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THE IMPACT OF GLOBAL CRUDE OIL PRICE FLUCTUATIONS ON THE ECONOMY OF SRI LANKA WITH A SPECIAL REFERENCE TO THE TOURISM AND AGRICULTURAL SECTORS

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ABSTRACT: This research paper analyses the relationship between global crude oil price fluctuations and their impact on Sri Lanka's economy, with particular emphasis on the tourism and agriculture sectors. Utilizing secondary data sources from the Central Bank of Sri Lanka (CBSL), the study examines the period from 1984 to 2023 and employs statistical methods to evaluate how changes in oil prices affect these sectors. This reperch paper centres around the objectives of identifying trends and patterns in global crude oil prices, tourism revenue, and agricultural contributions to Gross Domestic Product (GDP), and to assessing the correlation between these variables. As per the findings, oil price volatility has a significant influence on both sectors. It is evident that the tourism sector has shown resilience with a moderate positive correlation with oil prices which can be attributed to Sri Lanka's positioning as a budget-friendly travel destination. Conversely, the agricultural sector shows a negative trend and a strong negative correlation with rising oil prices. This can be understood as the sector's high sensitivity to increased input costs and economic pressures. The autoregressive nature of both sectors, observed through the Autoregressive Integrated Moving Average (ARIMA) model is a clear indication of a dependency of future outcomes on past trends. As per the findings it can be concluded that while the tourism sector displays agility to a greater extent, the agricultural sector is highly affected by increases in oil prices and requires assistance and strategic measures to mitigate adverse impacts. The paper highlights the necessity for continuous efforts and longer-term solutions to address the dual effects of oil price volatility. It is recommended to improve the models by incorporating additional variables into the analysis and incorporating predictive tools. This research paper provides valuable insights for policymakers and industry stakeholders in navigating the economic impacts of crude oil price variability.

Keywords: agricultural sector, ARIMA, crude oil prices, economy, tourism sector

1. INTRODUCTION

Sri Lanka depends on imports to fulfil its domestic crude oil requirements, exposing the economy to fluctuations in the global crude oil market. The agricultural sector, which contributes over 7% to the country's Gross Domestic Product (GDP), is a direct user of crude oil as it heavily relies on oil for inputs and distribution. Similarly, the tourism sector, a key determinant of foreign exchange income, also relies significantly on crude oil inputs and logistics throughout the value chain. Existing research, including studies by Wanigasooriya (2018) and Lanzi (2016) has analysed the impact of oil price fluctuations. However, specific studies focusing on Sri Lanka and these two sectors are limited.

This research paper evaluates data available from 1984 to 2023 to understand the impact of oil price volatility on Sri Lanka's tourism and agriculture sectors. The primary objectives of the research include identifying patterns in oil prices, tourism revenue, and agricultural GDP contributions, analysing correlations between these variables, and employing time series and regression analyses to model their relationships. This paper aims to provide valuable insights on the topic and facilitate informed decision making.

2. METHODOLOGY

The research paper adopted a quantitative research approach to evaluate the impact of global crude oil price fluctuations on Sri Lanka's tourism and agricultural sectors. Statistical methods including time series and regression analysis were used to analyse the observed data spanning almost four decades from 1984 to 2023. This longitudinal data analysis captured long-term trends and fluctuations in oil prices and their effects on the tourism and agricultural sectors

Descriptive Statistics: Descriptive statistics were employed to measure key characteristics of the dataset, including the mean, median, standard deviation, skewness, and kurtosis. Additionally, a trend chart was utilized to visually illustrate the relationships among variables over time, providing a graphical representation of how the variables evolved over the years.

Simple Linear Regression: Simple linear regression was applied to assess the relationship between one dependent and one independent variable, using Ordinary Least Squares (OLS) for parameter estimation. The model assumptions include linearity, no autocorrelation, homoscedasticity, and normality of residuals (Mayel, 2022).

$$Y_t = \beta_0 + \beta_1 X_t + \epsilon_t \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where; Y_t : dependent variable at time X_t : independent variable at time t
β_0 : intercept β_1 : coefficient
ϵ_t : error term or residual at time t

The error term is crucial to the model's assumptions, with the main assumptions being linearity, independence, homoscedasticity, and normality.

Univariate Time Series Analysis: Stationarity was tested using the Augmented Dickey-Fuller test. The Autoregressive Moving Average (ARMA) models were fitted using Box-Jenkins methodology to capture temporal patterns.

a. Stationarity Assessment: The stationarity ensured that the statistical attributes of the information remained stable over time and the tools such as Augmented Dickey Fuller test could be used to determine stationarity (Petchko, 2018).

b. The Box-Jenkins Methodology and the ARMA Model Fitting: This methodology uses a finite number of parameters namely Autoregressive process (AR), Moving Average process (MA) and Autoregressive Moving Average (ARIMA) process. A model that contains both AR and MA parameters is called an "ARMA" model. These models are very efficient in such time series data that is known to be temporal in nature due to the presence of the AR, and MA components (Camporeale, Wing, & Johnson, 2018).

$$Y_t = c + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \cdots + \phi_p Y_{t-p} + \theta_1 e_{t-1} - \theta_2 e_{t-2} + \theta_q e_{t-q} + e_t \ldots\ldots\ldots (2)$$

Y_t : observed value of the time series at time t c : constant

ϕ_1, ϕ_2, ϕ_p : autoregressive coefficients representing the relationship between the current value of the time series and its past p values
$\theta_1, \theta_2, \theta_q$: moving average coefficients representing the relationship between the current value of the time series and the past q error terms

e_t : white noise error term assumed to be normally distributed with mean zero and constant variance

The model adequacy is evaluated through residual diagnostics. Residual autocorrelation was measured by the Ljung-Box Q test (Hee & Ha, 2004), heteroskedasticity was checked using the Lagrange multiplier (LM) test for autoregressive conditional heteroskedasticity (ARCH LM test) (Sjölander, 2011) and normality of residuals was assessed by the Jarque-Bera (JB) statistic (Thadewald & Büning, 2007).

3. RESULTS AND DISCUSSION

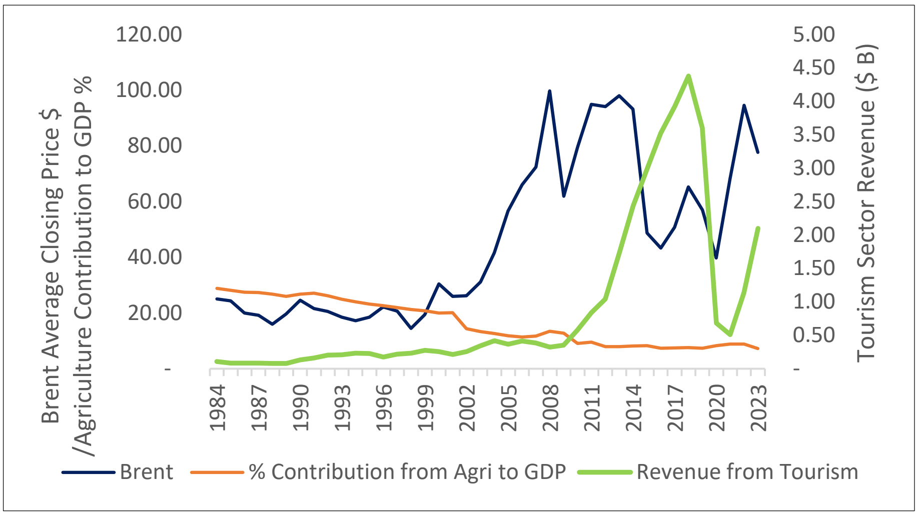

Fig. 1. Trend for Brent, Agriculture contribution and Tourism revenue

Crude oil prices have exhibited a significant upward trend over time with high volatility, influenced by global events. In contrast, the agriculture sector's contribution to GDP has steadily declined, reflecting a shift towards other sectors (see Fig.1). The tourism sector's revenue has been increasing, with fluctuations due to external factors. The correlation analysis reveals a strong negative relationship of -0.8 between crude oil prices and the agriculture sector's GDP contribution, while tourism revenue shows a weaker positive correlation of 0.41 with oil prices.

The regression analysis of the agricultural sector and tourism sector revenue relative to Brent crude oil prices reveals distinct insights. For agriculture, a linear regression model indicates a significant negative relationship with Brent prices, with an R^2 of 63%, though residuals show high autocorrelation (Durbin-Watson = 0.52). In contrast, the tourism sector shows a positive correlation with Brent prices when using natural logarithms, with an R^2 of 51% and significant coefficients (Durbin-Watson = 1.30). Since the model carries weaknesses, including moderate correlation for tourism revenue and autocorrelation of residuals for both agriculture sector's GDP contribution and tourism revenue. To address these limitations, time series analysis is recommended as a more robust approach.

The ARIMA modelling of the agricultural sector's contribution to GDP involves examining various AR and MA models using Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plots. The ARIMA (1,2,2) model was selected as the optimum based on the lowest Akaike's Information Criteria (AIC) and the significant of its AR and MA components. Residual diagnostics indicate that the model's residuals are white noise, normally distributed, and exhibit homoskedasticity. The AR and MA roots are within the unit circle, confirming the model's stationarity and invertibility. The ARIMA (1,2,2) model demonstrates a good fit with an R^2 of 78% and a root mean squared error of 0.7, showing an acceptable performance.

For the tourism sector's revenue data, ACF and PACF plots of the second difference were used to assess potential ARIMA models. The ARIMA (1,2,1) model was identified as optimal due to its lowest AIC and significant AR and MA components. Residual diagnostics confirmed that the residuals are white noise, normally distributed, and homoscedastic. The ARIMA (1,2,1) model's AR and MA roots also lie within the unit circle, ensuring stationarity and invertibility. The model demonstrates reasonable performance with an R^2 of 67% and a root mean squared error of 0.8. Fitted values align well with the actual data, indicating a good model fit (Fig.2 and 3).

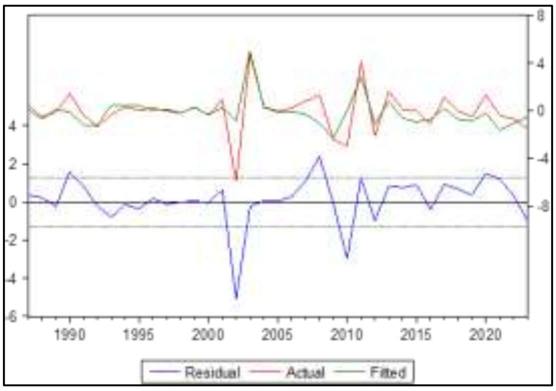

Fig. 2. Actual Vs Fitted model for Agriculture

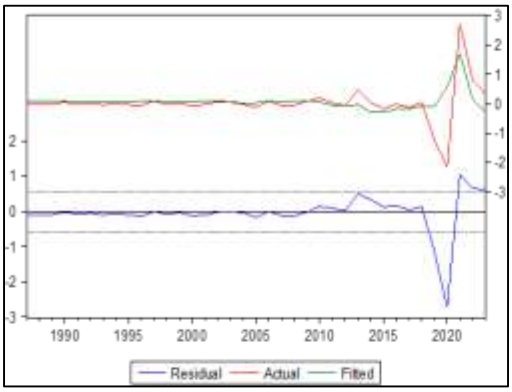

Fig. 3. Actual Vs Fitted model for Tourism

4. CONCLUSION

From 1984 to 2023, the average closing price of crude oil showed a general rising trend, influenced by geopolitical events, technological advancements, and market dynamics. Notable disruptions included the Gulf War, 2008 financial crisis, and the shale oil revolution. During this period, Sri Lanka's agricultural sector's contribution to GDP gradually declined, reflecting its reduced relative importance due to industrialization, urbanization, and international economic shifts. The sector's average contribution was 16.42%, but its revenue was unstable, with a high standard deviation of 7.92%. Conversely, Sri Lankan tourism revenue, with an average of $0.88 billion, showed resilience to crises like the 2006 tsunami, civil war, and COVID-19.

The correlation analysis indicated a strong negative relationship between the agricultural sector's GDP contribution and oil prices (Pearson coefficient of -0.8), while tourism revenue and oil prices had a moderate positive correlation (0.41). OLS regression revealed that increasing oil prices negatively impacted crop yields but positively affected tourism revenue, likely due to Sri Lanka's status as an affordable tourist destination. However, since the OLS regression has limitations including autocorrelation and moderate correlation, adjustments including transforming the variables and considering Generalized Least Squares (GLS) could be looked at.

ARIMA models for both sectors demonstrated the influence of past performance on current results. The agricultural sector's model had high AR (1) and MA (2) coefficients, while the tourism sector's model highlighted significant AR (1) and MA (1) components. The models had R^2 values of 0.78 and 0.67, respectively, indicating their effectiveness in predicting future trends. Overall, the findings underscore the need for strategic planning in the agricultural sector and highlight the stability of the tourism industry amid oil price volatility.

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