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THE LINKAGE BETWEEN PALM OIL PRODUCER PRICES AND ECONOMIC FACTORS

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Abstract

Background: Despite being the world's dominant CPO producer (contributing approximately 58 percent of global output in 2023), Indonesia structurally operates as a price taker. CPO pricing consistently refers to international exchanges (BMD and Rotterdam) because domestic futures exchanges (BBJ/ICDX) are suboptimal due to the voluntary and inconsistent implementation of Bappebti Regulation No. 7/2023, which leads to low liquidity and transaction fragmentation.
Purpose: This study addresses the underexplored gap by analyzing how global market integration and domestic price factors jointly determine Indonesian CPO forward prices and their causal relationship with Malaysia and Rotterdam prices.
Design/Methodology/Approach: The study utilized monthly data from May 2010 to January 2025, as this period captures major global economic events, policy changes, and market fluctuations that significantly influenced Indonesia's CPO price dynamics. The econometric models employed include the Error Correction Model (ECM) and Vector Error Correction Model (VECM), supported by Granger Causality, Impulse Response Function (IRF), and Variance Decomposition (VD) analyses.
Findings/Results: The Indonesian CPO forward price is positively and significantly influenced by both Malaysian and Rotterdam CPO prices. Causality analysis confirms the price-taker status, identifying a one-way causal relationship in which Malaysia and Rotterdam predict Indonesian price changes. Dynamically, Indonesian prices exhibit a sensitive adjustment, responding positively to global shocks only briefly before they turn negative. The Rotterdam CPO price is the most significant external contributor to the Indonesian price variance over the long term.
Conclusion: The findings confirm the persistent structural dependence of Indonesian CPO prices on international benchmarks. This underscores the urgent need for decisive policy intervention specifically, the mandatory domestic CPO trading policy through the Indonesia Commodity and Derivatives Exchange (ICDX) to foster stronger market liquidity, thereby enabling Indonesia to leverage its global production dominance and effectively transition into a global price reference for CPO.
Originality/Value (State of the Art): This study provides a cutting-edge empirical contribution by combining ECM–VECM, IRF, and VD models to measure the structural relationships among major CPO markets. Unlike previous studies that typically examine price transmission using only single-equation models or limited time frames, this study incorporates a longer dataset and a comprehensive multivariate framework to capture both short-run adjustments and long-run causality. This study fills a key gap in the literature regarding the persistent structural dependence of Indonesian CPO prices on international benchmarks and highlights the urgency of strengthening Indonesia's role in the global pricing mechanism.

Keywords: crude palm oil, futures exchange, price integration, causality analysis, econometric models

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INTRODUCTION

The plantation subsector remains the most dominant contributor to Indonesia's GDP at 4.17%, largely driven by the palm oil industry (Ministry of Agriculture, 2023). Palm oil is a critical global commodity, widely used for food, industrial materials, and biodiesel, and it contributes substantially to the global vegetable oil supply (BPS, 2025). Indonesia occupies a strategic position in this global chain, serving as the largest producer and exporter of Crude Palm Oil (CPO). In 2023, Indonesia produced 46.5 million metric tons approximately 58% of the world's output (The Jakarta Globe, 2025). This dominance theoretically positions Indonesia as a potential global price maker (Pane, 2022). Structural advantages such as abundant land and competitive labor further strengthen Indonesia's production capacity relative to Malaysia and Thailand (Arsyad et al. 2020; Widyaningtyas & Widodo, 2017; Turnip et al. 2016).

Despite this dominance, a fundamental paradox persists. Empirical evidence shows that Indonesia has limited influence on global price formation. Domestic and export CPO prices remain tied to international benchmarks chiefly the Bursa Malaysia Derivatives (BMD) and the Rotterdam exchange reflecting the underperformance of Indonesia's domestic futures exchanges, namely the Jakarta Futures Exchange (BBJ) and the Indonesia Commodity and Derivatives Exchange (ICDX), in establishing credible price discovery (Pane, 2022; Mandiri Research, 2023; BRI Danareksa Sekuritas, 2024). Consistent with this, Indonesia's spot market functions as a price follower, whereas BMD and Rotterdam serve as global leaders (Helbawanti et al., 2022). While Bappebti Regulation No. 7/2023 was introduced to formalize domestic price referencing, the regulation remains voluntary, leading to fragmented transactions and low liquidity in the market. Consequently, Indonesia faces persistent exposure to international volatility and a reduced bargaining power in global trade.

Price movements across Malaysia (cpo_2mfsp), Rotterdam (cpo_rotp), and Indonesia (cpo_ifsp) from 2010 to 2025 exhibit strong co-movements, reflecting high global integration (Figure 1). Fluctuations followed similar patterns: a surge in 2010–2012, a decline until 2015–2016, stabilization during 2017–2019, and record highs in 2022. The 2022 spike was driven by COVID-19 supply disruptions and geopolitical tensions, such as the Russia–Ukraine war, which tightened global edible oil markets. In Indonesia, these global pressures were amplified by domestic interventions, including temporary export bans, export levy adjustments, and DMO–DPO requirements, which restricted export flows and weakened the domestic market's responsiveness. Consequently, Indonesian prices reflect both global volatility and domestic regulatory frictions.

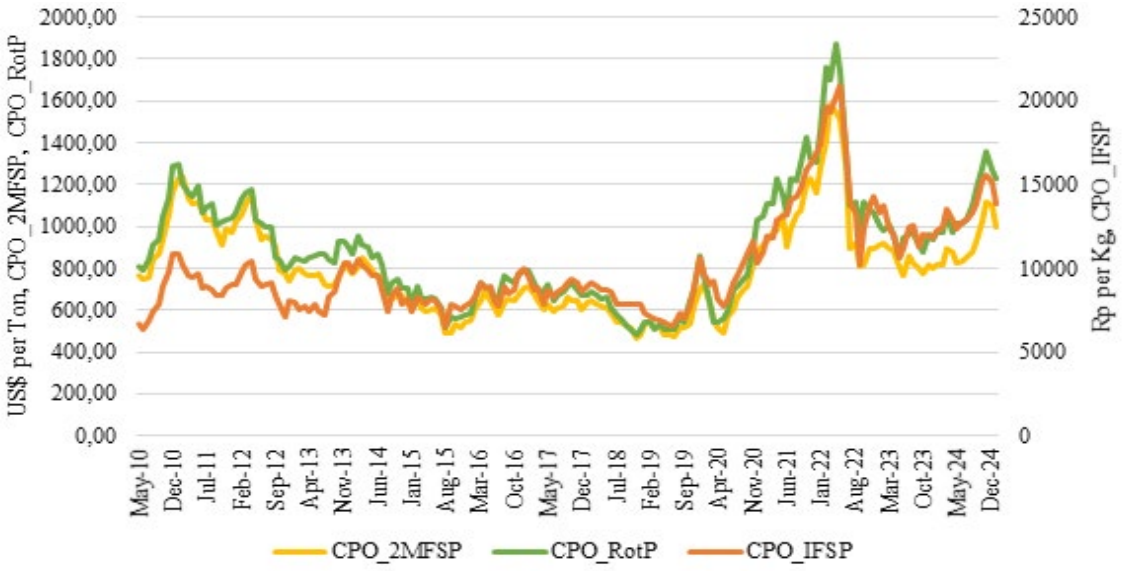


Figure 1. CPO Price Development in Indonesia, Malaysia, and Rotterdam

Although prices corrected in late 2022–2023, they remained above the pre-pandemic levels. Rotterdam consistently recorded the highest prices, while Indonesian prices quoted in Rupiah mirrored global trends. These patterns reinforce Indonesia's structural dependence on external benchmark prices. This reliance is further entrenched by the long-standing credibility of the BMD, launched in 1980, and the strong transparency and liquidity of Rotterdam's derivatives market (Bursa Malaysia Berhad, 2025). Meanwhile, prior studies show that when Indonesia lacks pricing influence, global price increases have only limited impact on key domestic macroeconomic indicators, reinforcing Indonesia's role as a price taker (Winardi et al. 2017).

Indonesia has sought to strengthen domestic price discovery through the establishment of futures exchanges, namely BBJ, which has been operating since 2000, and ICDX, which introduced CPO contracts in 2010. To reinforce this effort, Bappebti Regulation No. 7/2023 was issued to formalize the use of domestic prices as a reference benchmark. However, the regulation is voluntary and does not impose mandatory trading requirements that could ensure sufficient market liquidity. Consequently, CPO transactions remain fragmented across different channels, with limited participation from market players. These conditions prevent domestic futures exchanges from functioning effectively as credible price benchmarks (Hortus Archipelago, 2024; Mandiri Research, 2023; MarketsWiki, 2024; Paramita et al. 2015).

Prior empirical studies have highlighted several persistent issues: weak long-term linkages between domestic spot and futures markets (Helbawanti et al. 2022), partial influences of macroeconomic variables such as GDP growth, exchange rates, ROE, DER, and export dynamics (Ayudya et al. 2017), and fragmented analyses that do not jointly account for global market integration and domestic determinants. Recent evidence also shows increasing price uncertainty, especially during a crisis. Gandhy et al. (2022) demonstrate that COVID-19 triggered asymmetric price adjustments where price increases had stronger long-run effects than declines and that hedging remained effective due to efficient long- and short-run spot–futures relationships. This constellation of issues highlights the strategic urgency of understanding the determinants of Indonesia's CPO price formation both globally and domestically and the barriers preventing Indonesia from transitioning from being a price taker to a price setter. Broader economic implications include persistent exposure to international volatility, reduced bargaining power in international trade, and lost opportunities to capture greater value added domestically.

To address these gaps, this study adopts an integrated analytical framework. The framework jointly examines the causal relationships among Indonesian, Malaysian, and Rotterdam CPO prices. In addition, it estimates the influence of key domestic macroeconomic variables on CPO prices in Indonesia. This combined approach enables a comprehensive assessment of both global market integration and domestic price dynamics. Consequently, the analysis provides a stronger basis for explaining Indonesia's price formation structure and formulating practical recommendations for improving domestic price discovery mechanisms.

Based on these gaps, this study proposes the following expectations: international benchmark prices particularly from BMD and Rotterdam are hypothesized to exert significant short- and long-run influences on Indonesia's CPO prices (H1), while domestic variables such as exchange rate movements, export volumes, and consumption growth are expected to have weaker but meaningful impacts (H2). Additionally, Indonesia's CPO market is hypothesized to exhibit causality and price transmission patterns consistent with global integration rather than independent domestic price formation (H3). The overall expectation is that Indonesia will be confirmed as a price follower, with Rotterdam and Malaysia as the dominant leaders. These findings are anticipated to strengthen the case for mandatory trading on the ICDX to support liquidity, enhance price transparency, and build the structural foundations necessary for Indonesia to evolve into a global price setter.

Based on these gaps, this study formulates several research expectations. First, international benchmark prices, particularly those from BMD and Rotterdam, are hypothesized to exert significant influence on Indonesia's CPO prices in both the short and long run (H1). Second, macroeconomic factors are expected to significantly affect Indonesia's CPO price dynamics (H2). Third, Indonesia's CPO market is expected to display causality and price transmission patterns that reflect global market integration rather than independent domestic price formation (H3). Overall, this study anticipates confirming Indonesia's position

as a price follower, with Rotterdam and Malaysia acting as the dominant price leaders, thereby reinforcing the rationale for mandatory trading on the ICDX to enhance liquidity and price transparency.

METHODS

To identify and analyze the determinants of the Indonesian CPO commodity futures exchange and its role as a reference price, this study employs an econometric approach to the data. The analysis uses monthly data from May 2010 to January 2025. Data were obtained from the Indonesia Commodity & Derivatives Exchange (ICDX), Bank Indonesia, and the International Monetary Fund (IMF). This period captured significant fluctuations in the global and domestic markets. Major global shocks, including the COVID-19 pandemic and the U.S.–China trade war, are therefore considered to better explain external influences on Indonesia's CPO price dynamics.The variables utilized in the econometric models include:

1. Target Variable: Indonesian CPO Future Settlement Price (cpo_ifsp).
2. Global Benchmarks: Malaysian CPO Future Price (cpo_2mfsp) and Rotterdam CPO Spot Price (cpo_rotp).
3. Macroeconomic Determinants: Rupiah–US Dollar exchange rate (er_rpus), Ringgit–US Dollar exchange rate (er_myusd), Euro–US Dollar exchange rate (er_euusd), and Bank Indonesia interest rate (bi_rate).

Data were collected using archival and documentation methods by retrieving historical records from the official databases of ICDX, Bank Indonesia, and the IMF. The dataset consists of monthly observations covering a 15-year period. Commodity variables are represented by the monthly closing prices. Macroeconomic indicators were measured using monthly average values. This approach ensures data consistency and reliability in econometric analyses.

The analysis utilized the Error Correction Model (ECM) and the Vector Autoregressive (VAR)/Vector Error Correction Model (VECM). The Vector Error Correction Model (VECM) is specifically designed to handle non-stationary time series data that are integrated of the same order and exhibit cointegration. Instead of differencing the data and losing long-run information, the VECM incorporates an error correction term (ECT) that represents the long-term equilibrium relationship among the variables. This term measures the extent to which the system deviates from equilibrium in each period and adjusts the short-run dynamics accordingly. Thus, while the differenced components of the model capture short-run fluctuations, the ECT ensures that any disequilibrium is gradually corrected over time, pulling the variables back toward their long-run cointegrated relationships. Thus, the VECM simultaneously models both short-run adjustments and long-run equilibrium behavior in non-stationary but cointegrated data.

In econometric analysis, if the variables analyzed are not stationary but have the same integration or Y~I(1) and all explanatory variables or X~I(1), then the relationship between these variables can occur in the long term (cointegrated). Assuming that the long-term model is as follows:

$$\log(cpo\_ifsp)_t = \beta_1 \log(cpo\_2mfsp)_t + \beta_2 \log(cpo\_rotp)_t + \beta_3 \log(er\_rpus)_t + \beta_4 \log(er\_myusd)_t + \beta_5 \log(er\_euusd)_t + \beta_6 \log(bi\_rate)_t + ECT_t$$

Then, the short-term dynamic model can be represented by the following Error Correction Model (ECM):

$$dlog(cpo\_ifsp)_t = \gamma_1 dlog(cpo\_2mfsp)_t + \gamma_2 dlog(cpo\_rotp)_t + \gamma_3 dlog(er\_rpus)_t + \gamma_4 dlog(er\_myusd)_t + \gamma_5 dlog(er\_euusd)_t + \gamma_6\, dlog(bi\_rate)_t + \gamma_7 ECT_{t-1} + v_t$$

Description: cpo_2mfsp (Future price of Malaysian CPO); cpo_rotp (Rotterdam CPO spot price); cpo_ifsp (Future price CPO Indonesia); er_rpus (Rupiah–US Dollar exchange rate); er_myusd (Ringgit–US Dollar exchange rate); er_euusd (Euro–US Dollar exchange rate); bi_rate (Bank Indonesia interest rate); α (Parameter); ε (Error term).

This study also examines the relationship between price movements in the three major CPO markets (Indonesia, Malaysia, and the Rotterdam). To analyze market integration, it applies the Vector Autoregression (VAR) and Vector Error Correction Model (VECM) frameworks. The VAR/VECM model represents a linear function consisting of a constant term, past lag values of each variable, and lag values of other related variables (Zainuddin et al. 2015). In addition to VAR and VECM, the methodology incorporates Impulse Response Function (IRF) and Variance Decomposition (VD) analyses to identify how each variable responds

to shocks and how much each contributes to price fluctuations. The primary tool used to assess the causality between Indonesia's, Malaysia's, and Rotterdam's CPO pricesis the VECM approach. Prior to conducting this analysis, several preliminary tests were required.

Data Stationary Test

The stationarity test serves as the initial stage in conducting market integration analysis with time-series data to prevent spurious regression results. Stationarity can be assessed using the Augmented Dickey-Fuller (ADF) test, which evaluates whether a variable contains a unit root. The ADF test is represented by the following equation:

$$\Delta cpo\_ifsp_t = \alpha_0 + \gamma cpo\_ifsp_{t-1} + \sum^{j}_{i=1}\beta_i \gamma cpo\_ifsp_{t-1} + \varepsilon_t$$

$$\Delta cpo\_2mfsp_t = \alpha_0 + \gamma cpo\_2mfsp_{t-1} + \sum^{j}_{i=1}\beta_i \gamma cpo\_2mfsp_{t-1} + \varepsilon_t$$

$$\Delta cpo\_rotp_t = \alpha_0 + \gamma cpo\_rotp_{t-1} + \sum^{j}_{i=1}\beta_i \gamma cpo\_rotp_{t-1} + \varepsilon_t$$

Description: cpo_ifsp (Future price CPO Indonesia); cpo_2mfsp (Future price of Malaysian CPO); cpo_rotp (Rotterdam CPO spot price); α_0, γ, β_i (Coefficient); j (Length of lag used in the model); t (Time rend); ε (Error term).

Optimum Lag Test

The second step involves determining the optimal lag length to prevent autocorrelation in the residuals. This process evaluates the time taken for one variable to respond to changes in another. Several statistical criteria are used to identify the appropriate lag structure, including the Likelihood Ratio (LR), Akaike Information Criterion (AIC), Final Prediction Error (FPE), Hannan–Quinn Criterion (HQ), and Schwarz Information Criterion (SC). The optimal lag is selected based on the AIC and SC (or SBC) values, with the best lag indicated by the lowest value among the available lags (Enders, 2015).

Cointegration Test

The Johansen cointegration test, introduced by Johansen (1991), is used to evaluate whether non-stationary variables share a long-run equilibrium relationship. Even when individual series are non-stationary, they may still be cointegrated if their residuals or deviations from equilibrium are stationary. This method examines long-term price dynamics by comparing the trace statistic and maximum eigenvalue statistic with their respective critical values at the 5 percent significance level (Enders, 2015). The test findings demonstrate that the trace statistic and maximum eigenvector exceed the critical value at the 5 percent level. This outcome suggests that the model equation is cointegrated in the long run (Yuningtyas et al. 2019).

The test is based on the following equation:

$$\lambda_{trace\ (r)} = -T\sum^{n}_{t=r+1} \ln(1-\lambda_t)$$

$$\lambda_{max(r,r+1)} = -T \ln(1-\lambda_t)$$

Description: λ_{trace}(Trace statistic value); λ_{max} (Maximum eigenvalue); λ_t (The estimated value of the characteristic root of the matrix estimate); T (Number of observations); r (Rank of the sum of cointegrating vectors).

If the Johansen cointegration test indicates the presence of at least one cointegrating relationship (trace statistic or maximum eigenvalue > critical value at α = 5%), it can be concluded that the variables in the model share a long-run equilibrium relationship. Under this condition, the appropriate model to use is the Vector Error Correction Model (VECM).

Granger Causality Test

Within market integration analysis, the Granger causality test is used to examine the directional relationships between variables. This test evaluates whether the past values of one variable help predict movements in another based on the selected lag length determined during the optimum lag assessment. In this study, Granger causality is applied to analyze the interaction between Indonesian, Malaysian, and Rotterdam CPO prices, allowing us to identify whether price changes in one country influence those in the other. The decision rule compares the probability value with the 5 percent significance level: if the probability value is below this threshold, it indicates that price changes in one market Granger-cause price movements in the other (Lütkepohl, 2005).

VAR/VECM Model Estimation

The VAR method is used to test the causality of Indonesian CPO prices with Malaysia and Rotterdam using the following model equation:

$$\begin{pmatrix} cpo\_2mfsp_t \\ cpo\_rotp_t \\ cpo\_ifsp_t \end{pmatrix} = \begin{pmatrix} \alpha_{10} \\ \alpha_{20} \\ \alpha_{30} \end{pmatrix} + \begin{pmatrix} \alpha_{11} & \alpha_{12} & \alpha_{13} \\ \alpha_{21} & \alpha_{22} & \alpha_{23} \\ \alpha_{31} & \alpha_{32} & \alpha_{33} \end{pmatrix} \begin{pmatrix} cpo\_2mfsp_{t-1} \\ cpo\_rotp_{t-1} \\ cpo\_ifsp_{t-1} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \end{pmatrix}$$

Description: cpo_2mfsp (Future price of Malaysian CPO); cpo_rotp (Rotterdam CPO spot price); cpo_ifsp (Future price of CPO Indonesia); α (Parameter); ε (Error term).

After completing the first four preliminary tests, the VAR/VECM modeling approach was applied to address the research objectives. This model was used to examine the spatial dependence between Indonesian, Malaysian, and Rotterdam CPO prices. The VECM framework represents a restricted version of the VAR (Faizah & Nur, 2023). According to Christopher A., who first introduced the VAR model in 1980, VAR is a simple, non-structural, and theory-free model. In contrast, the VECM modeldeveloped by Johansen and Juselius (1990)is specifically designed for non-stationary time series data that exhibit cointegration. This allows researchers to capture both the long-term equilibrium relationship and short-term dynamic adjustments between economic variables. Cointegration is central to the VECM approach, as it reflects the existence of a long-run equilibrium among several non-stationary series (Nugroho et al. 2021). The VECM model is appropriate when variables become stationary after the first differencing and are found to be cointegrated. The general form of the VECM equation is as follows (Yuningtyas et al. 2019):

$$\Delta cpo\_ifsp_t = \theta_1 + \alpha_{cpo\_ifsp}\omega_{t-1} + \sum_{i=1}^{n}\delta_{11}\Delta cpo\_ifsp_{t-1} + \sum_{i=1}^{n}\delta_{21}\Delta cpo\_2mfsp_{t-1} + \sum_{i=1}^{n}\delta_{31}\Delta cpo\_rotp_{t-1} + \mu_{cpo\_ifspt}$$

$$\Delta cpo\_2mfsp_t = \theta_2 + \alpha_{cpo\_2mfsp}\omega_{t-1} + \sum_{i=1}^{n}\delta_{21}\Delta cpo\_2mfsp_{t-1} + \sum_{i=1}^{n}\delta_{22}\Delta cpo\_ifsp_{t-1} + \sum_{i=1}^{n}\delta_{32}\Delta cpo\_rotp_{t-1} + \mu_{cpo\_2mfspt}$$

$$\Delta cpo\_rotp_t = \theta_3 + \alpha_{cpo\_rotp}\omega_{t-1} + \sum_{i=1}^{n}\delta_{12}\Delta cpo\_rotp_{t-1} + \sum_{i=1}^{n}\delta_{23}\Delta cpo\_ifsp_{t-1} + \sum_{i=1}^{n}\delta_{33}\Delta cpo\_2mfsp_{t-1} + \mu_{cpo\_rotpt}$$

Description: cpo_ifsp_t (Future price CPO Indonesia); cpo_2mfsp_t (Future price of Malaysian CPO); cpo_rotp_t (Rotterdam CPO spot price); θ_1, θ_2, θ_3 (Intercept vector); ω_{t-1} (Long-run equilibrium term between markets (ECT)); α (Long-run adjustment coefficient); δ (Short-run dynamic parameters); μ (Error term); t (Time trend).

Once the market integration relationship has been established, the subsequent analytical tools are employed to evaluate the dynamic responses and contribution patterns among CPO prices in Indonesia, Malaysia, and Rotterdam as follows (Juanda & Junaidi, 2011; Enders, 2015; Lütkepohl, 2005):

Impulse Response Function (IRF)

After estimating the VECM model, an IRF analysis was conducted to evaluate how a shock in one market affects price movements in the other. This method illustrates the transmission of shocks between Indonesia, Malaysia, and Rotterdam CPO prices, which are typically presented in graphical form. IRF serves as a complementary tool to the VAR/VECM results, especially when the direct interpretation of model coefficients is difficult.

Variance Decomposition (VD)

VD is then used to quantify the proportion of future price variation in each variable that can be attributed to shocks originating from other variables. This method provides insight expressed in percentage into how much each market contributes to the forecast error variance of the other.

Hypotheses

H1: Indonesian, Malaysian, and Rotterdam CPO prices have a long-run cointegrated relationship. The VECM is specifically chosen because these markets are expected to exhibit a long-term equilibrium, where they adjust back to a common trend after short-term deviations.

H2: Global benchmark prices (Malaysia and Rotterdam) significantly predict Indonesian CPO prices. This study seeks to confirm Indonesia's role as a price taker by testing whether past values of international prices help predict domestic prices via Granger causality.

H3: Domestic macroeconomic factors and international prices jointly determine the short-run dynamics of the Indonesian CPO market. The ECM incorporates exchange and interest rates as structural components to measure their collective impact on the domestic settlement price.

The framework illustrates how Indonesian CPO prices are analyzed by integrating global benchmark data with macroeconomic indicators (Figure 2). The analysis began with preliminary tests to ensure data stability and suitability for time-series modeling. It then applies the ECM approach to capture both long-run equilibrium relationships and short-run adjustments. Causality analysis was used to identify the direction of price transmission among markets. Finally, Impulse Response Function (IRF) and Variance Decomposition (VD) analyses assess the market's resilience to global shocks and determine whether Indonesia acts as a price maker or a price taker.

RESULTS

Determinants of Indonesian CPO Prices

Before estimating the factors influencing Indonesian CPO prices, stationarity tests were conducted on all variables included in the study, as presented in Table 1. The results indicate that all variables are non-stationary at their levels but become stationary after the first differencing. This finding implies that all variables share the same order of integration, I(1). Given this condition, a cointegration test was performed using the Engle Granger approach. The results confirm the existence of cointegration among the variables, indicating a long-run equilibrium relationship.

Table 2 presents the results of the Error Correction Model (ECM) estimation for the Indonesian CPO forward price. The results show that the Malaysian CPO forward price has a positive and statistically significant effect on Indonesia's CPO forward prices. The Rotterdam CPO price exerts a positive and significant influence. In addition, the rupiah exchange rate against the US dollar significantly affects the Indonesian CPO forward price with a relatively large elasticity. The error correction term (ECT) is negative and statistically significant, indicating the existence of a stable, long-run adjustment mechanism.

The Indonesian crude palm oil (CPO) forward price (IFSP) is influenced by various factors in both the short and long terms. The estimation results indicate that several variables have a significant impact on the movement of the IFSP, particularly the Malaysian CPO forward price (dlog(CPO_2MFSP)) and the Rotterdam CPO forward price (dlog(CPO_ROTP)), which exert positive and statistically significant effects. The coefficients for these variables are 0.409 and 0.445, respectively, indicating that an increase in CPO prices in Malaysia and Rotterdam leads to a corresponding rise in Indonesian CPO prices, with the influence of Rotterdam being slightly greater than that of Malaysia. This reflects the strong market linkages between the primary producer (Malaysia) and the key export destination market (Rotterdam), which together form the global reference prices. These findings are supported by Hafizah (2009), who notes that Rotterdam serves as a critical price reference market, and by Lestari & Oktavilia (2020), who highlight that international CPO prices are the most dominant factor driving price fluctuations. The slightly higher coefficient for Rotterdam suggests a marginally stronger price transmission mechanism, further emphasizing the complex interconnections in the global CPO market.

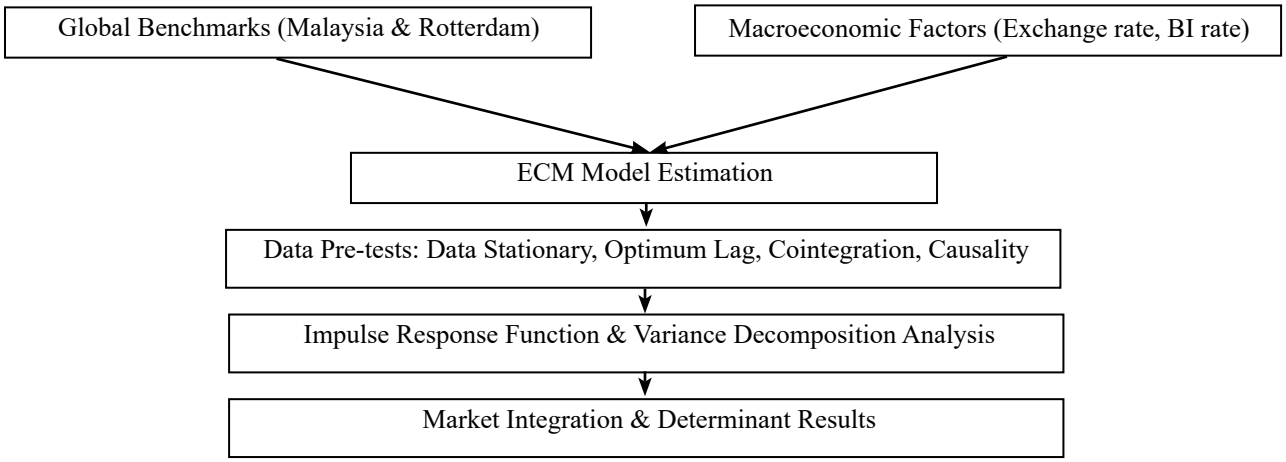


Figure 2. Framework of thought

Table 1. Stationary Test Results of Indonesian, Malaysian, and Rotterdam CPO prices and macroeconomic variables

Variables	Level (p-value)	1st Difference (p-value)	Stationary Conclusion
cpo_2mfsp	0.1109	0.0000	I(1)
cpo_rotp	0.4220	0.0000	I(1)
er_rpusd	0.7359	0.0000	I(1)
er_myusd	0.6412	0.0000	I(1)
er_euusd	0.5891	0.0000	I(1)
bi_rate	0.4579	0.0000	I(1)

Table 2. ECM estimation results of factors affecting Indonesian CPO forward prices

Variables	Coefficient	p_value
Constant	-0.001	0.870
dlog(cpo_2mfsp)	0.409***	0.000
dlog(cpo_rotp)	0.445***	0.000
dlog(er_rpusd)	1.137***	0.000
dlog(er_myusd)	-0.068	0.767
dlog(er_euusd)	-0.275	0.140
dlog(bi_rate)	-0.048	0.614
ECTt-1	-0.515***	0.000
R-squared	0.710	
F-statistic	58.879	
Prob(F-statistic)	0.000	

Description: *** significant at the 1% level of significance. The heteroscedasticity test results are not significant, the autocorrelation test is not significant, and the residual estimation results are normal.

These estimation results are consistent with the findings of Susila (2004), who reported that international CPO prices significantly influence Indonesia's real domestic CPO price. Therefore, an increase in international CPO prices is likely to be followed by a rise in domestic prices. This pattern reflects the strong integration between the global and domestic CPO markets. Similar conclusions were drawn by Gultom et al. (2023), who showed that fluctuations in domestic CPO prices are closely linked to changes in international prices. These studies reinforce the view that international market dynamics play a dominant role in shaping the price movements of Indonesia's CPO.

In addition to the Malaysian and Rotterdam CPO prices, the Rupiah exchange rate against the US Dollar (dlog(er_rpusd)) also has a positive and significant effect on the forward price of Indonesian CPO, with a coefficient of 1.137. This means that Rupiah depreciation will increase the price of CPO in the Rupiah. This is because CPO prices in the international market are priced in US Dollars; therefore, when the Rupiah weakens, prices in Rupiah become more expensive. This result aligns with Ramadhan et al. (2025), who indicate that a rise in the Rupiah exchange rate will be met with a positive response in CPO prices. Similarly, Gultom et al. (2024) confirmed that in both the short and long runs, domestic CPO prices are significantly influenced by international prices and the Rupiah-USD exchange rate.

Several other variables included in the model did not exhibit statistically significant effects on Indonesian CPO prices. The Malaysian Ringgit–US Dollar exchange rate (dlog(er_myusd)) does not have a meaningful influence. Similarly, the Euro–US Dollar exchange rate (dlog(er_euusd)) is not statistically significant in explaining price movements. The BI interest rate (dlog(bi_rate)) does not significantly impact Indonesian CPO forward prices. These results indicate that variations in these macroeconomic variables do not directly drive Indonesian CPO price dynamics in the specified model.

The Error Correction Term (ECT) coefficient is estimated at −0.515, which is statistically significant. This negative value indicates the presence of a long-run adjustment mechanism in equilibrium. This confirms a stable long-term relationship between the explanatory variables and Indonesia's forward CPO

price. The magnitude of the coefficient suggests that deviations from the long-run equilibrium are corrected relatively quickly. Overall, the ECM results indicate that Indonesia's forward CPO prices are closely linked to international market conditions and domestic macroeconomic factors, reflecting strong integration between the local and global markets.

Causality of Indonesian CPO Prices with Malaysia and Rotterdam

Causality testing was conducted on the prices of Indonesian CPO (cpo_ifsp), Malaysian CPO (cpo_2mfsp), and Rotterdam CPO (cpo_rotp) in both the long-term (level) and short-term (first difference). The results of the causality tests are presented in Table 3. In the long term, at the 1 percent significance level, the Rotterdam CPO price influences the Malaysian CPO price, while the Indonesian CPO price also has a significant effect on Malaysian prices at the 10 percent level. This indicates that the Malaysian market is highly responsive to price changes in Indonesia and Rotterdam. Indonesian prices can shape trading expectations and strategies in Malaysia, although the influence is not as strong as that of Rotterdam. Meanwhile, Rotterdam's CPO price behaves as an independent market, as it is not influenced by price changes in Malaysia and Indonesia. Conversely, Indonesia's CPO price is significantly influenced by Malaysian and Rotterdam prices in the long term, highlighting Indonesia's role as a price-taker in global market dynamics.

Short-term dynamics exhibit patterns that differ from those of long-term relationships. The causality test results reveal a unidirectional relationship from Malaysian and Rotterdam CPO prices to Indonesian CPO prices. This indicates that short-term fluctuations in international markets can be used to predict Indonesian price movements. In contrast, no evidence was found that Indonesian prices influence Malaysian or Rotterdam prices in the short run. These findings reinforce the view that Malaysia and Rotterdam function as price setters, whereas Indonesia acts as a price taker in the global CPO market.

Empirical evidence supports this pattern. Indonesian CPO export prices show a strong dependence on Malaysian market prices, with consistent evidence of one-way causality. Adyanti and Yafi (2024), using the Vector Error Correction Model (VECM), identified unidirectional integration in which Indonesian CPO export prices are driven by Malaysian price movements. Cointegration tests confirm this one-way price transmission mechanism. Similarly, Syahril et al. (2019), employing bivariate Granger causality analysis, reinforced these results and highlighted the complex interdependencies in the CPO export price formation. Both studies relied on robust time-series data spanning 10–15 years of monthly observations, providing convincing empirical evidence of Malaysia's dominant influence on Indonesian CPO export price dynamics.

Table 3. Granger Causality Test Results among Indonesian, Malaysian, and Rotterdam CPO Prices

Causality in Level VAR(2)		Causality in FD VAR(2)	
Dependent variable: log(cpo_2mfsp)		**Dependent variable: dlog(cpo_2mfsp)**	
Excluded	Prob.	Excluded	Prob.
log(cpo_rotp)	0.0000	dlog(cpo_rotp)	0.0000
log(cpo_ifsp)	0.0674	dlog(cpo_ifsp)	0.0816
All	0.0000	All	0.0000
Dependent variable: log(cpo_rotp)		**Dependent variable: dlog(cpo_rotp)**	
Excluded	Prob.	Excluded	Prob.
log(cpo_2mfsp)	0.3732	dlog(cpo_2mfsp)	0.8955
log(cpo_ifsp)	0.6249	dlog(cpo_ifsp)	0.9336
All	0.7002	All	0.9876
Dependent variable: LOG(CPO_IFSP)		**Dependent variable: dlog(cpo_ifsp)**	
Excluded	Prob.	Excluded	Prob.
log(cpo_2mfsp)	0.0004	dlog(cpo_2mfsp)	0.8604
log(cpo_rotp)	0.0001	dlog(cpo_rotp)	0.1972
All	0.0003	All	0.0542

To place these results in a broader context, it is important to compare the Indonesian CPO price behavior with trends in other major palm oil-producing countries. The observed dynamics reflect a common global pattern of strong market integration in the region. Despite being the world's largest producer of palm oil, Indonesia frequently follows international price benchmarks. These benchmarks are primarily established by dominant markets such as Malaysia and Rotterdam, respectively. This global perspective underscores the strategic importance of understanding international price formation mechanisms and identifying pathways for Indonesia to strengthen its domestic price discovery and market influence.

Indonesia acts as a price taker in the global CPO market, with the Malaysian and Rotterdam markets predominantly setting international price dynamics. Multiple studies have provided robust evidence of this relationship. In the long term, Rotterdam's CPO price significantly influences Malaysian prices at the 1% level, while Indonesian prices have a less pronounced effect at the 10% level. Short-term dynamics reveal a unidirectional causality, with Malaysian and Rotterdam prices predicting Indonesian price movements (Syahril et al. 2019). Empirical research using Vector Error Correction Models and Granger causality analysis consistently demonstrates a one-way price transmission mechanism, with Malaysian markets being particularly influential. This pattern is supported by time-series data spanning 10-15 years, highlighting Indonesia's position as a price follower despite being the world's largest palm oil producer (Hafizah, 2009).

The Impulse Response Function (IRF) analysis in Figure 3 illustrates how each variable responds to shocks originating from itself or from other variables in the model. It also shows the duration of these responses until a new equilibrium is achieved. A positive shock to the Malaysian CPO price leads to an increase in the Malaysian price during the first to fourth months. After this period, the response gradually declined and stabilized from the twelfth month onward. This pattern indicates that the Malaysian CPO market is sensitive to internal price shocks and adjusts progressively to equilibrium.

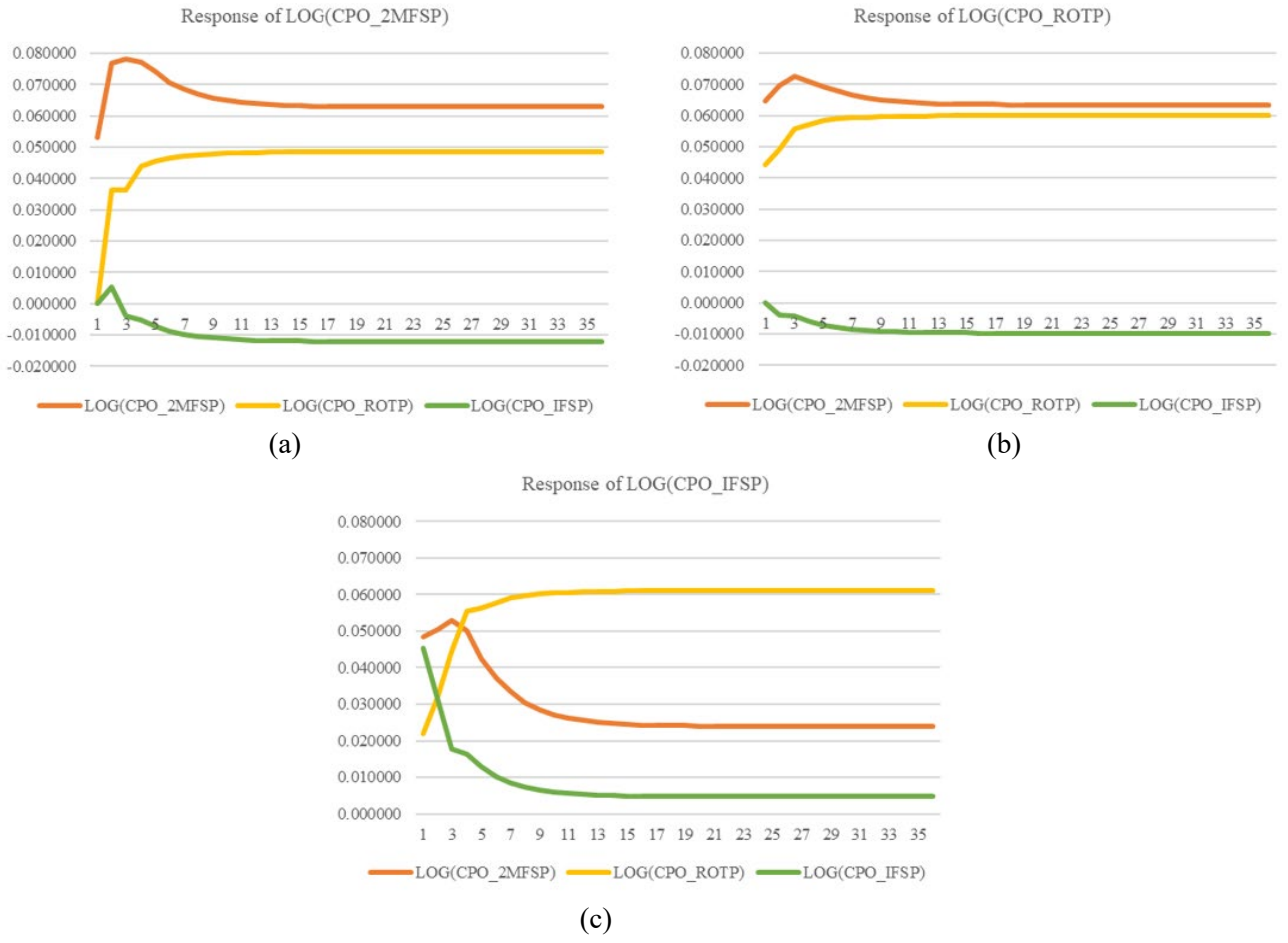


Figure 3. Impulse Response Function (IRF) results for Malaysian (a), Rotterdam (b), and Indonesian (c) CPO prices

The Rotterdam CPO price began to respond to shocks originating from the Malaysian CPO price in the second month. This response continued to increase until approximately the tenth month before reaching a stable level. This pattern indicates that changes in Malaysian CPO prices significantly influence Rotterdam prices, albeit with a noticeable time lag. In contrast, Indonesian CPO prices show a different adjustment pattern. They respond positively to Malaysian price shocks in the second month but turn negative from the third month onward, suggesting the presence of distinct adjustment mechanisms and domestic factors affecting CPO prices in Indonesia.

The analysis confirms that Malaysian CPO prices exert a significant influence on Indonesian prices through a predominantly one-way market integration mechanism. This finding indicates that price movements in Malaysia are transmitted to Indonesia without reciprocal effects on the latter. Adyanti and Yafi (2024) report similar evidence of unidirectional integration, where Indonesian CPO export prices are causally driven by Malaysian prices. Their results support the characterization of Indonesia as a price taker in the regional crude palm oil (CPO) market. In contrast, Syahril et al. (2019) identified bidirectional Granger causality between Indonesian and Malaysian CPO exports, highlighting a strong degree of market interconnectedness despite asymmetries in price leadership.

Unlike the Malaysian and Rotterdam markets, Indonesian CPO prices exhibit a distinct response to shocks originating in Malaysia. The Indonesian CPO price responds positively to Malaysian price shocks only in the second month. From the third month onward, the response was negative. This indicates that a one–standard deviation shock in Malaysian CPO prices eventually leads Indonesian prices to move in the opposite direction after an initial adjustment period. This suggests the presence of different adjustment mechanisms or additional domestic factors influencing Indonesian CPO price dynamics.

Malaysian CPO prices significantly influence Indonesian CPO prices through a predominantly one-way market integration mechanism. This indicates that while the two markets are closely interconnected, their price movements are not perfectly synchronized. Adyanti and Yafi (2024) identified a unidirectional integration pattern in which Indonesian CPO export prices are causally driven by Malaysian prices. Their findings confirm Indonesia's role as a price-taker in the international CPO market. Syahril et al. (2019) report bidirectional Granger causality between Indonesian and Malaysian CPO exports, highlighting the strong interconnectedness of the two markets despite asymmetries in price leadership.

When the Rotterdam CPO price experiences a shock, the Malaysian CPO price responds more strongly than the Rotterdam price. The Malaysian price reaction is observed from the initial period to the third month. After this phase, the response gradually declined and stabilized from approximately the twelfth month onward. This pattern demonstrates the strong influence of Rotterdam price movements on the Malaysian market and indicates a relatively faster adjustment process. In contrast, the Rotterdam CPO price's own response continues to increase from the second to the seventh month, reflecting price resilience and sustained reaction over time.

Indonesian CPO prices also exhibited a negative response to shocks originating from the Rotterdam CPO market. This reaction suggests that increases in Rotterdam prices do not directly translate into higher Indonesian prices. Instead, the responses indicate a degree of market sensitivity in Indonesia. Such behavior may reflect the structural characteristics of the domestic CPO market. It may also be influenced by domestic policies that limit the direct alignment of Indonesian CPO prices with the global Rotterdam price movements.

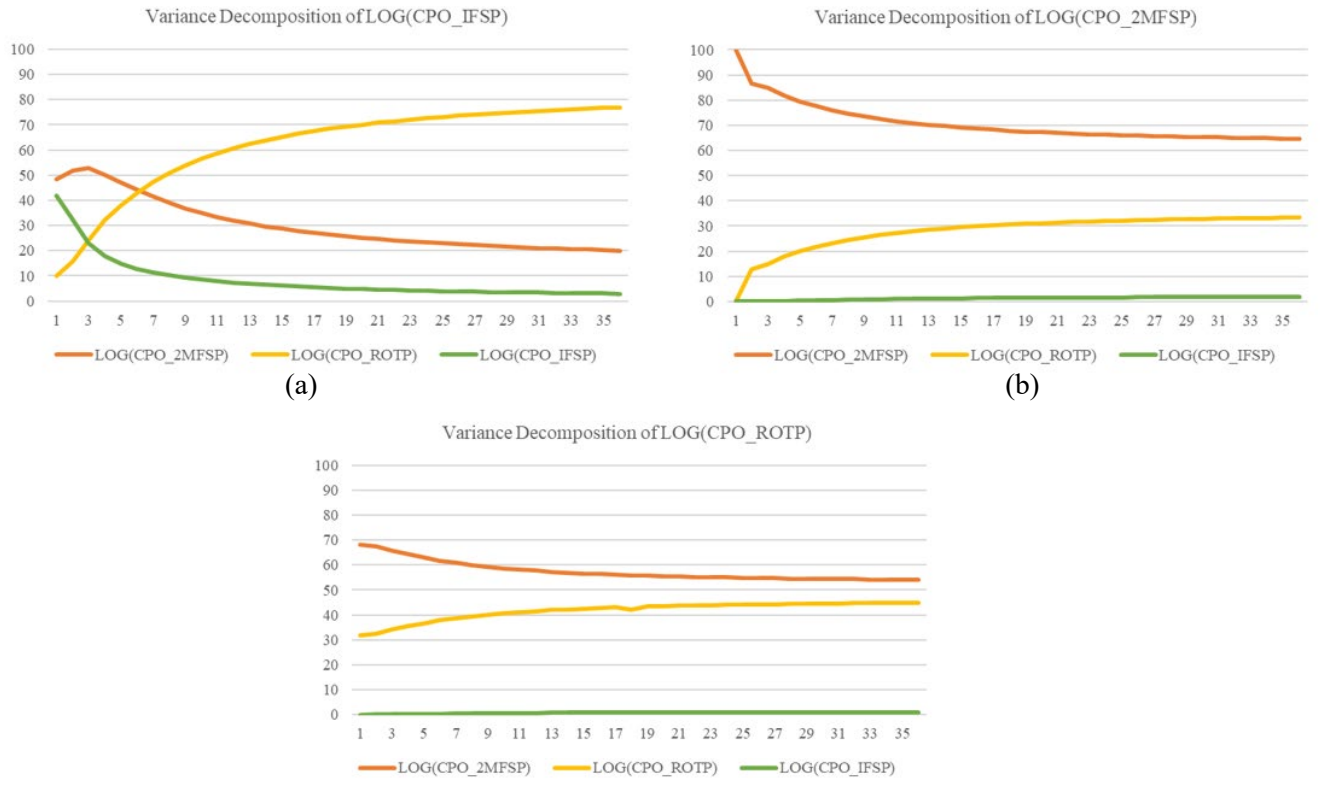
When the Indonesian CPO price experiences a one–standard deviation shock, the Malaysian CPO price exhibits the strongest response. The Malaysian price reacts with a consistent upward movement in the early period. This pattern reflects the Malaysian market's sensitivity to price fluctuations originating in Indonesia, a major palm oil producer. The response continued to increase until approximately the fourth month. After that point, it gradually declines beginning in the fifth month.

The Rotterdam CPO price responds positively to shocks originating from the Indonesian CPO price. Its response shows a steady upward trend from the initial period until it stabilizes around the ninth month. This pattern indicates that changes in Indonesian prices are transmitted to the Rotterdam market as time passes. In contrast, the Indonesian CPO price tended to

decline throughout the remainder of the period. This behavior suggests an internal market correction, as the Indonesian CPO market adjusts its price expectations and gradually returns to its long-term equilibrium.

The IRF analysis provides a definitive dynamic confirmation that Indonesian CPO prices are significantly influenced by those of Malaysian CPO and Rotterdam CPO, ultimately establishing Indonesia as a 'price taker' rather than a 'price maker' at the international reference price. Global market transmission is evident as a positive shock to Malaysian CPO prices triggers an increase in the Malaysian price and subsequently impacts the Rotterdam price after a time lag, while the Rotterdam price, in turn, demonstrates a strong influence on the Malaysian CPO price. However, the analysis highlights Indonesia's distinct and sensitive adjustment behavior: Indonesian CPO prices respond positively to a Malaysian CPO price shock only in the second month, but then turn negative from the third month onward, and similarly show a negative response to Rotterdam price shocks. This negative divergence suggests that structural market factors or domestic policies prevent direct alignment with global price changes. Although the reverse effect of Indonesian CPO prices on the global market is relatively small, both Malaysian and Rotterdam CPO prices show a positive response to an Indonesian CPO price shock, reflecting the global market's sensitivity to fluctuations in Indonesia as a major producer, even as Indonesian CPO price's own response declines as a form of internal market correction toward long-term equilibrium

After examining the dynamic responses of CPO prices using the Impulse Response Function (IRF) (Figure 3), the analysis proceeds to the Variance Decomposition (VD) approach, the results of which are presented in Figure 4. VD is used to explore the structural characteristics of the VAR model. This method measures the extent to which each variable's variability is explained by its own shocks. It also quantifies the contribution of shocks originating from other variables in the system. In essence, VD identifies the proportion of forecast error variance attributable to each source of shock over a given time horizon.



(a) (b)

(c)

Figure 4. Variance Decomposition (VD) results of Indonesian (a), Malaysian (b), and Rotterdam (c) CPO prices

For the Malaysian CPO price, the variance decomposition results show that its fluctuations are initially dominated by internal shocks. This internal contribution gradually declined from the second month onward. In contrast, the influence of the Rotterdam CPO price on Malaysian price variability increases notably after the second month. This contribution continued to rise throughout the remaining period, indicating a growing external influence. Meanwhile, the contribution of Indonesian CPO prices remains relatively small below 1 percent for most of the period although it shows slight incremental increases over time.

The variance decomposition results for the Rotterdam CPO price indicate that its fluctuations are largely explained by movements in Malaysian CPO prices. The Rotterdam price's own shocks also contribute significantly, reflecting the importance of internal market factors in the short run. In contrast, the influence of Indonesian CPO prices on Rotterdam's price variability is relatively small. This contribution began to appear from the second month onward but remained low throughout the period. These findings demonstrate Indonesia's limited influence on the price formation in the global CPO market.

The pattern of Indonesian CPO price contributions shows different dynamics. At the beginning of the period, Indonesian CPO price variability was heavily influenced by Malaysian CPO prices, which dominated until the fourth month of the study. However, starting in the fifth month, the contribution of Malaysian CPO prices to Indonesian CPO price fluctuations began to decline. Concurrently, the contribution of Rotterdam CPO prices continued to increase from the beginning and, in the eighth month, surpassed other contributors to become the most significant contributor to the Indonesian CPO price variance. This position persisted until the end of the study period. The contribution of Indonesian CPO prices was substantial in the first three periods but gradually decreased until the end of the observation period.

Policy Implication

The core policy implication is that Indonesia must undertake decisive reforms to shift its role from being the world's largest volume producer of CPO to becoming a global price reference. This requires strengthening the maturity of domestic exchange policies, as the voluntary nature of the current regulatory framework under Bappebti Regulation No. 7 of 2023 has proven insufficient to change market behavior or generate the liquidity necessary for effective price discovery. Consequently, policy direction must move toward mandatory compliance, particularly in allocating a portion of CPO export transactions through domestic exchanges to reduce transaction fragmentation. In parallel, government intervention is needed to address disparities in market integration, given that Indonesian CPO prices remain heavily influenced by Bursa Malaysia Derivatives (BMD) and Rotterdam prices and exhibit unidirectional dependence. Therefore, strengthening the domestic pricing mechanism and establishing a credible national benchmark are critical to reducing reliance on external references and repositioning Indonesia from a market follower to a price setter. Furthermore, the observed dynamic response—where Indonesian CPO prices react negatively to prolonged global shocks suggests that certain domestic policies or structural constraints may inadvertently distort the price formation process. This calls for a comprehensive structural and regulatory audit to identify and rectify the specific factors that hinder price alignment with Indonesia's fundamental market strength.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This study reveals that although Indonesia is a significant global CPO producer, it remains a price taker, as domestic prices are primarily determined by Bursa Malaysia and Rotterdam, which serve as market leaders. Indonesian CPO prices are closely integrated with the global market and are influenced by Malaysian and Rotterdam prices and the Rupiah exchange rate, exhibiting a strong long-term relationship. The negative response to external shocks suggests that structural factors or domestic policies are at play, differentiating Indonesia's pricing mechanisms. These findings underscore the need for strategies to strengthen domestic exchanges and further research on export policies, market participation, and trade structures, thereby enabling Indonesia to enhance its role in global price discovery.

Recommendations

To strengthen Indonesia's role in the global CPO market, recommendations should be pursued in an integrated manner. First, the liquidity and credibility of domestic exchanges must be enhanced through the implementation of mandatory trading for key CPO contracts to ensure consistent transaction volumes and reliable price signals. This should be complemented by greater transparency via real-time trade reporting, standardized contract specifications, and the provision of financial incentives—such as reduced transaction fees or tax benefits—to attract both domestic and foreign market participants. Collaboration with international market players is also essential to align domestic pricing mechanisms with global standards and facilitate cross-border participation, thereby positioning Indonesia's exchanges as credible global price references. In parallel, improving derivatives market literacy and accessibility among domestic business actors is necessary to encourage the effective use of CPO derivatives for hedging purposes and to reduce dependence on external price benchmarks. Moreover, routing CPO export transactions through domestic exchanges, in line with international best practices, should be considered to increase transaction volumes and strengthen domestic price discovery in the future. These policy measures need to be supported by further research that explicitly examines export policies, exchange design, and market integration, with particular attention to regulatory frameworks, institutional arrangements, and structural factors that can enhance Indonesia's influence on global price-setting, while also drawing comparative lessons from other major palm oil-producing countries. Finally, stronger coordination among government institutions, regulators, and industry stakeholders is crucial to overcome fragmented transactions and regulatory inconsistencies, thereby facilitating Indonesia's transition from a price-taker to a price-maker in the global CPO market.

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REFERENCES

Adyanti, A. S., & Yafi, M. A. (2024). Market Integration of Indonesia and Malaysia Crude Palm Oil (CPO) Export Prices (A VECM Approach). Buletin Penelitian Sosial Ekonomi Pertanian Buletin Penelitian Sosial Ekonomi Pertanian, 26(2), 177-188.

Ahmed, K., Zain, M., Noor, A. M., Alsaadi, A. R., & Milhem, M. (2020). The Impact of The Impact of Commodity Futures Prices : An Evidence from Malaysian Crude Palm Oil Futures. European Journal of Molecular & Clinical Medicine, 07(06), 2095-2105.

Antara. (2023, Mei 19). Bappebti akan wajibkan 10 persen ekspor CPO masuk bursa komoditi. Retrieved from Ekonomi, Bisnis, Antara: https://www.antaranews.com/berita/3546540/bappebti-akan-wajibkan-10-persen-ekspor-cpo-masuk-bursa-komoditi

Aprina, H. (2014). The Impact of Crude Palm Oil Price on Rupiah'S Rate. Buletin Ekonomi Moneter dan Perbankan, 16(4), 295-314.

Arsyad, M., Amiruddin, A., Suharno, S., & Jahroh, S. (2020). Competitiveness of Palm Oil Products in International Trade: An Analysis between Indonesia and Malaysia. Caraka Tani: Journal of Sustainable Agriculture, 35(2), 157-167.

Ayudya, R., Suwandari, A., & Hartadi, R. (2017). The impacts of fundamental and macroeconomic factors on the stock price of oil palm plantation companies in Indonesia Stock Exchange (IDX). Journal of Economics, Business, and Accountancy Ventura, 20(2), 141-148. doi:https://doi.org/10.14414/JEBAV.V20I2.847

BPS. (2025). Statistik Tanaman Perkebunan Tahunan Indonesia 2024. Badan Pusat Statistik.

BRI Danareksa Sekuritas. (2024, September 18). Lolos Tahap I Penilaian Eksternal, Bappebti Semakin Dekat dengan ZI 2024. Retrieved from PT BRI Danareksa Sekuritas: https://www.bridanareksasekuritas.co.id/en/news-update-detail/news-update/19668

Bursa Malaysia Berhad. (2025). Crude Palm Oil Futures (FCPO). Retrieved from Derivatives, Commodity Derivatives, Bursa Malaysia Berhad: https://www.bursamalaysia.com/trade/our_products_services/derivatives/commodity_derivatives/crude_palm_oil_futures

Enders, W. (2015). Applied Econometric Time Series (4th ed.). John Wiley & Sons.

Faizah, & Nur, S. (2023). Integrasi Pasar Biji Kakao Indonesia dengan Pasar Dunia. Agro Ekonomi, 41(1), 39-49. doi:https://doi.org/http://dx.doi.org/10.21082/jae.v41n1

Firdaus, M. (2018). Aplikasi Ekonometrika: Data Panel dan Time Series. Bogor: IPB Press.

Gandhy, A., Harianto, Nurmalina, R., & Suharno. (2022). The Efficiency of the Spot Market and Crude Palm Oil (CPO) Commodity Futures Market Before and During the Covid-19 Pandemic in Indonesia. Jurnal Manajemen & Agribisnis, 19(1), 139-151.

Gultom, G. A., Harianto, Saragih, B., & Suharno. (2024). Estimating Factors That Affect Domestic CPO Prices in The Short And Long Run Using The ECM Approach. IOP Conf. Series: Earth and Environmental Science, 1359, 012057.

Gultom, G. A., Krisnamurthi, B., & Saragih, B. (2023). Pengaruh Harga Internasional, Ekspor, Harga TBS, dan Volume Produksi Biodiesel Terhadap Harga CPO Domestik. Forum Agribisnis, 13(2), 152-163.

Hafizah, D. (2009). Integrasi Pasar Fisik Crude Palm Oil di Indonesia, Malaysia dan Pasar Berjangka di Rotterdam. Economics, Business, Environmental Science.

Helbawanti, O., Bunda, C. A., & Faqihuddin, F. (2022). Integrasi Pasar Berjangka Komoditi Crude Palm Oil (CPO) Indonesia Di Masa Pandemi Covid-19. Jurnal Agrica, 15(1).

Hortus Archipelago. (2024, Mei 21). Implementasi Bursa CPO Perkuat Tata Kelola Perdagangan CPO. Retrieved from Sawit, Majalah Hortus Archipelago: https://news.majalahhortus.com/implementasi-bursa-cpo-perkuat-tata-kelola-perdagangan-cpo/

Immanuel, I., Suharno, S., & Rifin, A. (2019). The Progressive Export Tax and Indonesia's Palm Oil Product Export Competitiveness. Buletin Ilmiah Litbang Perdagangan, 13(2). doi:10.30908/bilp.v13i2.417

Juanda, B., & Junaidi. (2011). Ekonometrika Deret Waktu (Teori dan Aplikasi). Bogor: IPB Press.

Kementerian Pertanian. (2023). Analisis PDB Sektor Pertanian Tahun 2023. Pusat Data dan Sistem Informasi Pertanian, Kementerian Pertanian.

Kusumawardhana, R., & Chen, J. K. (2018). Price Transmission and the Effect of Indonesia's Export Tax on Crude Palm Oil (CPO) Prices. The International Journal of Business & Management, 6(4), 98-106.

Lestari, D., & Oktavilia, S. (2020). Analysis of Palm Oil Price in Southeast Asia. AFEBI Economic and Finance Review, 5(2), https://doi.org/10.47312/aefr.v5i02.494.

Lütkepohl, H. (2005). New Introduction to Multiple Time Series Analysis (https://doi.org/10.1007/978-3-540-27752-1 ed.). Springer.

Mahadi, M. I., Mansor, W., Mahmood, W., & Ismail, F. (2014). Dynamic Cross-Market Linkages of Commodity Futures Markets : Evidence from FCPO and DCE. Journal of Applied Environmental and Biological Sciences, 4(5), 41-46.

Mandiri Research. (2023). CPO: Peluncuran Bursa Berjangka Minyak Sawit Mentah (CPO). Industry & Regional Brief, Office of Chief Economist, Mandiri .

MarketsWiki. (2024, Januari 20). Indonesia Commodity & Derivatives Exchange (ICDX). Retrieved from MarketsWiki: https://www.marketswiki.com/wiki/Indonesia_Commodity_%26_Derivatives_Exchange_(ICDX)

Nugroho, W. S., Astuti, A. B., & Astutik, S. (2021). Vector Error Correction Model to Forecasting Spot Prices for Coffee Commodities During Covid-19 Pandemic. Journal of Physics: Conference Series, 1811(1), 1-10. doi:https://doi.org/10.1088/1742-6596/1811/1/012076

Pane, L. G. (2022, Februari 22). Diproduksi Indonesia, Ditentukan Malaysia. Retrieved from Detikcom: https://news.detik.com/kolom/d-5953086/diproduksi-indonesia-ditentukan-malaysia

Paramita, D. P., Nuryartono, N., & Achsani, N. A. (2015). Analisis Faktor yang Mempengaruhi Harga dan Integrasi Harga Olein. Jurnal Ekonomi dan Kebijakan Pembanguan, 4(1), 28-48.

Priyati, R. Y. (2018). Determinants of Global Palm Oil Demand: A Gravity Approach. Economic Journal of Emerging Markets, 10(2), 148-164. doi:https://doi.org/10.20885/EJEM.VOL10.ISS2.ART4

Ramadhan, M. F., Sitepu, R. K., Nasution, I., & Novrini, S. (2025). Faktor-faktor yang Mempengaruhi

Volatilitas Harga CPO Indonesia Periode 2020-2023. Jurnal Ilmu Pertanian, 13(1), 56-60.

Susila, W. R. (2004). Impacts of CPO-export tax on several aspects of Indonesian CPO industry. Jurnal Manajemen Agribisnis, 1(2), 89-102.

Syahril, Masbar, R., Majid, M. S., & Syahnur, S. (2019). Does Indonesia As The World Largest Palm Oil Producing Country Determine The World Crude Palm Oil Price Volatility. Regional Science Inquiry, XI(2), 93-104.

The Jakarta Globe. (2025, Agustus 11). ICDX CPO Bourse Receives Award at 2025 Sawit Indonesia Expo. Retrieved from The Jakarta Globe: https://jakartaglobe.id/special-updates/icdx-cpo-bourse-receives-award-at-2025-sawit-indonesia-expo#google_vignette

Turnip, S. M., Suharyono, & Mawardi, M. K. (2016). Analisis Daya Saing Crude Palm Oil (CPO) Indonesia di Pasar Internasional. Jurnal Administrasi Bisnis (JAB), 39(1), 185-194.

Widyaningtyas, D., & Widodo, T. (2017). Analisis Pangsa Pasar Dan Daya Saing CPO Indonesia Di Uni Eropa. Jurnal Manajemen Daya Saing, 18(2), 138-145.

Winardi, W., Susanto, H., & Martana, K. (2017). The Impact of World CPO Price Change Towards Prices, Economic Activities, and Income Distribution in Indonesia. Buletin Ilmiah Litbang Perdagangan, 11(2), 207-226.

Yuningtyas, C. V., Hakim, D. B., & Novianti, T. (2019). Integrasi Pasar Karet Alam Indonesia dengan Pasar Dunia. Jurnal Penelitian Karet, 37(2), 139-150. doi:https://doi.org/10.22302/ppk.jpk.v37i2.647

Zainuddin, A., Asmarantaka, R. W., & Harianto, H. (2015). Integrasi Harga Daging Sapi di Pasar Domestik dan Internasional. Buletin Ilmiah Litbang Perdagangan, 9(2), 109-128. doi:https://doi.org/https://doi.org/10.30908/bilp.v9i2.4