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THE EFFECT OF COMMODITY EXPORTS AND FOREIGN DEBT ON FLUCTUATIONS OF INDONESIA'S FOREIGN EXCHANGE RESERVES

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Abstract

Foreign exchange reserves are crucial in maintaining macroeconomic stability, particularly in developing countries. This study aims to analyze the impact of commodity exports and external debt on Indonesia's foreign exchange reserves from 1990 to 2023. A quantitative approach with a multiple linear regression model was employed, using time-series data sourced from BPS, the World Bank, and Bank Indonesia. The dependent variable is foreign exchange reserves, while the independent variables include CPO exports, metal exports, and external debt. The findings indicate that CPO exports significantly improve foreign exchange reserves, highlighting their strategic importance as a primary export commodity. In contrast, metal exports show a significant negative impact, driven by low value-added processing and high dependency on imported materials. External debt demonstrates positive and significant effects, reflecting its utility in strengthening reserves when effectively managed. This study emphasizes the need to enhance value-added processes for commodity exports and prudently manage external debt to optimize Indonesia's foreign exchange reserves. Future research could explore other variables, such as foreign direct investment (FDI), monetary factors, tourism, or labour, to provide deeper insights and refine analytical tools.

Keywords: ***CPO exports, external debt, foreign exchange reserves, Indonesia, metal exports***

1. INTRODUCTION

The international economy is facing significant challenges, one of which is that global growth is projected to slow down compared to 2023. This is due to high interest rates and geopolitical conflicts such as the war in Ukraine. Political uncertainty also affects economic stability, including potential risks from conflict in Taiwan, elections in various countries, and the impact of the transition to green energy. Therefore, it is necessary to have policies that focus on economic stabilization to face evolving global challenges (Drew, 2023).

The role of foreign exchange reserves is significant in supporting the country's economy because it is used to maintain stability when unexpected external and internal pressures impact macroeconomic resilience. In addition, the role of foreign exchange reserves in the economy is to pay for international trade. For developing countries such as Indonesia, foreign exchange reserves have an essential role in maintaining macroeconomic stability, including maintaining rupiah exchange rate stability, financing imports of goods and services, and as a cushion against external economic shocks (Mankiw, 2016).

Based on the regulation of Law (UU) Number 23 of 1999, foreign exchange reserves are assets owned by the central bank and monetary authorities, usually stored in foreign currency. Foreign exchange reserves can be defined as several international currencies owned by a country's central bank or monetary authority, to finance international transactions and maintain domestic currency exchange rate stability (Krugman et al., 2018).

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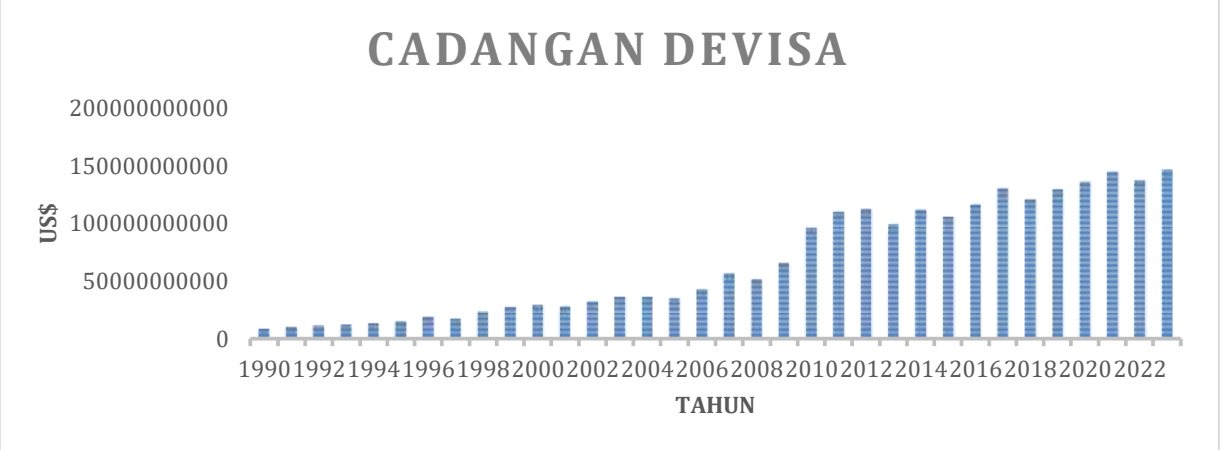

Figure 1. Foreign Exchange Reserves 1990-2023

Source: World Bank (data processed, 2023)

Based on data collected from various sources, foreign exchange reserves have fluctuated and tend to show a positive trend. World Bank data (2023) shows an increase in the value of foreign exchange reserves in 2012-2021 of US$ 112.78 billion in 2012 and reached US$ 144.90 billion in 2021. Indonesia's foreign exchange reserves at the end of December 2023 are known to reach US$146.4 billion, an increase compared to the position at the end of November 2023 of US$138.1 billion. Tax and service revenues and the government's withdrawal of foreign loans influenced this increase. The foreign exchange reserves are equivalent to 6.7 months of imports or 6.5 months of imports and servicing the government's external debt. They exceed the international adequacy standard of around 3 months of imports (Haryono, 2024). In the data comparison chart, almost all variables experience data fluctuations. Commodity export data initially experienced a positive trend but fluctuated from 2014 to 2023. Commodity exports increased at a certain point, such as in 2022, but foreign exchange reserves fell. This is due to price volatility, more significant import financing, and post-COVID-19 economic recovery.

Export activities are one of the sources that can increase foreign exchange reserves in Indonesia. It is aligned with Heckscher-Ohlin's international economic theory, which focuses on factors of production such as labour, capital, and natural resources that countries use to focus on producing certain goods in international trade. Countries tend to export goods that require abundant production factors (Malik, 2017). One of the largest commodity-exporting countries in the world is Indonesia, with main products such as palm oil, coal, rubber, and natural gas (BI, 2022). Feryanto (2018) explained that exporting means sending goods and services from domestic customs areas to foreign customs areas according to the stipulated provisions. According to Law No. 32/1964 Article 1, paragraph 9 Chapter 1, export is the shipment of commodities out of Indonesian territory from circulation.

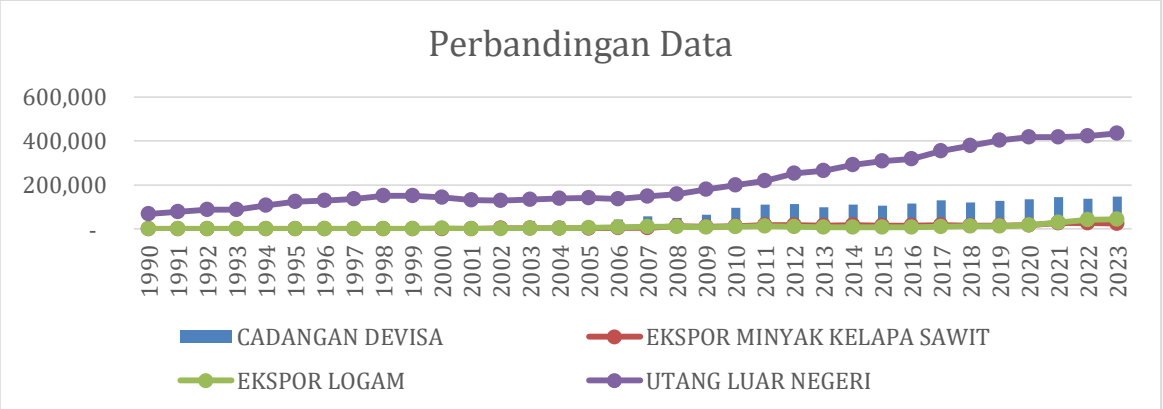

Figure 2. Data Comparison

Source: World Bank (data processed, 2023)

Commodity exports are the primary source of the country's foreign exchange revenue and play an important role in Indonesia's macroeconomic stability. One of Indonesia's most significant export contributors comes from the plantation subsector, namely palm oil exports. The Ministry of Agriculture, Directorate General of Plantations (2022) stated that 96.86% of the total value of agricultural exports came from plantation commodities, namely oil palm, at 73.83% (Plantations, 2023). Data from the World Bank and Food and Agriculture Organization (FAO) 2018-2019 shows that the export value of palm oil has decreased from 16.527 thousand US$ to 14.633 thousand US$, but on the other hand, foreign exchange reserves have increased from 120.654 billion US$ to 129.183 US$.

Indonesia is also one of the largest metal-producing countries in the world, and it exports metals such as nickel, copper, tin, and bauxite. Nickel, in particular, has an essential role in the global industry, especially in manufacturing batteries for electric vehicles. Along with the increasing focus on renewable energy and environmentally friendly vehicles, the demand for these commodities continues to increase (Wood Mackenzie, 2023). As a country rich in mineral resources, Indonesia has great opportunities to export metals such as nickel, copper, gold, and bauxite. These export proceeds increase foreign exchange reserves needed to support macroeconomic stability, maintain the rupiah exchange rate, and meet international payment needs.

External debt also contributes to the increase in Indonesia's foreign exchange reserves due to the trend of external debt, which continues to increase yearly. External debt is the state's capital from foreign creditors, including private banks, foreign governments, and international financial institutions such as the IMF and the World Bank (Khusnatun & Hutajulu, 2021). As foreign debt increases, funds coming in from foreign loans add to foreign exchange reserves, especially in the early stages of its receipt. If the funds from the debt are managed and invested correctly, it can strengthen the foreign exchange rate against the rupiah, thereby supporting economic stability and growth.

Previous research focusing on factors affecting foreign exchange reserves has been carried out a lot, but there are research gaps that have yielded different results. Research conducted by (Maesyaroha & Kundhani, 2024) shows that exports and foreign debt positively and significantly impact foreign exchange reserves in the short and long term. Research from (Fitria et al., 2021) focuses on the variables that affect changes in foreign exchange reserves from 1999-2019. Partially, non-oil and gas exports significantly and positively affect Indonesia's long-term and short-term foreign exchange reserves. At the same time, debt is insignificant and negatively affects long-term and short-term foreign exchange reserves. Research conducted by (Restanti, 2022), namely the "Keynesian Model of Indonesia's International Balance of Payments for 2011-2020", shows that exports have a positive and significant effect. Research conducted by (Matsumoto, 2021) develops a quantitative small-open economic model to study the factors determining the optimal rate of accumulation of foreign exchange reserves by developing countries. The model in the study shows two main determinants of the optimal rate of reserve accumulation: the elasticity of the spread of foreign loans to external debt and the entry cost for FDI.

Based on these phenomena and data, the author is interested in re-examining the role and allegations of factors that affect fluctuations in foreign exchange reserves so that later evidence can be obtained and developed into policies that support them.

2. IMPLEMENTATION METHOD

This study uses quantitative methods and multiple linear regression models. The type of data according to the source is secondary data from BPS, the World Bank, the Ministry of Trade, and Bank Indonesia. The type of data used according to the unit of time is a time series spanning 34 years from 1990-2023. The research location is in Indonesia, and the software used in this analysis is Stata. Data was collected through survey techniques, interviews, documentation, and literature studies. The variable in this study is foreign exchange reserves as a dependent variable (Y) with billions of US$. The independent variables are CPO exports (X_1) with units of thousands of US$, metal exports ($X_2$) with units of thousands of US$, and foreign debt ($X_3$) with units of billions of US$.

This study uses a multiple linear regression model involving more than one independent variable to achieve the research objectives and test the hypothesis. The multiple linear regression

analysis model is generally formulated as follows:

$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + e$ **(2.1)**

Information:

Y : Dependent Variable
α : Constanta
$\beta_1 \beta_2$: Coefficient
$X_1 X_2$: Independent Variable
e : Error

Furthermore, the multiple linear regression model for foreign exchange reserves, CPO commodity exports, metal commodity exports, and external debt is formulated as follows:

$CD = \alpha + \beta_1\ CPO + \beta_2 Logam + \beta_3 ULN +$ **e** **(2.2)**

Information:

CD = Foreign exchange reserves
α = Constanta
$\beta_1\ \beta_2 \beta_3$ = Coefficient
CPO = CPO Exports
Logam = Metal Exports
ULN = Foreign Debt
e = Error

2.1 Classical Assumption Test

Classical assumption testing is performed before interpreting the results of multiple regression analysis. The classical assumption tests used are normality, multicollinearity, heteroscedasticity, and autocorrelation tests. Classical assumption tests are performed as a prerequisite in multiple linear regression to determine whether the estimation model used meets the specified assumptions

2.2 Partial Test (t-Test)

Ghozali (2016) explained that the t-test (partial test) determines how individual independent variables affect the variation of dependent variables. If, in the data analysis, it is found that the value of t hitung > t tabel for each variable, and the significance value is < 5%,, then the independent variable significantly influences the dependent variable. If t hitung < t tabel or the significant value is > 5%, The independent variable does not significantly influence the dependent variable.

The hypothesis tested by the t-statistic is:

H_0 : partially does not have a significant effect on the dependent variable
H_a : partially has a significant effect on the dependent variable

2.3 Simultaneous Test (F-Test)

The statistical test F tests independent variables together against their dependent variables in the regression model. For hypothesis testing, a distribution of F was used with $\alpha = 0{,}05$.

The test criteria are as follows:

1. If $F_{hitung} > F_{tabel}$ with the provision of a significant level 5%, then reject H_0 which means that the independent variable significantly influences the dependent variable.
2. If $F_{hitung} < F_{tabel}$ with the provision of a significant level 5% then accept H_0 which means that the independent variable does not significantly influence the dependent variable.

3. RESULTS AND DISCUSSION

3.1 Descriptive Statistics

Descriptive statistics provide a general overview of the data and summarize it in an informative way to make it easier to understand. This function does not generalize or make inferences about the population but only describes the existing data.

```
. summarize Y X1  X2 X3
```

Variable	Obs	Mean	Std. Dev.	Min	Max
Y	34	66761.85	48931.27	8656	146358
X1	34	9234.382	8716.862	277	27765
X2	34	8771.235	10542.98	993	43643
X3	34	213159.8	116562.1	69848	435000

Figure 3. Descriptive Statistics

Source: **(**data processed in stata, 2024)

Based on Figure 3, the number of observations is 34 years for each variable. The Y variable or foreign exchange reserves has a maximum range of 146358 while the minimum value is 8656. The mean value is 66761.85, while the standard deviation value is 48931.3. This shows that the variation in foreign exchange reserve data is below the average value. Variable X_1. or CPO exports have a maximum value range of 27765 and a minimum value of 277. The mean value is 9234,382, while the standard deviation is 87161,862. This shows that the variation in CPO export data is below the average value.

Variable, X_2 or metal exports have a maximum value range of 43643, while the minimum is 993. The mean value is 8771.235, while the standard deviation value is 10542.98. This shows that the variation in metal export data is above the average value. Variable, X_3. or foreign debt has a maximum value range of 435000 while the minimum value is 69848. The mean value is 213159.8, while the standard deviation value is 116562.1. This shows that the variation in foreign debt data is below the average value.

3.2 Normality Test

The normality test tests whether the residual distributed data is normal. This study's normality test is a skewness test, corroborated by the w value on the Shapiro-Wilk Test.

H_0: The residual data is normally distributed

H_1: The residual data is not normally distributed

α: 0.05

Provision: Reject H_0 if $p - value < 0.05$ or Accept H_0 if $p - value > 0.05$

Decision: $P - value = 0.0581 > 0.05$

```
. sktest abs_res

                    Skewness/Kurtosis tests for Normality
                                                              ------ joint ------
    Variable |   Obs  Pr(Skewness)  Pr(Kurtosis)  adj chi2(2)    Prob>chi2
-------------+-----------------------------------------------------------------
     abs_res |    34       0.0181        0.5099         5.69          0.0581

. swilk abs_res

                    Shapiro-Wilk W test for normal data
    Variable |   Obs        W          V          z       Prob>z
-------------+-------------------------------------------------
     abs_res |    34     0.90814    3.207      2.429     0.00758
```

Figure 4. Normality test

Source: (data processed in stata, 2024)

Based on the output, the probability value or $-value > 0.05$ is $0.0581 > 0.05$, so it fails to reject H_0 or H_0. Accepted. The data residue in this study is normally distributed. This conclusion is also strengthened by the W value, which is close to 1 and 0.90.

3.3 Uji Multikolinearitas

The multicollinearity test evaluates whether a significant or perfect correlation exists between the independent variables in the regression model results. It can be identified using the Variance Inflation Factors (VIF) or tolerance values.

The testing criteria:

H_0= there are no symptoms of multicollinearity

H_1= there are symptoms of multicollinearity

```
. estat vif

    Variable |      VIF      1/VIF
-------------+----------------------
          X1 |     7.84   0.127500
          X3 |     6.04   0.165500
          X2 |     3.61   0.277327
-------------+----------------------
    Mean VIF |     5.83
```

Figure 5. Normality test

Source: (data processed in stata, 2024)

Based on the output, the VIF values of each variable are, $X_1 = 7.84$, $X_2 = 6.04$ and, $X_3 = 3.61$. This value indicates no symptoms of multicollinearity due to a VIF value of ≤ 10or tolerance ≥ 0.1. This means that each of the independent variables is not related to each other

3.4 Heteroskedasticity Test

The Heteroscedasticity test in regression analysis evaluates whether the error variance is constant (homoscedasticity) or not (heteroscedasticity). Heteroscedasticity tests commonly used in stata software are the Breusch-Pagan test, which detects the relationship between errors and independent variables. The White test detects heteroscedasticity without determining the specific relationship between errors and independent variables—the Glesjer test for detecting heteroscedasticity by using the residual absolute value on the independent variable.

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```
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of abs_res

         chi2(1)      =     1.73
         Prob > chi2  =   0.1880
```

Figure 6. Heteroscedasticity Test

Source: (data processed in stata, 2024)

Based on the output of the heteroscedasticity test using Breusch-Pagan, it was obtained, $p-value > \alpha$ 0.05 $yaitu$ 0.1880 $> 0.$, which was 0.18800.05. This indicates that there are no symptoms of heteroscedasticity or variants of constant or homoscedastic data error.

3.5 Autocorrelation Test

Autocorrelation tests identify the relationship between variables in the observed dataset based on time or space sequence. In this study, the Breush-Pagan Test was used to identify autocorrelation symptoms.

```
. estat dwatson

Durbin-Watson d-statistic(  4,    34) =  1.556636

. estat bgodfrey, lag(1)

Breusch-Godfrey LM test for autocorrelation
---------------------------------------------------------------------------
> ---------------------
    lags(p)  |          chi2               df
>       Prob > chi2
-------------+-------------------------------------------------------------
> ---------------------
       1     |          1.856               1
>          0.1731
---------------------------------------------------------------------------
> ---------------------
                        H0: no serial correlation
```

Figure 7. Autocorrelation Test

Source: (data processed in stata, 2024)

Based on the output of the autocorrelation test using Breusch-Godfrey, it was obtained $p-value > \alpha$ 0.05 that is 0.1731 > 0.05. This indicates that the data in this study are free from autocorrelation or that there is no correlation between the error of the current year and the error of the previous year.

3.6 Multiple Regression Model

Multiple Regression Model The model used to answer the purpose of this study is multiple linear regression. Foreign exchange reserves as Y or dependent variables and independent variables, respectively, are CPO exports, which are notated as X_1, and metal exports as X_2 and foreign debt as $X_3$3. Next, the hypothesis based on economic theory will be tested partially and simultaneously. Partial hypothesis testing is carried out with the following provisions:

H_o: Independent variables (Koefisien $\beta_1, \beta_2, \beta_3$) does not have a positive effect on the dependent variable

H_1: Independent variables (Koefisien $\beta_1, \beta_2, \beta_3$) has a positive effect on the dependent variable

Significance level $(\alpha) = 5\%$; $CI = 95\%$; Test Statistics: t-Test

Conditions: Reject H_o jika $\alpha < 0.05$; Accept H_0 jika $\alpha > 0.05$

```
. regress Y X1 X2 X3

      Source |       SS       df       MS              Number of obs =      34
-------------+------------------------------           F(3, 30)      =  429.43
       Model |  7.7213e+10     3  2.5738e+10           Prob > F      =  0.0000
    Residual |  1.7980e+09    30  59934651.4           R-squared     =  0.9772
-------------+------------------------------           Adj R-squared =  0.9750
       Total |  7.9011e+10    33  2.3943e+09           Root MSE      =  7741.7

------------------------------------------------------------------------------
           Y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
          X1 |   4.130356   .4329783     9.54   0.000     3.246096    5.014616
          X2 |  -1.107341   .2427294    -4.56   0.000    -1.60306    -.6116211
          X3 |    .198083   .0284201     6.97   0.000     .1400415    .2561246
       _cons |  -3890.031   3477.307    -1.12   0.272    -10991.64    3211.578
------------------------------------------------------------------------------

.
```

Figure 8. Multiple Regression

Source: **(**data processed in stata, 2024)

$$\mathbf{CD = \beta_0 + \beta_1\ CPO + \beta_2 Logam + \beta_3 ULN + e} \quad \textbf{(3.1)}$$

$$\boldsymbol{CD = -3890.031 + 4.13CPO - 1.10Logam + 0.19ULN + e} \quad \textbf{(3.2)}$$

Based on the regression equation model, the constant value or β_0 is -3890.031, meaning that when CPO exports, metal exports and foreign debt are valued at zero or constant, the foreign exchange reserve variable will have a negative value.

The CPO variable coefficient is 4.130356, meaning that the CPO variable has a positive direction towards foreign exchange reserves. If the value of CPO increases by one unit or 1 thousand, foreign exchange reserves will increase by 4,130356 billion US$, assuming other variables remain fixed (ceteris paribus). In the provisions of the hypothesis test of the CPO export variable has a $p - value$ 0.00 $< \alpha$ 0.05 then the decision is rejected, H_0. and accept H_1. It can be concluded that CPO exports significantly affect foreign exchange reserves.

The coefficient of the metal export variable is -1.107341, which means that the metal export variable has a negative direction towards foreign exchange reserves. If the value of metal exports increases by one unit or 1 thousand, foreign exchange reserves will decrease by 1.107341 billion US dollars, assuming other variables remain fixed (ceteris paribus). The metal export variable has a $-value$ 0.00 $< \alpha$ 0.05, so the decision is to reject, H_0. and accept, H_1. It can be concluded that metal exports significantly affect foreign exchange reserves.

The variable coefficient of external debt is 0.198083, meaning that the variable external debt has a positive direction towards foreign exchange reserves. If the value of external debt increases by one unit or 1 billion, foreign exchange reserves will increase by 0.198083 billion US$, assuming other variables remain fixed (ceteris paribus). The foreign debt export variable has $p - value$ 0.00 $< \alpha$ 0.05, so the decision is to reject, H_0 and accept, H_1. It can be concluded that foreign debt significantly affects foreign exchange reserves.

R-squared (R^2) 0.9772 or 97%, which means that this model is well-suited to explaining the variation in foreign exchange reserves based on the variables of CPO exports, metal exports, and foreign debt. The remaining 0.03% is influenced by other variables that do not fit into the model equation.

3.6 Discussion

CPO exports positively contribute to foreign exchange reserves because CPO is one of Indonesia's leading export commodities. The increase in CPO exports directly increases foreign exchange receipts. CPO exports are a source of foreign exchange due to the high global demand for crude palm oil (CPO). The negative relationship of metal exports to foreign exchange reserves shows that although they are increasing, their impact on foreign exchange reserves tends to decrease. This can be caused by various factors, such as low added value in raw metal exports or high production/logistics costs that reduce the net foreign exchange generated. Metal exports are often carried out in raw or

semi-finished form, which has a lower added value than processed products. In addition, dependence on imports of raw materials or machinery for metal exploitation can drain more foreign exchange than it produces. The positive relationship of external debt to foreign exchange reserves indicates that foreign debt is used to fund development or strategic investments that increase foreign exchange, such as exports, economic supporting infrastructure, or other productive sectors. The funds are in foreign exchange (USD or other foreign currencies) when foreign debt is received. Foreign debt can be a productive investment if used to build infrastructure or support the export sector, which can increase the country's foreign exchange reserves through increasing export revenues. In some cases, foreign debt from multilateral institutions (such as the IMF or the World Bank) directly increases the country's foreign exchange reserves, as these funds are channelled to maintain monetary or macroeconomic stability.

So, the conclusion from the discussion is that CPO exports, (X_1) have a significant positive impact on foreign exchange reserves, reflecting its strategic role as Indonesia's main export commodity. Metal exports (X_2) showed a negative impact on foreign exchange reserves due to low added value and high dependence on imports of supporting materials. Therefore, managing metal exports is key to optimizing their contribution to foreign exchange reserves. Value-added optimization, price stability, and logistics efficiency are important aspects that must be managed to maximize the positive impact of metal exports on foreign exchange reserves. External debt (X_3) has a significant positive relationship with foreign exchange reserves. This suggests that external debt can serve as an additional source of foreign exchange reserves, especially when used to fund productive investments or directly channelled in the form of foreign exchange. However, it is important to ensure that foreign debt is managed effectively so that it does not become a burden in the future

4. CONCLUSION

1. Palm oil (CPO) exports have a positive direction and a significant influence on Indonesia's foreign exchange reserves.
2. Metal exports have a negative direction and significantly influence Indonesia's foreign exchange reserves.
3. External debt has a positive direction and a significant influence on Indonesia's foreign exchange reserves

4.1 Advice

1. The government needs to support increasing the added value of CPO products through industrial downstreaming, such as developing processed palm oil products and ensuring production sustainability by implementing more environmentally friendly agricultural practices.
2. Based on findings that show a negative relationship between crude metal exports and foreign exchange reserves, the government needs to optimize the added value of metal exports by focusing on downstreaming. In addition, the government needs to reduce dependence on raw material imports, which can reduce the contribution of metal exports to foreign exchange reserves.
3. The government needs to pay transparent attention to foreign debt management policies and the debt-to-GDP ratio so that it remains within safe limits, does not increase dependence, and does not endanger long-term economic stability.
4. Suggestions for further research can use other variables, such as foreign direct investment (FDI), monetary variables, the tourism sector, or labour on foreign exchange reserves, to examine more deeply the implications or analytical tools used.

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