total Indonesian crude palm oil exports to the EU, Spain, Italy and Germany as well as the development of crude palm oil imports in the EU in the same period in detail is presented in Figure 1.

Figure 1 shows the total exports of Indonesian crude palm oil to EU member countries during the period of 2000-2021. Based on the trend line, it is shown that the average increase is 43,969 tons each year. The largest export was in 2013 amounted to 2,710,434 tons and the smallest in 2000 amounted to 603,982 tons. Meanwhile, the total import of crude palm oil in EU countries shows an increasing tendency. The sharp decline occurred after the enactment of Red II in 2019.



Source: UN Comtrade [5]

**Figure 1.** Indonesian crude palm oil exports to the European Union, 2000-2021.

### 3.1. The estimated results of Indonesian palm oil export to some EU countries

**3.1.1. Indonesian palm oil export to Spain.** The estimated results of Indonesian palm oil export to Spain show the R-Square value of 0.8421, meaning that the variation of it can be explained by the explanatory variable by 84.21 percent and the remaining of 15.79 percent is explained by other variables outside the model. F-test value is 16.01 and significant at level of  $\alpha$  1 percent. This condition describes that all variables in the equation together affect the exports of Indonesian palm oil to Spain. The result of the estimation for Indonesian palm oil export to Spain is as in Table 2.

**Table 2.** Estimation result of Indonesian palm oil export to Spain.

Variable	Parameter estimate	Pr >  t	Variable Label
Intercept	-656.963	0.0102	Intercept
PEU	12.08429	0.2586	Palm oil price in EU (USD/TON)
DRED0	25.53355	0.8757	Pra <i>Directive</i> 2003 Policy
DRED1	511.7654	0.0003*	<i>Directive</i> 2003 Policy
DRED2	1062.577	<.0001*	RED II <i>Policy</i>
NTR	-7.75689	0.0003*	Real exchange rate Rp to Euro
Pr > F	<.0001	Adj R-Sq	0.78958
F Value	16.01	DW	1.98687
R-Square	0.84218		

\* significant at  $\alpha$  of 5%

RED policy in Table 2 is divided into three periods and inputted as dummy variable in the model, namely Pre directive 2003 (DRED0), Directive 2003 (DRED1), and Renewable Energy Directive II (DRED2). Estimation result in Table 2 shows that the price of palm oil in the EU and pre directive 2003 policy did not influence Indonesian palm oil export to Spain, but Directive 2003, RED II, and real exchange rate of Rupiah to Euro did.

It is suspected that Spanish demand for Indonesian palm oil has increased before the non-tariff barrier in the form of a 2003 Directive Policy due to the needs of palm oil as raw materials continues to increase. Mustajab [6] reported that the European Union market showed an increase because more and more companies in Europe used CPO as raw material for production, cosmetic manufacturing materials, and oleochemicals. In addition, the use of biofuel as an alternative fuel energy encourages an increase in CPO consumption in the European Union.

Implementation of Directive 2003 shows a significant positive effect on Indonesian palm oil export to Spain with parameter value of 511.76 meaning that in the 2003 Directive period Spanish demand for Indonesian palm oil increased by 511.76 tons. It is presumed that the 2003 Directive did not make Spain decrease the demand for palm oil from Indonesia

RED II Policy shows a positive effect on Indonesian palm oil export to Spain. The estimation results show a value of 1062.58 meaning that in the renewable energy directory policy period Spain's demand for Indonesian palm oil increased by 1062.58 tons. The renewable energy directive policy imposed by the European Union does not make Spanish demand for Indonesian palm oil decreased. This is in line with [6] that the Renewable Energy Directive is significant but the sign is not in accordance with the allegations because it has a positive value where palm oil exports become higher than before the enactment of the Renewable Energy Directive policy. This result is also supported by [7] stated that the positive effect of EU RED policy because of various things. The Indonesian Sustainable Palm Oil (ISPO) policy began to be held, which requires palm oil producers to certify its palm oil products. ISPO certification is able to convince the European Union that Indonesian palm oil that has an ISPO certificate has met the renewable energy directive criteria.

The rupiah's real exchange rate to Euro shows a negative and significant effect on Indonesian palm oil export to Spain at 1 percent of  $\alpha$ . An increase in exchange rate (depreciation of rupiah) will decrease Indonesian palm oil export to Spain by 7.76 ton. An empirical finding by [8] revealed that the exchange rate will affect the formation of export prices, while prices will affect the export of palm oil. Therefore, there is no policy that is able to control the exchange rate that occurs.

3.1.2. *Indonesian palm oil export to Italy.* The model prediction results show the R-Square value of 0.7662 meaning that the variation of Indonesian palm oil export to Italy can be explained by the explanatory variable by 76.62 percent. The result also exhibits that the value of F is 9.84 and it is significant at 1 percent  $\alpha$ . It means that the model is good enough to explain the influence of the explanatory variables to Indonesian palm oil export to Italy. 3 out of 5 explanatory variables have significant effect as shown in the Table 3.

**Table 3.** Estimation result of Indonesian palm oil export to Italy.

Variable	Parameter estimate	Pr >  t	Variable Label
Intercept	-988.465	0.0070	Intercept
PEU	37.93413	0.0200**	Palm oil price in EU (US\$/ton)
DRED0	217.9234	0.3528	Pra Directive 2003 Policy
DRED1	501.0305	0.0050*	Directive 2003 Policy
DRED2	-291.4525	0.3162	RED II Policy
NTR	6.30727	0.0170**	Real exchange rate Rp to Euro
Pr > F	0.0003	Adj R-Sq	0.68839
F Value	9.84	DW	1.729229
R-Square	0.76629		

\* significant at  $\alpha$  of 1%

\*\* significant at  $\alpha$  of 5%

Table 3 shows that Indonesian palm oil export to Italy was influenced by the price of palm oil in the European Union, Directive 2003, and the real exchange rate of the rupiah to Euro. Price of palm oil has a positive effect on Indonesian palm oil export to Italy at  $\alpha$  5 percent. An increase in the price of palm oil in the EU markets by 1 US\$/ton increases Indonesian palm oil export to Italy by 37.93 tons.

Directive 2003 policy has a positive and significant influence on Indonesian palm oil export to Italy at 1 percent of  $\alpha$ . The parameter value indicates that in the 2003 Directive period Indonesian palm oil export to Italy increase by 501.03 tons. The increase in 2003 directive period is presumed that the 2003 Directive did not make Italy decrease the demand for Indonesian palm oil.

The real exchange rate of Rupiah to Euro has a positive and significant effect on Indonesian palm oil export to Italy at a level of  $\alpha$  5 percent. The parameter value of 6.3073 means that if there is an increase in the exchange rate by 1 rupiah per Euro it can increase Indonesian palm oil export to Italy by 6.31 tons. This result is in line with [7] and [9] stated that the rupiah exchange rate had a positive and significant effect on Indonesian palm oil exports.

*3.1.3. Indonesian palm oil export to Germany.* The estimated results of the Indonesian palm oil export to Germany give the R-Square value of 0.7011 meaning that the variation of Indonesian palm oil export to Germany can be explained by the explanatory variable by 70.11 percent and F value of 7.04 and significant at level of  $\alpha$  of 1 percent. This indicates that all variables in the equation together have significant influence on Indonesian palm oil export to Germany. The detail estimation result is presented in Table 4.

Table 4 shows that Indonesian palm oil export to Germany was influenced by the price of palm oil in the European Union, Directive 2003 policy, and the real exchange rate of rupiah to Euro. Price of palm oil has a positive and significant effect on Indonesian palm oil export to Germany at  $\alpha$  of 1% with parameter value of 30.4462. An increase in the price of palm oil in the EU markets by 1 US\$/ton increases Indonesian palm oil export to Germany by 30.45 tons.

**Table 4.** Estimation result of Indonesian palm oil export to Germany.

Variable	Parameter estimate	Pr >  t	Variable Label
Intercept	191.4051	0.4015	Intercept
PEU	30.44620	0.0093*	Palm oil price in EU (US\$/ton)
DRED0	6.705039	0.9670	Pra <i>Directive</i> 2003 Policy
DRED1	-202.766	0.0768***	<i>Directive</i> 2003 Policv
DRED2	-104.503	0.6032	RED II <i>Policy</i>
NTR	-4.02456	0.0273**	Real exchange rate Rp to Euro
Pr > F	0.0014	Adj R-Sq	0.60148
F Value	7.04	DW	1.578291
R-Square	0.70111		

\* significant at  $\alpha$  of 1%

\*\* significant at  $\alpha$  of 5%

\*\*\* significant at  $\alpha$  of 10%

Directive 2003 policy has a negative and significant effect on Indonesian palm oil export to Germany at a 10% of  $\alpha$ . The parameter value indicates that in the 2003 Directive period Indonesian palm oil export to Germany decrease by 202.77 tons. The decrease in 2003 directive period is presumed that Germany strictly implements the directive to Indonesian palm oil.

The real exchange rate of Rupiah to Euro has a negative and significant effect on Indonesian palm oil export to Germany at a level of  $\alpha$  5%. The parameter value of 4.0246 means that an increase in the exchange rate by 1 rupiah per Euro can decrease Indonesian palm oil export to Germany by 4.02 tons. This result is in line with [9] and [10] stated that the exchange rate had a significant and negative effect on the exports volume.

*3.1.4. Price of palm oil in EU markets.* The estimated results of the palm oil price in the European Union showed that the value of R-Square was 0.7999 meaning that the variation of the palm oil price in EU market can be explained by the explanatory variable by 80 percent. The result also revealed that the F value is 16.00 and significant at level of  $\alpha$  of 1 percent. This result indicates that all variables in the equation have a simultaneous effect on the price of palm oil in the European Union. The detail results of the estimation are presented in Table 5.

Table 5 shows that the palm oil prices in the European Union is not affected by total palm oil exports and total palm oil imports in the European Union. But the current price is significantly affected by the

previous year prices. The parameter value is 0.8095 means that if the price of palm oil in the European Union in previous year experienced an increase of 1 USD/ton, it would increase the current price of palm oil in the European Union amounting to 0.81 USD/ton. This in line with [11] stating that the price increase is not only due to increased volatility from time to time, but the price itself has risen and indicates a trend factor.

**Table 5.** Estimation result of palm oil price in EU market.

Variable	Parameter estimate	Pr >  t	Variable Label
Intercept	-9.06449	0.9839	Intercept
LXEU	6.540231	0.1060	Lag total exports of palm oil in EU (ton)
MEU	-0.26959	0.4544	Lag total imports of palm oil in EU (ton)
LPEU	0.809554	0.0500*	Lag Palm oil price in EU (US\$/ton) (USD/TON)
Pr > F	0.1300	Adj R-Sq	0.37664
F Value	2.81	DW	1.324294
R-Square	0.58442		

\* significant at  $\alpha$  of 5%

#### 4. Conclusion

The development of Indonesian palm oil exports to Spain, Italy and Germany in a period of 2000-2021 fluctuates and tends to increase. On the average export of Indonesian palm oil to the European Union has increased by 43,969 tons each year. The EU RED Policy is a tool to guarantee that biofuels produced and consumed in EU countries are environmentally friendly and sustainable.

The result of the research concludes that the it had significant effects on Indonesian palm oil export to Spain, Italy and but not to Germany. The results obtained are contrary to the initial hypothesis due to several things, including the government's rapid response in the implementation of the Indonesian Sustainability Palm Oil (ISPO) certification policy by oil palm plantation companies, including smallholders.

RED II Policy only had a significant effect on Indonesian palm oil export to Spain, but not to Italy and Germany. On the other hand, the price of palm oil in the European Union was only significantly affected by the previous palm oil price, not by total exports and total import of palm oil in European Union.

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