Isparta Uygulamalı Bilimler Üniversitesi
Ziraat Fakültesi Dergisi
ISSN 1304-9984

Research Article/Araştırma Makalesi

Ziraat Fakültesi Dergisi,
Cilt 18, Sayı 2,
Sayfa 100-109, 2023

Journal of the Faculty of Agriculture
Volume 18, Issue 2,
Page 100-109, 2023

Indonesian Palm Oil Export Analysis

Zahraturrahmi ZAHRATURRAHMI*[1], Vecdi DEMIRCAN[1]

Abstract: Palm oil is a plantation commodity essential to economic occupation in Indonesia due to its capability to make plant-based oil, which is critical to the manufacturing sector. This study aims to analyze the factors affecting Indonesian palm oil exports between 1990-2019. The methods used in this study are testing regression prerequisites (normality and linearity test), classical assumption (multicollinearity, heteroscedasticity, and autocorrelation test), and multiple linear regression (F, t, and R2) to analyze the factors that affect Indonesian palm oil exports. Based on the outcomes of the F test, it is evident that palm oil production, the USD exchange rate against the IDR, and the global palm oil price collectively influence palm oil exports. As per the t-test results, both production levels and global palm oil prices significantly impact Indonesian palm oil exports. However, the US dollar to Indonesian rupiah exchange rate does not significantly affect palm oil exports due to its fluctuating nature in both the short and long term. These fluctuations introduce uncertainty for exporters engaged in long-term trade agreements with foreign nations. According to the R2 test results, palm oil production, the USD exchange rate against the IDR, and the world palm oil price had a 96.5% impact on Indonesian palm oil exports.

Keywords: Palm oil, export, Indonesia

Endonezya Palm Yağı İhracat Analizi

Öz: Palmiye yağı, sanayi sektörünün çok ihtiyaç duyduğu bitkisel yağı üretme potansiyeli nedeniyle Endonezya'nın ekonomik faaliyetleri için gerekli olan bitkisel bir ürünüdür. Bu çalışma, 1990-2019 yılları arasında Endonezya'nın palm yağı ihracatını etkileyen faktörleri analiz etmeyi amaçlamıştır. Çalışmada, palm yağı ihracatını etkileyen faktörleri analiz etmek için regresyon ön koşullarının test edilmesi (normallik ve doğrusallık testi), klasik varsayım (çoklu doğrusallık, değişen varyans ve otokorelasyon testi) ve çoklu doğrusal regresyon yöntemleri kullanılmıştır (F, t ve R^2). F testi sonuçlarına göre palm yağı üretimi, IDR (Endonezya Rupiahı) karşısındaki USD döviz kuru ve dünya palm yağı fiyatı eş zamanlı olarak palm yağı ihracatı etkilemektedir. Öte yandan, t-testi sonuçlarına göre, üretim ve dünya palm yağı fiyatları Endonezya palm yağı ihracatını anlamlı bir şekilde etkilemektedir. ABD dolarının Endonezya Rupiahı karşısındaki döviz kuru palm yağı ihracatı üzerinde anlamlı bir etkiye sahip değildir, çünkü uzun ve kısa vadede Rupiahın dolar karşısındaki döviz kurunda yükselme ve düşme eğilimi gösteren dalgalanmalar vardır, bu da diğer ülkelerle uzun vadeli alım ve satım sözleşmeleri yapan ihracatçılar için belirsizlik yaratmaktadır. R^2 testi sonuçlarına göre, palm yağı üretimi, IDR karşısındaki USD döviz kuru ve dünya palm yağı fiyatı, Endonezya palm yağı ihracatı üzerinde %96.5'lik bir etkiye sahiptir.

Anahtar Kelimeler: Palm yağı, ihracat, Endonezya

Sorumlu yazar (Corresponding author)
zahraturrahmi25@gmail.com

Alınış (Received): 05/09/2023
Kabul (Accepted): 17/11/2023

[1]Isparta University of Applied Sciences, Faculty of Agriculture, Department of Agricultural Economics, 32000, Isparta, Turkiye

1. Introduction

Indonesia is one of the countries whose economy depends on exports. Export priority for Indonesia has been encouraged since 1983. Since then, exports have become an issue in stimulating economic growth in line with the change in industrialization scheme from prominence on import substitution industries to export promotion industries. One of the sectors contributing to Indonesian essential exports comes from the agricultural sector, the plantation sub-sector, namely palm oil (Ewaldo, 2015).

 DOI: 10.54975/isubuzfd.1355445

Palm oil is a plantation commodity essential to economic occupation in Indonesia due to its capability to make plant-based oil, which is critical to the manufacturing sector. The characteristics of palm oil, which is invulnerable to oxidation under elevated force, its capacity to break down chemicals that exhibit insolubility in alternative solvents, and its exceptional coating properties, palm oil finds applicability across a diverse range of purposes. These encompass its use as cooking oil, an industrial lubricant, and a biodiesel fuel source. The potential markets for the marketing of crude palm oil (CPO) and palm kernel oil (PKO) include the fractionation and refining industry, particularly in the culinary oil sector, as well as applications in special fats such as cocoa butter substitutes, margarine/shortening production, oleochemicals, and body wash products (BPS, 2020).

Indonesia is the biggest palm oil producing and exporter country on the global scale with an area of 15,38 million hectares and a total palm oil production of 45,58 million tons in 2022, followed by Malaysia with palm oil production of 19,20 million tons, Thailand with 3.26 million tons, Colombia 1.76 million tons, and Nigeria 1.40 million tons (Indexmundi, 2022a, 2022b).

Indonesian palm oil production tends to increase from 1990 to 2019. In 1990, the production of palm Indonesian palm oil exports have increased considerably over the past 30 years, except for 1998, 2010, 2012 and (million tons) (DGEIMA, 2022) 2016 which experienced a decline. The most significant increase in palm oil exports (including volume and export value) occurred in 2017, with an export volume of 29.13 million tons, an increase of 19.45 % compared to 2016. Even though export volume tends to increase, this increase is different from the export value of palm oil, which tends to fluctuate (BPS, 2018, 2019). Based on the publication of the World Bank (2023) Commodities Price Data (The pink sheet), in 2017, oil reached 2.41 million tons, increased to 7.00 million tons in 2000, and increased again by 14.94 % in 2001 to 8.39 million tons. In 2014, palm oil production was 29.27 million tonnes, increasing to 42.88 million tonnes in 2018, or an increase of 46 %. Palm oil production in 2019 increased by 9.8 % compared to 2018 47.12 million tonnes (Figure 1).

There was an average enhancement in the price of palm oil on the world market of 771.48 US$/mt, causing an increase in export value of up to 27.32 % compared to 2016. This price increase did not last long because, in 2018 and 2019, the price of palm oil decreased again to 627.49 US$/mt in 2018 and 604.52 US$/mt in 2019 (Figure 2). Exports of palm oil in 2019 reached 30.23 million tons with an export value of US$16.03 billion, although the export volume in 2019 was high, the export value was low.

According to PT Astra Agro Lestari Tbk (2022), if the world palm oil price continues to increase, Indonesia will benefit because the export price of palm oil will be higher and can

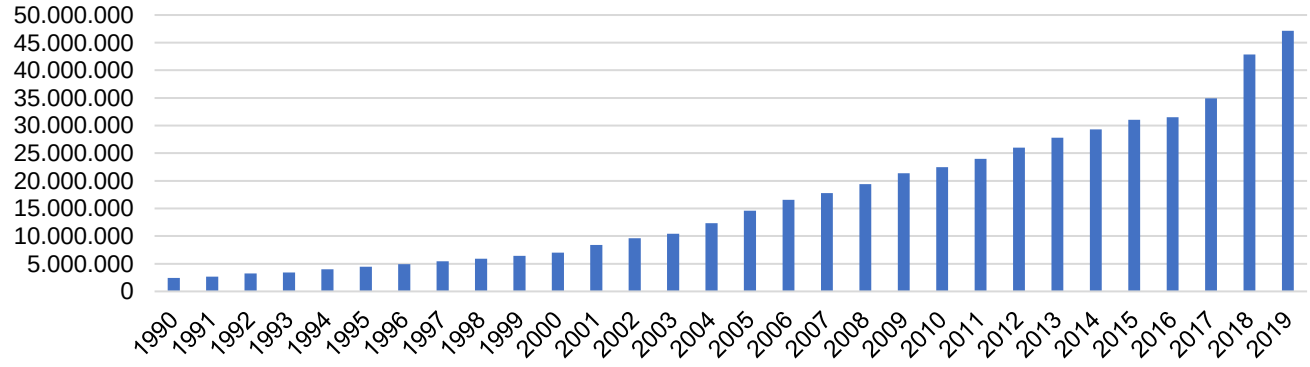

Figure 1. Indonesian palm oil production from 1990-2019 (million tons) (DGEIMA, 2022)

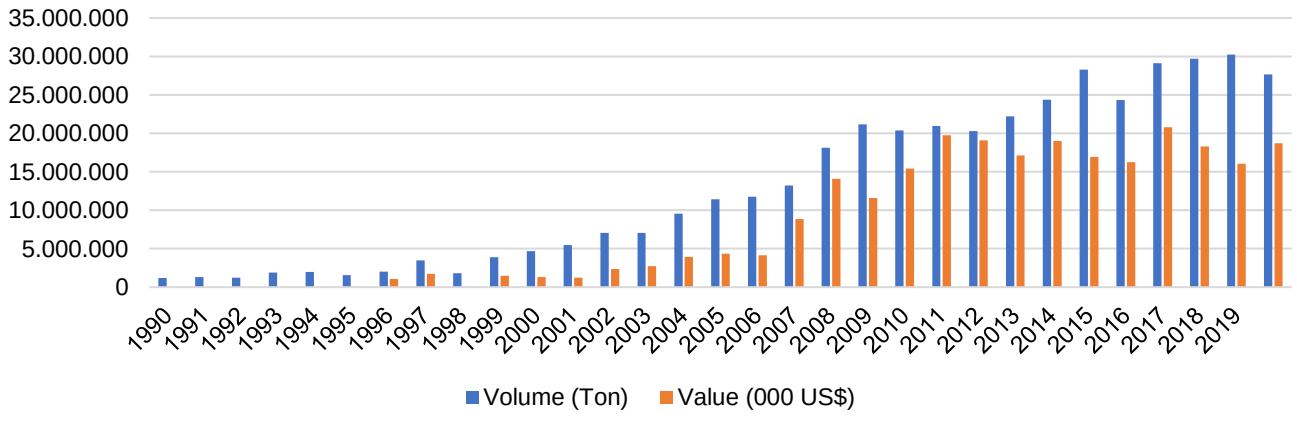

Figure 2. Total export of Indonesian palm oil from 1990-2019 (DGEIMA, 2022)

DOI: 10.54975/isubuzfd.1355445

contribute to Indonesian income and vice versa. Indonesia and Malaysia contribute around 90 % of global palm oil production, while India, China, and Europe are the primary consumers of world palm oil. The palm oil sector is crucial in Indonesian trade equilibrium performance. They were illustrated by their contribution, which reached 13.50 % to non-oil and gas exports and 3.50 % to the Indonesian Gross Domestic Product (GDP). Assistant Deputy for Agribusiness and Plantation Development at the Coordinating Ministry for the Economy of Indonesia, Edy Yusuf, said that the palm oil industry has four economic benefits. First, it is labor-intensive because this industry has absorbed 4.2 million core and 12 million non-core employees. Second, the palm oil industry annually contributes 3.50 % to the Indonesian Gross Domestic Product (GDP). Third, it contributes 13.50 % to the average non-oil and gas exports. Fourth, create energy independence through Biodiesel to save foreign exchange and positively impact the environment (Herman, 2021). This study aims to analyze palm oil exports, which are important in the Indonesian economy and exports. To determine the factors influencing Indonesian palm oil exports between 1990-2019.

2. Material and Method

2.1. Data types and research variables

The research employs secondary data in the form of time series data obtained from several institutions and government agencies, including Statistics of Indonesia (BPS), Director General of Estate Indonesian Ministry of Agriculture, World Bank, Index Mundi, Indonesian Palm Oil Association (GAPKI), Socio-Economic Center and Agricultural Policy of the Ministry of Agriculture of Indonesia, including several websites that support and relate to this research.

This research used two variables including:

1. Independent variables are variables that are thought to freely influence the dependent variable, namely Indonesian palm oil production in millions per ton (X1), the Exchange rate US Dollar (US $) against the Indonesian Rupiah (IDR) (X2), and World palm oil prices (US$/mt).
2. The dependent variable in this study refers to the export volume of Indonesian palm oil, measured in tons (Y), and it is influenced by the independent variable.

2.2. Method of data analysis

2.2.1. Testing regression prerequisites

A normality test aims to assess the distribution of data within the variables utilized in the research. One-Sample Kolmogorov Smirnov is used to test the normality of each variable data. Data normality can be seen by using the skewness value, which is utilized to establish the normal distribution of data in the variable by assessing the slope of the curve.

The value is good if it is close to zero (Ghozali, 2001). The normality test is (Equation 1):

$$d = maximum\,[Sn\,1\,(X) - Sn\,2\,(X)] \qquad (1)$$

Description:
D: Deviation
Sn_1: Cumulative distribution
Sn_2: Cumulative distribution of documentation
X: Number of Variables

The data normality test in this study uses the following hypothesis:

Ho: p data is not normal
Ha: p data is normal

The criteria used in determining whether the data is normal or not are as follows: if Kolmogorov-Smirnov is smaller than the probability (p: 0.05), then Ho is rejected.

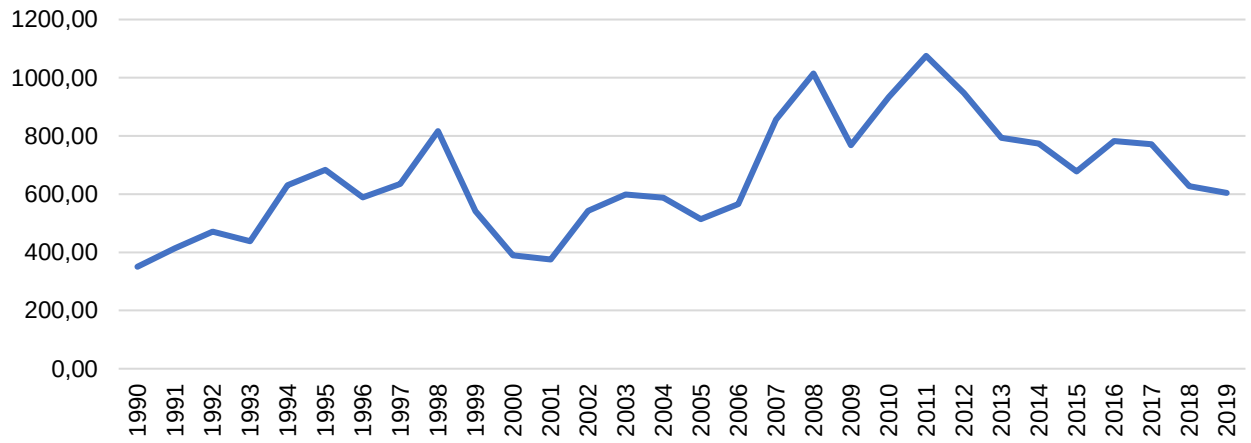

Figure 3. World palm oil prices ($/mt) (World Bank, 2022)

Meanwhile, if the Kolmogorov-Smirnov calculation is greater than the probability (p: 0.05), then Ha is accepted.

Linearity testing is deliberated to determine if there is a relationship between the independent and dependent variables (Sudjana, 2006). Testing is done with the F test with the following Equation (2):

$$F_{reg} = \frac{S^2TC}{Se^2} \quad (2)$$

The equation is:
F_{reg} : Price of F number for regression line
S^2TC: Variance of the Tuna Match
Se^2 : Error Variance

2.2.2. Classical assumptions test

The classical assumption test is a statistical evaluation employed to ascertain the connection between variables. This encompasses examinations such as tests for multicollinearity, heteroscedasticity, and autocorrelation to gauge different aspects of this relationship. The classical assumption test is used to detect whether there is a violation in multiple linear regression testing (Supranto, 1984).

A multicollinearity test aims to identify the presence of substantial correlations among variables within a multiple regression framework. A pronounced correlation among the independent variables can lead to a disturbance in the connection between these variables and the dependent variable (Gani and Amalia, 2015) (Equation 3).

$$X^2 = \left[n - 1 - \frac{1}{6}(2k + 5)\right] \ln D \quad (3)$$

Description:
n: number of predictors
k: number of independent variables
D: correlation determinant value
X^2: multicollinearity calculation
In: Linearity value

A heteroscedasticity test aims to analyze whether unequal residual variance exists across examinations in a regression model (Ghozali, 2007). In this study, to detect heteroscedasticity problems, Spearman's rank correlation test was used by correlating the residual values with the independent variable values. Spearman's correlation formula is defined as follows (Equation 4):

$$r_1 = \frac{6\sum_{t=1}^{n} d^2}{n(n^2-1)} \quad (4)$$

Description:
r_1: Heteroscedasticity test
t and t-1: Last and previous observation
n: Variable
$d^{2:}$ Determinant value

The autocorrelation test assesses whether a linear connection exists among errors within a sequence of observations organized chronologically, typically seen in time series data. This type of test is particularly applicable when dealing with time series datasets (Gujarati, 1988). The essential condition for conducting an autocorrelation test is the lack of autocorrelation.

The autocorrelation can be examined using the Durbin-Watson (DW) statistic. The formulation for the Durbin-Watson statistic, as presented by Ghozali (2007), is expressed subsequently (Equation 5).

$$dW = \frac{\sum_{t=2}^{n}(e^1 - t_1 - t_2)^2}{\sum_{t=2}^{n} {e_1}^2} \quad (5)$$

Description:
e_1: Estimation error
t and t_{-1}: Last and previous observations
t and t_{-2}: Observation value
DW: Durbin Watson

2.2.3. Multiple linear regression analysis

Multiple regression constitutes a statistical method employed for examining the correlation between a sole dependent variable and multiple independent variables. This test is performed to estimate the magnitude of the relationship in the middle of independent variables (palm oil production, the exchange rate of the US dollar against the Indonesian Rupiah, and world palm oil prices) to the dependent variable (palm oil export volume). The form of the model used (Sugiyono, 1997) (Equation 6):

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 \quad (6)$$

Description:
Y: Palm oil export volume in tons
a: Constanta
$b_{1,2,3}$: Regression coefficient X_1, X_2, X_3
X_1: Palm oil production in tons
X_2: Exchange rate of US dollar against Indonesian rupiah
X_3: World palm oil price in million US$

The F test is employed to assess whether there is a collective impact of all independent variables on the dependent variable. If the significance level of $F_{value} > F_{table}$, this signifies the rejection of the null hypothesis (H_0) and the acceptance of the alternative hypothesis (H_a), indicating that all independent variables together have a significant effect on the dependent variable. The formula is as follows (Sugiyono, 1997) (Equation 7):

$$\text{The formula } F_{value} = \frac{R^2/k}{(1-R2)/(n-k-1)} \quad (7)$$

Description:
F: Price F regression line
R: Multiple correlation coefficient
k: Count of independent variables
n: Quantity of sample members

The t test aims to test the significance of the influence of the independent variable (Production of palm oil, USD exchange rate against IDR, and World palm oil prices) on the dependent variable (Palm oil exports).

Determine the H_0 and H_a formulas

1. Palm oil production

H_0 = There is no significant impact of palm oil production on palm oil exports.
H_a = Palm oil production has a significant influence on palm oil exports

2. USD to IDR exchange rate

H_0 = USD to IDR exchange rate has no effect on palm oil exports

H_a = USD to IDR exchange rate affects palm oil exports

3. World palm oil prices

H_0 = There is no significant impact of world palm oil prices on palm oil exports

H_a = World palm oil price has no significant influence on palm oil exports

The coefficient of determination (R^2) test explains how much the independent variable can explain the proportion of the dependent variable. When the R2 value approaches 1, it indicates a more substantial impact, while if it approximates 0, the influence of the independent variable on the dependent variable diminishes.

3. Results and Discussion

3.1. Description of research data

This analysis uses secondary data (time series) and sample data from 1990-2019 (Table 1). The variables used are independent variables consisting of Indonesian palm oil production, exchange rates in US Dollar ($) against Indonesian Rupiah (IDR), and world palm oil prices and the dependent variable is Indonesian palm oil export volume (tons).

Table 1. Research data

Year	X1 Production of palm oil (million ton)	X2 Exchange rate USD against IDR	X3 World palm oil prices ($/metric ton)	Y Volume export of palm oil (million ton)
1990	2 412 612	1 842.81	350.48	1 173 883
1991	2 657 600	1 950.32	413.86	1 304 011
1992	3 266 250	2 029.92	471.58	1 252 813
1993	3 421 449	2 087.10	437.60	1 907 237
1994	4 008 062	2 160.75	631.10	1 971 707
1995	4 479 670	2 248.61	683.47	1 576 423
1996	4 898 658	2 342.30	588.80	2 013 275
1997	5 448 508	2 909.38	635.27	3 470 568
1998	5 930 415	10 013.62	816.69	1 826 287
1999	6 455 590	7 855.15	541.00	3 896 830
2000	7 000 508	8 421.77	389.96	4 688 852
2001	8 396 472	10 260.85	375.39	5 485 144
2002	9 622 344	9 311.19	542.92	7 072 124
2003	10 440 834	8 577.13	598.74	7 046 303
2004	12 326 419	8 938.85	587.21	9 565 974
2005	14 619 830	9 704.74	513.73	11 418 987
2006	16 569 927	9 159.32	565.24	11 745 954
2007	17 796 374	9 141.00	855.80	13 210 742
2008	19 400 794	9 698.96	1 014.18	18 141 006
2009	21 390 326	10 389.94	768.33	21 151 126
2010	22 496 857	9 090.43	933.02	20 394 174
2011	23 995 973	8 770.43	1075.15	20 972 382
2012	26 015 519	9 386.63	947.04	20 296 759
2013	27 782 004	10 461.24	793.77	22 222 508
2014	29 278 189	11 865.21	773.88	24 372 011
2015	31 070 015	13 389.41	677.91	28 276 871
2016	31 487 986	13 308.33	782.38	24 336 303
2017	34 940 289	13 380.83	771.48	29 135 179
2018	42 883 631	14 236.94	627.49	29 690 649
2019	47 120 247	14 147.67	604.52	30 232 555

 DOI: 10.54975/isubuzfd.1355445

3.2. Regression prerequisite test

According to the Kolmogorov-Smirnov normality test results, the significance value of 0.68 exceeds The results of testing the value of the linear relationship between variables of production of palm oil, the USD exchange rate against the IDR, and world oil prices on palm oil exports in Indonesia from 1990-2019 are fully presented in the following Table 3.

0.05. Therefore, it can be concluded that the data exhibits a normal distribution (Table 2).

Table 2. Normality test using One-Sample Kolmogorov-Smirnov test

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		30
Normal Parameters[a,b]	Mean	.0000000
	Std. Deviation	1943230.17
Most Extreme Differences	Absolute	579665
	Positive	.131
	Negative	.097
Kolmogorov-Smirnov Z		-.131
Asymp. Sig. (2-tailed)		.718
		.682

a. Test distribution is Normal.
b. Calculated from data.

The results of testing the value of the linear relationship between variables of production of palm oil, the USD exchange rate against the IDR, and world oil prices on palm oil exports in Indonesia from 1990-2019 are fully presented in the following Table 3.

Table 3. Linearity test results

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	298465932830 3088.500	3	9948864427676 96.100	236.211	.000[b]
Residual	109508161967 675.140	26	4211852383372 .121		
Total	309416749027 0763.500	29			

a. Dependent Variable: Palm Oil Export (Y)
b. Predictors: (Constant), Price (X3), Exchange rate (X2), Production (X1)

From the calculation of linearity testing using SPSS version 20 above, the estimated F_{value} is 236.211 with a probability of 0.000. The result of the F_{value} is then contrasted with the F_{table}. By employing a significance level (α) set at 0.05, a numerator of 3, and a denominator of 26, an F_{table} value of 2.98 is procured. Consequently, as the F_{value} of 236.211 surpasses the critical F_{table} value of 2.98, we reject the null hypothesis (H_0) and accept the alternative hypothesis (H_a). This outcome implies that there exists a linear relationship between the dependent variable Y (Palm oil exports) and the independent variables X (palm oil production, USD to IDR exchange rate, and global palm oil prices).

3.3. Classical assumption testing

The multicollinearity test proposes to determine if there is a relationship between the independent variables (production of palm oil, US dollar exchange rate against the Indonesian Rupiah, and world palm oil prices). A good regression model does not occur in multicollinearity (Table 4).

To determine whether multicollinearity occurs, use the following provisions:

If VIF > 5 , then multicollinearity is observed
If VIF < 5 , then multicollinearity is not present

Production of Palm Oil (X1), from the findings of the "Collinearity Statistic" output, the VIF is obtained at 3.694, which means the VIF value < 5. Then the production of palm oil variable "no multicollinearity occurs." So that means the production of palm oil as an independent variable has no relationship or correlation with other variables.

Exchange Rate of US Dollar ($) to Indonesian Rupiah (IDR) (X2), from the findings of the "Collinearity Statistic" output, the VIF is obtained at 3.351, which means that the VIF value is < 5. Then, the US dollar exchange rate against the Indonesian rupiah "no multicollinearity occurs." So that means the US dollar exchange rate against the Indonesian rupiah as an independent variable has no relationship or correlation with other variables.

World Palm Oil Prices (X3), from the findings of the "Collinearity Statistic" output, the VIF is obtained at 1.312, which means that the VIF value is < 5. Then, the world palm oil price had "no multicollinearity." So that means the world palm oil price as an independent variable has no relationship or correlation with other variables.

In this study, the heteroscedasticity test was implemented utilizing Spearman's rank correlation test. This test is conducted to show that the variation (Varian's) of the

Table 4. Multicollinearity test results

Coefficients[a]							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-4472894.748	1528662.449		-2.926	.007		
Production (X1)	.705	.058	.867	12.224	.000	.271	3.694
Exchange rate (X2)	1.598	1.710	.063	.934	.359	.298	3.351
Price (X3)	62.714	22.812	.116	2.749	.011	.762	1.312

a. Dependent Variable: Palm Oil Export (Y)

Table 5. Heteroscedasticity test using Spearman's rank corellation test

Correlations					
		Export (Y)	Production (X1)	Exchange rate (X2)	Price (X3)
Pearson Correlation	**Palm Oil Export (Y)**	1.000	.976	.836	.564
	Production (X1)	.976	1.000	.838	.487
	Exchange rate (X2)	.836	.838	1.000	.399
	Price (X3)	.564	.487	.399	1.000
Sig. (1-tailed)	**Palm Oil Export (Y)**	.	.000	.000	.001
	Production (X1)	.000	.	.000	.003
	Exchange rate (X2)	.000	.000	.	.014
	Price (X3)	.001	.003	.014	.
N	**Palm Oil Export (Y)**	30	30	30	30
	Production (X1)	30	30	30	30
	Exchange rate (X2)	30	30	30	30
	Price (X3)	30	30	30	30

variable is not the same for each observation. Furthermore, using the SPSS This test is conducted for all independent variables:

Production of palm oil (X1) and residuals. In the output between (X1) and residuals, the number (r) is 0.087, with a probability of 0.649. So by comparing the probability obtained, P 0.649 > 0.05. This shows that between production of palm oil and palm oil export volume "no heteroscedasticity."

US Dollar to Indonesian Rupiah Exchange Rate (X2) and residuals. The output between (X2) and the residual produces a number (r) of 0.039 with a probability of 0.836. So by comparing the probability obtained, P 0.836 > 0.05. This shows that between the US dollar exchange rate against the Indonesian rupiah and palm oil exports, "there is no heteroscedasticity."

World palm oil price (X3) and residuals. In the output between (X3) and residuals, the number (r) is 0.043, with a probability of 0.820. So by comparing the probability obtained, P 0.820> 0.05. This shows that between world palm oil prices and palm oil exports, "there is no heteroscedasticity."

The autocorrelation test examines whether a correlation exists between residual errors at period t-1 within a linear regression analysis. The assessment for the presence or absence of autocorrelation issues is typically conducted by computing the "Durbin-Watson statistic, denoted as d" (Table 6) This test employs the Durbin-Watson value to determine the presence or absence of autocorrelation.

Table 6. The Durbin-Watson value

d Value	Description
< 1.10	There is autocorrelation
1.10 – 1.54	No conclusion
1.55 – 2.46	There is no autocorrelation
2.47 – 2.90	No conclusion
2.91	There is autocorrelation

Based on the Durbin-Watson test analysis results, the statistical value is 1.252, with N = 30, k = 3, and a significance level of 0.05 (5%). The Durbin-Watson value is 1.252, which means "there is no definite conclusion whether there are symptoms of autocorrelation or not (No conclusion)."

Table 7. Autocorrelation test with Durbin-Watson

Model Summary[b]					
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**Durbin-Watson**
1	.982[a]	.965	.961	2052279.801	1.252

a. Predictors: (Constant), Price (X3), Exchange rate (X2), Production (X1)
b. Dependent Variable: Palm Oil Export (Y)

Because the Durbin-Watson test results do not produce a definite conclusion on whether autocorrelation symptoms occur, a good alternative to overcome this problem is to use another method, namely the run test. The Run test belongs to the non-parametric statistics category and serves as a method for evaluating the presence of significant correlations within residuals. When no such correlations are detected among the residuals, they are regarded as being distributed randomly.

Table 8. Runs test results

Runs Test	
	Unstandardized Residual
Test Value[a]	95734.29753
Cases < Test Value	15
Cases >= Test Value	15
Total Cases	30
Number of Runs	12
Z	-1.301
Asymp. Sig. (2-tailed)	.193

a. Median

The basis for decision-making in the Run test is as follows:

1. If the Asymp.Sig. (two-tailed) value is less than 0.05, it indicates the presence of autocorrelation symptoms

2. If the Asymp.Sig. (two-tailed) value is greater than 0.05, there are no indications of autocorrelation.

Based on the results of the Runs test, the value of Asymp.Sig. (2-tailed) 0.193 > 0.05 (Table 8), it is concluded that "there is no autocorrelation."

3.4. Multiple linear regression analysis

Statistical examinations were conducted using the SPSS version 20 software, relying on the outcomes of multiple linear regression analysis. The regression equation model applied in this study is as follows (Equation 8):

$$Y = a + b1X1 + b2X2 + b3X3 \quad (8)$$

$$Y = -4472894.748 + 0.705X1 + 1\,598X2 + 62\,714X3$$

Description:

Y: Palm oil export volume in tons
a: Constanta
$b_{1,2,3}$: Regression coefficient X_1, X_2, X_3
X_1: Palm oil production in tons
X_2: US dollar to Indonesian rupiah exchange rate
X_3: World palm oil price in million US$

The statistical tests include the F, t and R^2 tests.

The F test is employed to assess if there is a collective impact of all independent variables on the dependent variable. If the significance value of $F_{value} > F_{table}$ means H_0 is refused and Ha has been approved, indicating that all independent variables together significantly influence the dependent variable. Conversely, if the significance value of $F_{value} < F_{table}$ means H_0 is approved and H_a has refused, all independent variables together do not significantly affect the dependent variable.

According to Table 9, the analysis finding obtained the F_{value} of 236.211 with a significance of 0.000. Because $F_{value} > F_{table}$ (F_{value} 236.211 > F_{table} 2.98), H_0 is refused, and H_a is approved. That implies the variables of palm oil production, the USD exchange rate against the IDR, and the world palm oil price "significantly affect" the palm oil export variable.

Table 9. F test analysis results

ANOVA[a]

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	298465932830 3088.500	3	9948864427676 96.100	236.211	.000[b]
Residual	109508161967 675.140	26	4211852383372 .121		
Total	309416749027 0763.500	29			

a. Dependent Variable: Palm Oil Export (Y)
b. Predictors: (Constant), Price (X3), Exchange rate (X2), Production (X1)

The t-test is utilized to test if the independent variable individually affects the dependent variable. If the $t_{value} > t_{table}$ means H_0 is refused and H_a is approved, the independent variable individually has a significant effect on the dependent variable. Conversely, if $t_{value} < t_{table}$ means H_0 is approved, and H_a is refused, the independent variable has no significant effect on the dependent variable.

According to the multiple linear regression results in Table 10, can be interpreted the t-test results as follows:

Production of palm oil (X1). The findings of the coefficient calculation in the regression analysis equation obtained -4472894.748 for the constant coefficient and 0.705 for the coefficient of palm oil production. Based on the significance test using the t-test, for each coefficient of the regression equation, the t_{value} for the constant is -2.926, with a significance value of 0.007. The findings of the t-test analysis for the palm oil production variable obtained a t_{value} 12.224 with a significance of 0.000. Because the t_{value} 12.224 > t_{table} 1.697, it means that H_0 is refused and H_a is approved, so the palm oil production variable has a "significant effect" on palm oil export variable. This aligns with Adam Smith's Theory of Absolute Advantage, substantiating that more excellent production increases export volume. This is corroborated by Komalasari's (2009) findings, highlighting a constructive correlation between heightened production and expanded export provision. With augmented production, the provide of palm oil, both domestically in Indonesia and globally, rises, subsequently resulting in an upswing in Indonesian palm oil exports.

Exchange rate USD against IDR (X2). The findings of the coefficient calculation in the regression analysis equation obtained –4472894.748 for the constant coefficient and 1.598 for the coefficient of the USD exchange rate against IDR. The findings of the t-test analysis for the USD exchange rate against the IDR variable obtained a t_{value} of 0.934 with a significance of 0.359. Because the calculated t_{value} 0.934 < t_{table} 1.697 means that H_0 is accepted and H_a is rejected, the USD exchange rate against the IDR variable has "no significant effect" on the palm oil export variable. The findings of this research diverge from the established theory, which posits that the exchange rate has an impact on the availability of a commodity. When the Rupiah's exchange rate appreciates, implying a decrease in the value of the US dollar, the supply of goods for export to other countries decreases because the prices of these goods in their country of origin rise. Conversely, when the exchange rate depreciates, the prices of goods in the country of origin decrease, leading to an increase in the supply of goods for export to other countries

The findings indicate that the fluctuation in the exchange rate between the US dollar and the Indonesian rupiah

Table 10. Multiple linear regression results

Coefficients[a]							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-4472894.748	1528662.449		-2.926	.007		
Production (X1)	.705	.058	.867	12.224	.000	.271	3.694
Exchange rate (X2)	1.598	1.710	.063	.934	.359	.298	3.351
Price (X3)	62.714	22.812	.116	2.749	.011	.762	1.312

a. Dependent Variable: Palm Oil Export (Y)

does not exert a substantial influence on Indonesian palm oil exports. This is primarily due to the recurring shifts in the long and short-term exchange rates of the rupiah against the dollar, which tend to fluctuate unpredictably. These fluctuations introduce uncertainty for exporters who engage in long-term contractual agreements with other countries, rendering the rupiah-to-dollar exchange rate less significant in the context of Indonesian palm oil export activities. This aligns with the outcomes of prior research, as exemplified by Nurussalam and Shofwan (2019), who also found that the exchange rate lacks a noteworthy impact on Indonesian palm oil exports over both short and extended periods. Similarly, the research conducted by Sari (2016) corroborated these findings, indicating that fluctuations in the US dollar exchange rate against the Indonesian rupiah do not significantly affect export volumes.

World palm oil prices (X3). The findings of the coefficient calculation in the regression analysis equation obtained -4472894.748 for the constant coefficient and 62.714 for the world palm oil price coefficient. The results of the t-test analysis for the world palm oil price variable obtained a t_{value} of 2.749 with a significance of 0.011. Because the calculated t_{value} 2.749 > t_{table} 1.697 means that H_0 is rejected and H_a is accepted, the world palm oil price variable has a "significant effect" on the palm oil export variable. This aligns with the research conducted by Irawan (2018), which underscores a positive correlation between the volume of Indonesian palm oil exports and global palm oil prices. An escalation in global palm oil prices is shown to lead to an increase in Indonesian palm oil exports. Should the upward trend in global palm oil prices persist, Indonesia stands to gain, as higher palm oil export prices can bolster the country's revenue, as highlighted by Astra (2022).

Table 11. R^2 test analysis results

Model Summary[b]					
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**	**Durbin-Watson**
1	.982[a]	.965	.961	2052279.801	1.252

a. Predictors: (Constant), Price (X3), Exchange rate (X2), Production (X1)

b. Dependent Variable: Palm Oil Export (Y)

The coefficient of determination (R^2) is employed to assess the quality of the regression line or the extent to which independent variables can account for the variability in the dependent variable. It ranges from 0 to 1 or $0 \leq R^2 \leq 1$. A value closer to 1 indicates that the regression line provides a better explanation of the actual data, whereas a value closer to 0 signifies a weaker fit between the regression line and the data (Table 11).

This study obtained an R^2 of 0.965. This shows that the variables of palm oil production, USD exchange rate against IDR and world palm oil prices have an effect of 96.5% on the palm oil export variable, and the outstanding 3.5% is influenced by other variables not evaluated in this study.

4. Conclusion

According to the findings, palm oil production, the USD exchange rate against the IDR, and the world palm oil price had a 96.5% impact on Indonesian palm oil exports. In comparison, the outstanding 3.5% is influenced by other variables not evaluated in this study. Indonesian palm oil is still and will continue to face challenges in competition in the world market. This competition is mainly because palm oil has comparative and competitive advantages over other vegetable oils in the world. Therefore, the government and companies should continue increasing research and innovation investment to improve production efficiency, develop superior varieties, and create innovative palm-based products.

Acknowledgements

I want to express my deepest gratitude to my supervisor, Prof. Vecdi DEMIRCAN, for his guidance, patience, kindness, and support while writing this thesis. I wish him health, happiness, and a blessed life forever.

Author Contributions

The authors declare that they have contributed equally to the article.

Conflict of Interest

As the authors of this study, we declare that we do not have any conflict of interest statement.

Ethics Committee Approval

As the authors of this study, we declare that we do not have any ethics committee approval.

References

Astra, A. L. (2022). Top harga sawit rekor lagi termahal sepanjang masa. PT Astra Agro Lestari Tbk. Retrieved October 06, 2022, from https://www.astra-agro.co.id/2022/01/28/top-harga-sawit-rekor-lagi-termahal-sepanjang-masa/.

BPS (2018). Indonesian oil palm statistics 2018. ISSN:1978-9947. PN:05130.1920. BPS C:5504003. Statistics Indonesia, Jakarta.

BPS (2019). Indonesian oil palm statistics 2019. ISSN:1978-9947. PN:05130.2002. BPS C:5504003. Statistics Indonesia, Jakarta.

BPS (2020). Indonesian oil palm statistics 2020. ISSN: 1978-9947. PN:05100.2111. BPS C:5504003. Statistics Indonesia, Jakarta.

DGEIMA (2022). Statistical of national leading estate crops commodity 2021-2023. Director General of Estate Indonesian Ministry of Agriculture, Jakarta.

Ewaldo, E. (2015). Analisis ekspor minyak sawit Indonesia. *E-Jurnal Perdagangan, Industri dan Moneter, 3*(1), 10-15. https://doi.org/10.22437/pim.v3i1.3988

Gani, I., & Amali, S. (2015). Alat Analisis Data Aplikasi Statistik untuk Penelitian Bidang Ekonomi dan Sosial. Penerbit Andi, Yogyakarta.

Ghozali, I. (2001). Pengantar Ilmu Ekonomi Makro, Edisi Revisi. Penerbit Kanisius, Yogyakarta.

Ghozali, I. (2007). Aplikasi Analisis Multivariate dengan Program SPSS. Semarang, Universitas Diponegoro.

Gujarati, D. (1988). Ekonometrika Dasar. Erlangga, Jakarta.

Herman (2021). Industri kelapa sawit jadi tulang punggung ekonomi Indonesia. Berita Satu. Retrieved October 07, 2022, from https://www.beritasatu.com/ekonomi/855085/industri-kelapa-sawit-jadi-tulang-punggung-ekonomi-indonesia.

Indexmundi (2022a). Palm oil exports by country in 1000 MT. Indexmundi. Retrieved October 06, 2022, from https://www.indexmundi.com/agriculture/?commodity=palm-oil&graph=exports.

Indexmundi (2022b). Palm oil production by country in 1000 MT. Indexmundi. Retrieved October 06, 2022, from https://www.indexmundi.com/agriculture/?commodity=palm-oil.

Irawan, H. (2018). Analisis Faktor-Faktor yang Mempengaruhi Ekspor Minyak Kelapa Sawt Indonesia (1995-2015). Skripsi, Fakultas Ekonomi Universitas Islam Indonesia.

Komalasari, I. (2009). Analisis faktor-faktor yang mempengaruhi penawaran ekspor biji kakao indonesia. Institut Pertanian Bogor University Scientific Repository. Retrieved April 20, 2023, from http://repository.ipb.ac.id/handle/123456789/12960.

Nurussalam, K. N., & Shofwan (2019). Faktor – Faktor yang Mempengaruhi Ekspor Crude Palm Oil (CPO) Indonesia ke Tiongkok (Studi Kasus Periode 2009 – 2016). Skripsi Jurusan Ilmu Ekonomi, Fakultas Ekonomi dan Bisnis, Universitas Brawijaya, Malang.

Sudjana, S. (2006). Penilaian Hasil Proses Belajar Mengajar. PT Remaja Rosdakarya, Bandung.

Sugiyono (1997). Statistic untuk Penelitian. Bandung, Alfabeta Suki.

Supranto, J. (1984). Metode Ramalan Kuantitatif untuk Perencanaan. Jakarta, Penerbit Erlangga.

World Bank (2023). World bank commodity price data (the pink sheet), monthly prices in nominal US dollars 1960 to present. Retrieved March 07, 2023, from https://databank.worldbank.org/databases/commodity-price-data.