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ECONOMIC IMPACT ON PALM OIL STOCK RETURNS IN MALAYSIA, SINGAPORE, AND INDONESIA: A NARDL MODEL ANALYSIS

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Abstract: The study examines the relationship between Malaysia's economic conditions and the returns on palm oil stocks in Malaysia, Indonesia, and Singapore. The non-linear autoregressive distributed lag framework was used to analyse the asymmetric impact of Malaysian macroeconomic factors on palm oil stock returns in each country. The findings reveal that the exchange, inflation, and unemployment rates, as well as gold and crude oil prices, strongly influence the long-term returns of palm oil stock. Specifically, unfavourable changes in crude oil prices significantly impact palm oil stock returns. Other key variables also show significant associations with palm oil stock returns, both positively and negatively. In conclusion, investors and stakeholders should take Malaysia's general economic situation into account when developing investment plans, in addition to fluctuations in the returns on palm oil stocks.

Keywords: Non-linear autoregressive distributed lag, palm oil stock returns, impact analysis, macroeconomic variables.

Introduction

The Malaysian government began working to strengthen the nation's agricultural sector after the country gained independence, with a particular emphasis on promoting the expansion of the oil palm sector (Nathan *et al.,* 2023). Because of its consistent efforts over the past few decades, Malaysia is currently recognised as the second-largest producer of oil palm (Abdul Rahman *et al.,* 2023; Nathan *et al.,* 2023). Similarly, Indonesia, the world's top producer of palm oil, has solidified its significance in the industry. According to the Observatory of Economic Complexity, Indonesia's exports of palm oil hit a record-breaking US$17.9 billion in 2020, making it the country's most traded commodity. Furthermore, Indonesia claimed its status as the largest producer in the world in 2021 by producing 46 million tonnes of palm oil, which represented 4.5% of the nation's gross domestic product (GDP) (Rifin *et al.,* 2020; Choiruzzad *et al.,* 2021). Even though it is not a major producer of palm oil, Singapore is an important global trader of oil, particularly for Malaysian and Indonesian palm oil (Rifin *et al.,* 2020).

The war between Russia and Ukraine that started in 2022 has caused a shortage of sunflower oil since Ukraine, previously the world's top producer, was unable to maintain its production. As a result, global edible oil prices drastically increased (Hauser, 2022). To regulate the domestic price of edible oil, Indonesia, the world's largest supplier of palm oil, banned the export of the commodity. As a result, Malaysia became a supplier of palm oil for other countries, which led to an increase in palm oil prices there (Abdul Rahman *et al.,* 2023). Singapore consumers, however, experienced only minimal impact on palm oil prices due to the Indonesian palm oil export embargo, likely because Singapore sourced edible oil from other countries besides Indonesia.

Thus, this study aims to examine the factors that affect the returns on Malaysian, Indonesian, and Singaporean palm oil stocks. These factors included the price of Brent crude oil, the world gold price, the inflation and unemployment rates in Malaysia and the USD-MYR exchange rates. The Financial Time Stock Exchange (FTSE) Bursa Malaysia Asian Palm Oil Plantation (FBMAP) Index will be used as a proxy for the performance of palm oil stocks in Malaysia, Singapore, and Indonesia as it comprises companies from all three countries that generate at least 30% of their income from palm oil-related activities. This study also attempts to investigate the asymmetric effects of these identified factors on returns on palm oil stock throughout both the short and long term.

Prior empirical studies have shown that including the prices of crude oil and gold has a significant effect on how well palm oil stock returns perform (Kapusuzoglu, 2011; Nordin *et al.,* 2014). Investors are drawn to the returns of gold prices, which provide an alternative investment option during times of price volatility (Gokmenoglu & Fazlollahi, 2015; Beh & Yew, 2020). Inflation is strongly related because the rising money supply frequently puts pressure on inflation. Numerous studies have highlighted the significance of the unemployment and inflation rates as crucial indicators of economic development (Shahid, 2014). These indicators, which reflect the employment situation and the overall pricing for goods and services, provide crucial information about the overall stability and health of the Malaysian economy. By monitoring and studying changes in unemployment and inflation rates, it is possible to provide insights into the potential cost and demand challenges that palm oil companies may face, which could eventually influence the performance of palm oil returns. The US dollar to Malaysian ringgit exchange rate is one of the key factors in determining the competitiveness and profitability of palm oil exports because Malaysia is a significant palm oil exporter (Izraf *et al.*, 2017; Woan-Lin & Jia-Hong, 2020; Abdul Rahman *et al.,* 2023).

Materials and Methods

Data

Using a dataset spanning from January 2012 to April 2022 and containing 124 monthly observations, the FBMAP Index was used to study the performance of palm oil equities in Malaysia, Singapore, and Indonesia. The FBMAP Index contained 11 listed palm oil companies from Malaysia, four from Singapore, and three from Indonesia. The five macroeconomic factors included in this study were the price of Brent crude oil (*C*), the world gold price (*G*), the Consumer Price Index (*CP*), unemployment rates in Malaysia (*UE*), and the USD-MYR exchange rates (*EXR*). The FBMAP Index data was collected from Investing.com while *C* and *G* data were obtained from the World Bank and the remaining data was sourced from Bank Negara Malaysia. The data was transformed using a logarithmic function to standardise the variables.

Econometric Model – The NARDL Model

In this study, the non-linear autoregressive distributed lag (NARDL) model (Shin *et al*., 2014) was employed to assess the impact of economic variables on the price of the FBMAP Index. This model enables the estimation of asymmetry effects, which capture the individual influences of regressors on the stock index price (Beh & Yew, 2020; Chen *et al.,* 2020). Non-linearity can arise due to volatile fluctuations in variables or asymmetric responses to shocks from other variables, both of which can be observed in practice (Narayan & Narayan, 2007). The application of the NARDL model permits the investigation of non-linear cointegration relationships between variables in both the short and long term, in addition to assisting in the examination of variable non-linearity and non-stationarity through the development of an error correction model (ECM) (Raza *et al.,* 2016). The NARDL model divides the sum of squares into positive and negative partial sum components to comprehensively capture the asymmetric effects of independent variables over both short and long periods. Consequently, the following long-term linear asymmetric equation can be modified as:

$$lnFBMAP_t = \gamma^+ lnC_t^+ + \gamma^- lnC_t^- + \gamma^+ lnG_t^+ + \gamma^- lnG_t^- + \gamma^+ lnCP_t^+ + \gamma^- lnCP_t^- + \gamma^+ lnUE_t^+ + \gamma^- lnUE_t^- + \gamma^+ lnEXR_t^+ + \gamma^- lnEXR_t^- + u_t \quad \textbf{(1)}$$

where $lnFBMAP_t$ is the logarithmic price of the FBMAP Index at time t while $\gamma^+(\gamma^-)$ are the coefficients of the positive (negative) partial sums of changes in the regressors, x_t, and $x_t \in \{lnC_t, lnG_t, lnCP_t, lnUE_t, lnEXR_t\}$, and incorporated by the function $x_t = x_0 + x_t^+ + x_t^-$ based on the following process:

$$x_t^+ = \sum_{i=1}^{t} \Delta x_i^+ = \sum_{i=1}^{t} \max(\Delta x_i, 0) \quad \textbf{(2)}$$

$$x_t^- = \sum_{i=1}^{t} \Delta x_i^- = \sum_{i=1}^{t} \min(\Delta x_i, 0) \quad \textbf{(3)}$$

The NARDL model can therefore be represented by the following equation as an asymmetric ECM (Shin *et al.,* 2014), which is ECM-NARDL ($p, q_1, q_2, q_3, q_4, q_5$) model, where refers to the lag order of the error correction term in the model, and q_1, q_2, q_3, q_4, q_5 represent the lag orders for the independent variables in the NARDL model:

$$\Delta lnFBMAP_t = \theta lnFBMAP_{t-1} + \beta_1^+ lnC_{t-1}^+ + \beta_1^- lnC_{t-1}^- + \beta_2^+ lnG_{t-1}^+ + \beta_2^- lnG_{t-1}^- + \beta_3^+ lnCP_{t-1}^+ + \beta_3^- lnCP_{t-1}^- + \beta_4^+ lnUE_{t-1}^+ + \beta_4^- lnUE_{t-1}^- + \beta_5^+ lnEXR_{t-1}^+ + \beta_5^- lnEXR_{t-1}^- + \sum_{j=1}^{p-1} \rho_j \Delta FBMAP_{t-1} + \sum_{j=0}^{q_1-1} (\alpha_1^+ \Delta lnC_{t-j}^+ + \alpha_1^- \Delta lnC_{t-j}^-) + \sum_{j=0}^{q_2-1} (\alpha_2^+ \Delta lnG_{t-j}^+ + \alpha_2^- \Delta lnG_{t-j}^-) + \sum_{j=0}^{q_3-1} (\alpha_3^+ \Delta lnCP_{t-j}^+ + \alpha_3^- \Delta lnCP_{t-j}^-) + \sum_{j=0}^{q_4-1} (\alpha_4^+ \Delta lnUE_{t-j}^+ + \alpha_4^- \Delta lnUE_{t-j}^-) + \sum_{j=0}^{q_5-1} (\alpha_5^+ \Delta lnEXR_{t-j}^+ + \alpha_5^- \Delta lnEXR_{t-j}^-) + \varepsilon_t \quad \textbf{(4)}$$

where Δ represents the changes of *FBMAP*; $w_i^+ = -\beta_i^+/\theta$ and $w_i^- = -\beta_i^-/\theta$ are the long-term asymmetric coefficients, whereas α_j^+ and α_j^- are the short-term asymmetric coefficients, and ε_t is the stochastic error term, which is estimated using the ordinary least squares. It is reasonable to assume that Equation 4 is cointegrated, given that the F-statistics reject the null hypothesis, suggesting no cointegration. Furthermore, the Wald test is used to investigate the non-linear effects in both the short and long term. The null hypothesis of the Wald test assumes that the predictor variable evaluated has a symmetrical impact on the response variable, while the alternative hypothesis suggests an asymmetrical link between the predictor and response variables. Finally, utilising the dynamic multiplier, this study examines how the *FBMAP* reacts over time to common asymmetric shocks in the x_t, where $x_t \in \{lnC_t, lnG_t, lnCP_t, lnUE_t, lnEXR_t\}$. The asymmetric cumulative dynamic multiplier effect is expressed as follows:

$$dm_j^+ = \sum_{i=0}^{j} \frac{\partial lnFBMAP_{t+i}}{\partial x_t^+}, j=0, 1,2, \ldots \quad \textbf{(5)}$$

$$dm_j^- = \sum_{i=0}^{j} \frac{\partial lnFBMAP_{t+i}}{\partial x_t^-}, j=0, 1,2, \ldots \quad \textbf{(6)}$$

where $dm_j^+(dm_j^-)$ are the asymmetric long-term coefficients. Furthermore, to validate the NARDL model, the error correction term (ECT) must be negative, as a negative sign signifies convergence and a causal relationship. The tests used to assess the heteroscedasticity, serial correlation, and normal distribution of the residuals are Breusch-Pegan Godfrey, Jarque-Berra, and Remesy, respectively. The cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests are employed to evaluate the stability of the constructed model.

Results and Discussion

In this study, the unit root test is carried out using the augmented Dickey-Fuller test. With a 1% significance level, all the variables show stationarity at the first difference, $I(1)$. Hence, the prerequisites for using the NARDL are met (Shin *et al.,* 2014; Sinha, 2015). In the NARDL model, the optimal lag lengths are estimated using the Akaike information criterion. Therefore, the lag orders in Equation 4 are lower or equal to 2. Bound testing results reveal that the model is significant at 1% and rejects the null hypothesis of no cointegration in favour of the alternative hypothesis, indicating a long-term asymmetric relationship between the indicators (F-statistics is 4.4031 with critical value the or $I(1)$ being 3.61). Moving forward with the NARDL framework after confirming cointegration, we identify the significant predictor variables, which include *UE*, *G*, *EXR*, *C*, and *CP*. The long-term coefficients for these variables are estimated and presented in Table 1.

In the NARDL model, with the FBMAP Index as the response variable, we observe a significant positive relationship between a positive change and a decrease in the *EXR*. The results indicate that a 1% increase in *EXR* will lead to a 0.4132% improvement in the FBMAP Index while a 1% deduction in *EXR* will lead to a 0.6167% drop in the FBMAP Index. An increase in *EXR* suggests that the native currency has depreciated against other currencies, while a reduction indicates it has appreciated. Consequently, the competitiveness of palm oil export products in the global market increases with depreciation, resulting in higher stock prices for these export companies. Conversely, appreciation decreases competitiveness, leading to lower stock prices. These findings are consistent with Belghitar *et al.* (2021), who found that currency appreciation affects the competitiveness of export-oriented enterprises. Furthermore, fluctuations in the price of gold have a considerable impact on FBMAP Index returns, with both gains and falls in the gold price having equal magnitudes.

Furthermore, a positive change in the inflation rate (*CP*) is found to have a significant positive correlation with the FBMAP Index. Specifically, a 1% increase in *CP* is expected to induce a 2.5940% increase in the FBMAP Index. The relationship between *CP* and palm oil prices lowers the purchasing power of the currency and raises the price of the FBMAP Index (Omran & Pointon, 2001). On the other hand, a 1% decline in *CP* at its first differencing results in a 3.4000% fall in the FBMAP Index.

Additionally, Table 1 demonstrates that only negative shocks to *C* are significant in the long term. The FBMAP Index and *C* have a positive relationship. A decrease in the price of *C* specifically causes a decrease in the FBMAP Index. More specifically, it is expected that for every 1% loss in *C*, the FBMAP Index will fall by 0.2226%. Consequently, when *C* decreases, consumers tend to opt for crude oil over palm

Table 1: Long-term estimation results for the NARDL model

Variables	Model
	lnFBMAP
constant	-
Δln_G^{+}	0.6544***
$ln\_G^{+}_{t-1}$	0.6544***
ln_G^{-}	0.6035***
ln_EXR^{+}	0.4132**
ln_EXR^{-}	0.6167***
ln_CP^{+}	2.5940***
Δln_CP^{-}	3.4000***
$ln\_CP^{-}_{t-1}$	3.4000***
ln_C^{+}	-0.0272
ln_C^{-}	0.2226***
ln_UE^{+}	0.2769***
ln_UE^{-}	0.1827*

Note: *, **, *** denote statistical significance at 10%, 5%, and 1%, respectively oil, leading to a decrease in demand for palm oil and the profits of firms producing it. As a result, stock prices decline. This suggests that the decline in *C* does not appear to benefit the economies of Malaysia, Indonesia, and Singapore, which are the countries that produce palm oil. The price of the FBMAP Index is significantly affected by the *UE*, which is used as one of the indicators of Malaysia's economic health. The study reveals that it is expected that for every 1% increase in *UE*, the FBMAP Index will increase by 0.2769%, whereas for every 1% decrease in *UE* would result the FBMAP Index to reduce by 0.1827%.

Table 2 presents the estimated short-term NARDL coefficients for each regressor and the coefficient for the ECT. The results show that fluctuations of *C* significantly influence the FBMAP Index in the short term. Specifically, a decrease in *C* in the previous month impacts the price of the FBMAP Index while increases in *C* in both the current and previous months significantly affect the FBMAP Index. Additionally, contrary to the findings in the long-term estimation, *CP* does not show any influence on the FBMAP Index in the short term. Furthermore, the results reveal that fluctuations in *EXR* in the current month, regardless of the direction have a statistically significant influence on the FBMAP Index. Moreover, a decrease in *G* also has a significant impact on the FBMAP Index. There is a negative correlation between *G* from the previous month and the FBMAP Index. *G* also exhibits a negative association with the FBMAP Index when measured two months later. Additionally, the FBMAP Index also responds to the changes in *UE*, both in terms of decreases and increases. The ECT coefficient in the short-term model is -0.4645, indicating that if there are any deviations from the long-term equilibrium in the current month, 46.45% of the deviation will be corrected by the following month. Moreover, this finding confirms the existence of a long-term relationship between these variables.

Furthermore, the results of the Wald test in the long and short term are presented in Table 3, showing one *p*-value that is less than 0.01 in the long term, which is *C*. Thus, it has an asymmetric effect on the return of the FBMAP Index over the long term. Although *CP*, *UE*, *G*, and *EXR* play crucial roles in determining the price of the FBMAPIndex in the long term, their effects exhibit symmetry as shown in Table 3.

Conversely, the fluctuations of *C* have a significant impact only in the long-term, but also exhibit an asymmetry effect on the dependent variable. It is observed that all the significant

Table 2: Short-term estimation results for the NARDL model

Variables	**Model**
	$\Delta fbmap$
$\Delta ln\_C^{+}_{t-1}$	0.8977***
$\Delta ln\_C^{+}_{t}$	0.6939***
$\Delta ln\_C^{-}_{t-1}$	-0.2680*
$\Delta ln\_UE^{+}_{t}$	-0.5465**
$\Delta ln\_UE^{+}_{t-2}$	-1.1806***
$\Delta ln\_UE^{-}_{t-2}$	1.2197***
$\Delta ln\_EXR^{+}_{t}$	-2.0017*
$\Delta ln\_EXR^{-}_{t}$	1.6982*
$\Delta ln\_G^{-}_{t-1}$	-1.3935***
$\Delta ln\_G^{-}_{t-2}$	-0.9402**
ECT_{t-1}	-0.4645***

Note: *, **, *** denote statistical significance at 10%, 5%, and 1%, respectively

Table 3: Wald test results for NARDL long- and short-term estimation

Variables	Long-term Estimation	Short-term Estimation
	p-value	*p*-value
ln_CP	0.5949	-
ln_C	0.0006***	0.0000***
ln_G	0.7672	0.0006***
ln_UE	0.1635	0.0000***
ln_EXR	0.3577	0.0136**

Note: *, **, *** denote statistical significance at 10%, 5%, and 1%, respectively

regressors exhibit asymmetry impacts in the short term, as evidenced by rejecting the null hypothesis of the Wald test due to their *p*-values being smaller than the significance level. Moreover, the CUSUM and CUSUMSQ tests for the proposed model ensure that the series is stable in the defined error correction model at a 5% significance level.

Conclusions

The examination of Malaysia's economic impact on oil palm stock returns in Malaysia, Singapore, and Indonesia offers a crucial perspective on the correlation between Malaysia's economic conditions and the stock performance in these three nations. The study employs the NARDL framework to analyse the asymmetric effects of Malaysian macroeconomic factors (such as crude oil prices, inflation rates, exchange rates, unemployment rates, and gold prices) on palm oil stock returns, specifically the FBMAP Index. The exchange rate, the price of crude oil, the gold price, and the unemployment rate exhibit significant impacts on the return of the FBMAP Index over the short term. The computed ECT demonstrates the presence of cointegration among these variables, with fast adjustment speed when there is a deviation from the long-term equilibrium. Overall, these findings are beneficial for investors and policymakers who seek to identify the factors influencing the performance of the FBMAP Index and make well-informed decisions.

This study establishes the presence of cointegration among these variables, indicating that there is a long-term equilibrium relationship, which is crucial for comprehending the dynamics of the palm oil industry in the region. However, there are some limitations in the study. It focuses exclusively on Malaysia, Indonesia, and Singapore, which may not necessarily apply to other palm oil-producing and trading countries. Future research can address these limitations by exploring the impact of additional macroeconomic variables, like interest rates and GDP on FBMAP Index returns. Additionally, investigating the relationships between the FBMAP Index and associated industries, such as the food and beverage sectors, would provide a more comprehensive understanding. There are some recommendations for this study:

Expand the scope: Future research should consider expanding the geographical scope of the study to include other palm oil-producing and trading countries. This broader perspective would allow researchers to examine how economic conditions affect the palm oil industry on a global scale, considering diverse regional dynamics, market variations, and economic influences. It would provide a more comprehensive understanding of how different economic factors impact palm oil-related activities across various countries and regions.

Incorporate additional macroeconomic variables: This inclusion of extra macroeconomic variables such as interest rates and GDP will bolster the thorough examination of the factors influencing the FBMAP Index, resulting in a more in-depth analysis that better captures the dynamics governing palm oil stock returns.

Diversify the analysis: Additionally, broadening the scope of analysis to encompass related sectors like food and beverage industries would provide valuable insights into the interconnectedness of the palm oil industry with other economic sectors. This expanded investigation could uncover nuanced relationships and dependencies that shed light on the broader economic impact and interactions within these industries.

Consider technological innovations: As mentioned earlier, future research should explore the impact of technological improvements and innovations within the palm oil sector on FBMAP Index returns. Such research would help to comprehensively evaluate the direct effects and potential implications of these advancements on the overall performance and dynamics of the palm oil industry. Understanding how technological changes influence the industry's productivity, efficiency, and competitive positioning could provide valuable insights into its long-term financial performance, thereby enhancing the understanding of the industry's relationship with the FBMAP Index.

Long-term and short-term analysis: Differentiate between short-term and long-term impacts on the FBMAP Index. This would help investors and policymakers make more precise decisions based on the timeframe of their investment plans.

Incorporating these recommendations into future research could provide a more comprehensive and insightful analysis of the palm oil industry's relationship with economic conditions and technological advancements. This, in turn, will aid investors and policymakers in making informed decisions and better understand the complexities of the palm oil market.

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Conflict of Interest Statement

The authors declare that they have no conflict of interest.

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