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## Modelling the Common Edible Oil Price based on the US Dollar Index

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### Abstract

*Edible oil is a type of lipid which can be used to prepare food and is derived from plants, animals, or microorganisms. It is a heart-healthy type of cooking oil that can handle high heat while still maintaining its nutritional value. The study of edible oil prices is critical because it shows the demand and supply, which can affect the economy of a country. Meanwhile, the US Dollar Index is also important as it is a global currency, and any changes that occur can affect other commodity prices. Therefore, this study will investigate the relationship between edible oil prices and the US Dollar Index. Additionally, the best model will also be determined. Using a sample of 229 observations, this study explored the use of multiple linear regression in analysing the standard edible oil price based on the US Dollar Index. The result indicated that the best models for the US Dollar Index are the prices of coconut, peanut, rapeseed and sunflower oil. In conclusion, this model is valuable for traders, producers, consumers, and policymakers to forecast price trends and make informed decisions based on currency movements and market conditions.*

**Keywords:** Edible oil, Modelling, US Dollar

### Introduction

Edible oils play a crucial role in the human diet as they provide essential dietary fats that contribute to overall health, supporting growth and brain development. These oils, also known as cooking oils, are derived from plants, animals, or microorganisms and are used in food preparation [1]. Popular edible oils consumed worldwide include avocado, safflower, grapeseed, sesame, and extra virgin olive oil. These oils are desired due to their ability to handle high heat during cooking, making them heart-healthy options. The consumption of edible vegetable oil has increased over the years, as reported by the National Bureau of Statistics, which states that China consumed 39.78 million tonnes of edible vegetable oil between 2018 and 2019 [2]. This highlights the significant role of edible vegetable oil in daily nutrition, particularly in Asian diets.

In fiscal year 2022, vegetable oil sales in India amounted to approximately \$2.6 billion, reflecting a significant increase from the previous year's sales of over \$1.8 billion. It was



anticipated that the sales value would continue to rise, reaching around \$3.2 billion [3]. According to [4], the prices of sunflower oil, soybean oil, palm oil, and others are found in significant global edible oil trading centres. Edible oils, like coconut oil, peanut oil, olive oil, and palm oil, are typically traded globally, and their prices are often quoted in US Dollars. Therefore, the strength of the US Dollar plays a crucial role in determining the cost of these commodities on the international market.

Generally, researchers and analysts have employed various methods to predict the price of edible oils. These methods included the use of statistical models, supply and demand analysis, and the application of machine learning algorithms. A study using the autoregressive conditional heteroskedasticity (GARCH) method [5] discovered a negative correlation between crude oil prices and the value of the US Dollar, indicating their tendency to move together. The GARCH specification, although not based on any economic theory, offered a good approximation to the heteroskedasticity commonly seen in financial time-series data. Another study in [6] focuses on model-based simulations, as it is appropriate for trade policy analysis to forecast the economic implications of yet-to-be-implemented policy changes. This considers domestic production, price, income and government revenue of edible oil as the variables.

On the other hand, poor farm workers can significantly benefit from price forecasting by using it to assist them in deciding what to grow and when to sell [7]. In their study, artificial neural networks (ANN) and Auto Regressive Integrated Moving Average (ARIMA) were used to create forecasting models for the prices of three types of edible oils. Next, a study from [8], which forecasted the crude palm oil price, mentioned three forecasting techniques of multivariate time series. It was evaluated by comparing the evaluation metrics of MSE, RMSE, MAE and MAPE, and the lowest error value of the evaluation metrics determines the best model. In [9], a multiple log-linear regression model is used to determine the relationship between sunflower edible oil demand, sunflower and palm oil prices, and per capita income. Another study by [10] on oil's adulterant analysis uses simple linear regression (SLR), multiple linear regression (MLR), and partial least squares regression (PLSR) to predict lard in palm olein oil. Thus, this shows that modelling is also common in edible oil studies.

Linear regression is a popular statistical method which can model the relationship between explanatory and response variables in various studies. By analysing historical prices of edible oils, researchers could uncover the connection between different types of edible oils and their prices. However, fewer studies have been carried out which apply linear regression modelling to edible oils data with the US Dollar Index. Therefore, this study aims to determine the best model that explains the relationship between these two variables.

## **Methodology**

### ***Data description***

The research was conducted using secondary data obtained from the Kaggle website, consisting of 7 variables and 229 observations, covering the period from July 2003 to July 2022. The details and descriptions of each variable can be found in Table 1.



Table 1: Description of Variables

| No. | Variable Name         | Variable Type | Variable    | Description of price data |
|-----|-----------------------|---------------|-------------|---------------------------|
| 1   | US Dollar Index       | Interval      | Dependent   | monthly and yearly        |
| 2   | Coconut oil price     | Interval      | Independent | monthly                   |
| 3   | Olive oil price       | Interval      | Independent | monthly                   |
| 4   | Palm kernel oil price | Interval      | Independent | monthly                   |
| 5   | Peanut oil price      | Interval      | Independent | monthly                   |
| 6   | Rapeseed oil price    | Interval      | Independent | monthly                   |
| 7   | Sunflower oil price   | Interval      | Independent | monthly                   |

### *Theoretical Framework*

The research findings showed that the prices of coconut, olive, palm kernel, peanut, rapeseed, and sunflower oil had an impact on the US Dollar Index. This index was considered the dependent variable, while the oil prices served as independent variables. Figure 1 illustrates the relationship and the variable labels.

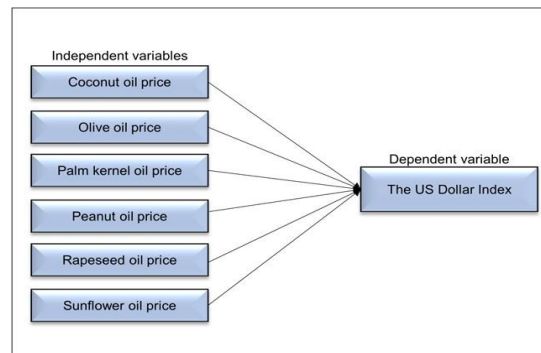


Figure 1: Theoretical Framework

### *Multiple Linear Regression*

Multiple linear regression (MLR) is used to model the linear relationship between the dependent variable and the six independent variables. This relationship can be described as in Eq. 1:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon \quad (1)$$

where  $Y_i$  is US Dollar Index,  $X_1$  = coconut oil price,  $X_2$  = olive oil price,  $X_3$  = palm kernel oil price,  $X_4$  = peanut oil price,  $X_5$  = rapeseed oil price,  $X_6$  = sunflower oil price and  $\varepsilon$  = error term.

If the  $p$ -value is less than 0.05, the null hypothesis is rejected, and it can be concluded that there is a significant difference in the model. To evaluate the model, it is necessary to make sure that all the assumptions of the regression model are fulfilled. These four assumptions for



MLR conditions that need to be fulfilled are that the error variable must be normally distributed, the error variance must be constant, the error terms must be independent, and no multicollinearity between the variables exists.

Stepwise regression is a technique in MLR used to identify the most important predictor variables and remove less significant ones from a large group. It is known to be computationally effective as it helps build a more straightforward and more effective model, particularly when there are many potential predictors [11]. Here, this method will be used as it can present the model simply and more understandably due to its capability of selecting a small selection of essential predictor variables. To test the significance of the regression model, Analysis of Variance (ANOVA) is used. This is to ensure that the model is valid before being used for forecasting or making inferences. The efficiency of the model predictive value is estimated by using root mean squared error (RMSE). Finally, the proportion of the variance in the dependent variable that is explained by the independent variables in the model is measured by using the coefficient of multiple determination,  $R^2$ .

## Results

### *Model adequacy checking*

Four assumptions need to be tested between the US Dollar Index, coconut, olive, palm kernel, peanut, rapeseed and sunflower oil. The regression model was used since all assumptions are fulfilled. The first assumption is fulfilled as it shows that the error variable is normally distributed (Figure 2a), since the points align closely with the diagonal line. The homoscedasticity assumption is also met as the pattern in Figure 2b shows a random dispersion of residuals around zero, with no discernible pattern or trend.

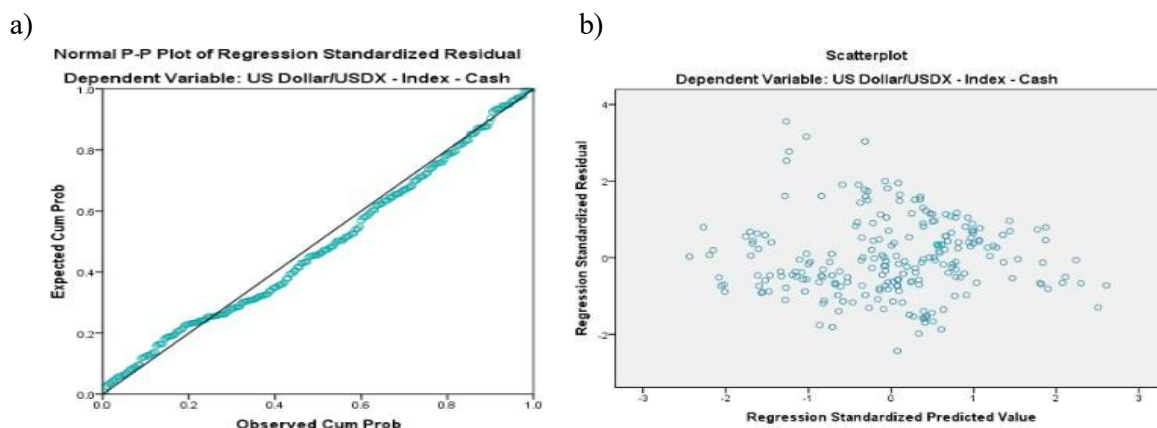


Figure 2: a) Normal P-P Plot of Regression Standardised Residuals b) Scatter Plot of Dependent Variable

For the Durbin-Watson (DW) statistic, if the value of the statistic is between 1.5 and 2.5, it can be assumed that the error terms are independent. The value calculated is 1.531, indicating



that they are independent since it is within the range. Thus, satisfying this assumption. Finally, there is no multicollinearity detected between the independent variables because all the Variance Inflation Factors are less than 10 and the tolerance scores are greater than 0.1. This is present in Table 2.

Table 2: Multicollinearity Test for Independent Variable

| Independent Variable | Collinearity Statistic |       |
|----------------------|------------------------|-------|
|                      | Tolerance              | VIF   |
| Coconut oil price    | 0.475                  | 2.107 |
| Peanut oil price     | 0.301                  | 3.326 |
| Rapeseed oil price   | 0.116                  | 8.619 |
| Sunflower oil price  | 0.114                  | 8.798 |

### ***Model validity checking***

The validity of the model is tested using the F-test regression and is presented using ANOVA in Table 3.

Table 3: ANOVA table result

|            | Sum of Squares | df  | Mean Square | F      | Sig.  |
|------------|----------------|-----|-------------|--------|-------|
| Regression | 6.219.063      | 4   | 1554.766    | 41.307 | 0.000 |
| Residual   | 8431.277       | 224 | 37.640      |        |       |
| Total      | 14650.340      | 228 |             |        |       |

It can be observed that the p-value is less than 0.05, therefore indicating the validity of the model. There is a statistically significant difference between the means of the variable in this model. Meanwhile, the RMSE value is 8431.277, obtained as the lowest value, thus making it a preferable model compared to others. Meanwhile, the R<sup>2</sup> value obtained between the independent and dependent variables is 0.424. This can be described as, 42.4% of the US Dollar Index can be explained by the price of coconut, peanut, rapeseed and sunflower oil, while other factors explain the remaining 57.6%.

The next step is testing the significance of each of the parameters after validating the model. This part is essential because it determines the importance of the independent variables in estimating the dependent variable. All variables are significant at a p-value less than 0.05. This shows that the price of coconut, peanut, rapeseed and sunflower oil is significantly affecting the US Dollar Index. The coefficient of the significant regression variable is given as MLR in Equation (2):

$$\hat{Y} = 243.734 + 0.011CoconutOilPrice + 0.009PeanutOilPrice + 9.484RapeseedOilPrice - 36.029SunflowerOilPrice \quad (2)$$

The coconut, peanut and rapeseed oil prices all have a positive impact on the US Dollar index, with the rapeseed oil having a higher value. This may indicate that it is the primary contributor



to the US Dollar index. Meanwhile, the price of sunflower oil harms the US Dollar index. This suggests that the increase in sunflower oil price may cause a reduction in the US Dollar index, which may be due to the cost adjustments in the market.

## Conclusion

Thus, by using MLR, this study has successfully shown how different types of edible oils can influence the overall market prices. A stronger US Dollar index will cause both coconut oil and rapeseed oil prices to become more expensive, while sunflower oil prices will become cheaper. It can be concluded that global exporters can adjust their strategies based on the US Dollar fluctuations, as a weaker US Dollar might increase their sales. This model can also assist stakeholders or policy makers in predicting the future price movements of edible oil and the US Dollar index.

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