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A Study on Oil Price Volatility: A Macroeconomic Perspective

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ABSTRACT

In the realm of international trade and economic analysis, certain commodities hold a position of exceptional prominence due to their value, utility, and global demand. Among these, crude oil stands out not only for its economic significance but also for its symbolic identities - Crude Oil as "Black Gold" This commodity occupies a central place in global economic discourse and financial systems, shaping national policies, investor behaviour, and market sentiment across the world. Their importance is reflected in the vast volume of research, media attention, and policy debates surrounding them. The title of this study, "A study on Oil price volatility: A macroeconomic perspective" reflects a focused academic inquiry into this critical commodity. This methodical approach allows for a structured investigation into the behaviour of crude oil, providing insights that are not only academically valuable but also practically relevant for investors and policymakers. The methodology adopted in this research emphasises simplicity and clarity, focusing on observable patterns and statistical analysis without overcomplicating the interpretive framework. The behaviour of crude oil prices is not solely determined by supply-demand fundamentals or immediate global shocks; it is also significantly influenced by key macroeconomic variables. Among the most critical are the Federal Reserve's interest rate decisions and exchange rate movements, particularly between the US dollar and other currencies such as the Indian Rupee (INR). The study considers the impact of key macroeconomic variables on crude oil prices. The findings indicate that Crude oil prices respond more sensitively to macroeconomic factors such as the Federal Fund rate and Exchange Rate movements.

***Keywords**: Crude Oil, Macroeconomic Variables, Commodity, Volatility, Exchange Rate.*

Introduction

In the realm of international trade and economic analysis, certain commodities hold a position of exceptional prominence due to their value, utility, and global demand. Among these, crude oil stands out not only for its economic significance but also for its symbolic identities. Crude oil is known as "Black Gold". This commodity occupies a central place in global economic discourse and financial systems, shaping national policies, investor behaviour, and market sentiment across the world. Its importance is reflected in the vast volume of research, media attention, and policy debates surrounding it. The title of this study, "A study on Oil price volatility: A macroeconomic perspective" reflects a focused academic inquiry into this critical commodity. "Black gold" signifies the strategic and industrial value of crude oil - a resource that **powers global transportation, fuels industri**es, and plays a pivotal role in shaping the geopolitical landscape. Crude oil is not merely a commodity but a central input for multiple sectors of the global economy. Its supply and demand dynamics can influence inflation, trade balances, and even foreign policy decisions. Understanding the behaviour of crude oil prices is thus critical for economists, investors, and policymakers alike.

This research focuses on crude oil because of its continued relevance in shaping both macroeconomic and microeconomic conditions. Crude oil drives industrial growth and energy consumption. By examining these two commodities together, the study seeks to understand how industrial and financial drivers interact in influencing market behaviour. Such a dual perspective enriches the analysis and allows for a more comprehensive understanding of economic signals.

The study also highlights the distinctive role of crude oil in financial markets. Crude oil is largely an industrial commodity subject to production costs, supply shocks, and geopolitical risks.

The methodology adopted in this research emphasises simplicity and clarity, focusing on observable patterns and statistical analysis without overcomplicating the interpretive framework. This ensures that the results are accessible and interpretable by a wide range of audiences, including economists, finance professionals, and students. By prioritising a transparent analytical approach, the study enhances its utility and relevance.

Crude Oil

Crude oil is a fundamental driver of the global economy, influencing production, transportation, and energy security. Its importance extends beyond its role as an industrial input; it serves as a key indicator of macroeconomic health and geopolitical stability. High oil prices often correlate with periods of strong industrial activity, whereas sharp declines can indicate oversupply or weakening economic growth. The global demand for crude oil is largely shaped by industrial development, urbanisation, and population growth, which makes it an essential commodity for policymakers, investors, and businesses alike. Supply-side factors play a decisive role in crude oil pricing. On the demand side, crude oil consumption reflects broader economic conditions. Industrial output, transportation needs, and seasonal energy requirements drive short-term consumption trends. Economic slowdowns or policy-induced energy transitions can reduce demand, putting downward pressure on prices. Emerging trends, such as the global push towards renewable energy, electric vehicles, and energy efficiency measures, are gradually reshaping demand structures.

The growing participation of financial players has intertwined crude oil markets with global equity, currency, and bond markets, reflecting how financial speculation and physical supply-demand dynamics jointly determine pricing. The Russia-Ukraine conflict highlighted the sensitivity of crude oil to geopolitical events. Sanctions on Russian oil exports constrained supply, causing significant price spikes and increased global volatility.

India’s domestic crude oil market is heavily influenced by global price trends due to high import dependency. Fluctuations in international crude prices directly affect domestic fuel pricing, inflation, and trade balances. The Indian government and refiners respond through pricing mechanisms, subsidies, and strategic reserves management to mitigate economic shocks. Current trends show India diversifying its crude sourcing to reduce dependence on any single region and investing in refining capacities to manage supply efficiently.

Influence of Macroeconomic Variables on Crude Oil Prices

The behaviour of crude oil prices is not solely determined by supply-demand fundamentals or immediate global shocks; it is also significantly influenced by key macroeconomic variables. Among the most critical are the US Consumer Price Index (CPI), the Federal Reserve’s interest rate decisions, and exchange rate movements, particularly between the US dollar and other currencies such as the Indian Rupee (INR). Each of these variables plays a unique role in shaping investor expectations, pricing mechanisms, and global commodity market dynamics.

- **Federal Reserve Interest Rate (Federal Funds Rate)**

The Federal Reserve’s interest rate, commonly referred to as the federal funds rate, is a key tool for regulating liquidity and controlling inflation within the US economy. Changes in this rate have a direct and often immediate impact on global commodity prices. Crude oil prices are influenced by the Federal Reserve’s rate policy as well, albeit indirectly. Interest rate adjustments affect economic growth, consumer spending, and industrial activity, which in turn determine energy demand. When rates rise, borrowing costs increase, consumption slows, and industrial production may contract, reducing the demand for oil and potentially leading to price declines. Lower interest rates, on the other hand, stimulate economic activity, increase energy consumption, and create upward pressure on oil prices. In this way, the Federal Reserve’s policy decisions are a significant macroeconomic determinant of crude oil price movements.

- **Exchange Rate (USD/INR)**

The exchange rate between the US dollar and other major currencies, such as the Indian Rupee (USD/INR), is another pivotal macroeconomic variable influencing commodity prices. Crude oil is globally priced in US dollars, which means that fluctuations in the exchange rate affect both domestic and international demand and pricing. When the USD strengthens relative to the INR, commodities priced in dollars become more expensive for Indian buyers, potentially reducing domestic demand for crude oil. For crude oil, the USD/INR exchange rate affects import costs, government policy considerations, and the pricing of refined products. A weaker domestic currency can increase the local price of oil, fuel inflation and affect consumer behaviour. The interplay between the dollar's strength, domestic currency fluctuations, and commodity demand underscores the importance of exchange rate movements in both global and local market dynamics.

Literature Review

- **Alquist, R., & Gervais, O. (2011)** in "*The Role of Financial Speculation in Driving the Price of Crude Oil The Role of Financial Speculation in Driving the Price of Crude Oil*." Have mentioned that over the past 10 years, financial firms have increased the size of their positions in the oil futures market. At the same time, oil prices have increased dramatically. The conjunction of these developments has led some observers to argue that financial speculation caused the run-up in oil prices. Yet several arguments cast doubt on the validity of this claim. First, although the stock of open futures contracts is many times larger than the flow of oil consumption in the United States, comparing these two statistics is misleading. Second, empirical analysis shows that changes in financial firms' positions do not predict oil-price changes, but that oil-price changes predict changes in positions. Third, the evidence indicates that financial firms' positions did not cause the market to expect persistent price increases during 2007/08. Other explanations for the increase in oil prices include macroeconomic fundamentals, such as interest rates and increased demand from emerging Asia.
- **Khan, K., Su, C., Umar, M., & Yue, X. (2021)** in the article "*Do crude oil price bubbles occur",*they opined that theGeneralised Supremum Augmented Dickey-Fuller (GSADF) test is employed to conclude whether crude oil price (OP) experiences multiple bubbles. The technique has distinctions to detect multiple bubbles along with its beginning and ending point. Oil is extremely significant due to its strategic position and several factors influence OP. The outcomes display the existence of bubbles, which imply that OP deviates three times. This indicates the beginning and termination of bubbles coincide with a particular crisis. The expansion of the world economy, the mismatch between demand and supply of oil, dollar depreciation, excess supply by the Organisation of the Petroleum Exporting Countries, shale oil production of the U.S., and low demand by the emerging economies are the leading factors of OP bubbles.
- **Jang, P. Y., &Beruvides, M. G. (2020).** In the article "*Time-Varying Influences of Oil-Producing Countries on Global Oil Price*" aims to investigate the time-varying influences of major crude oil-producing countries on Brent oil prices, with seven-panel data over the observation years of 1998 to 2018. I believe that this research contributes to the body of knowledge in better understanding the relative impacts of major oil-producing countries. Results show empirical evidences that the Organization of the Petroleum Exporting Countries (OPEC) production stayed as the greatest negative influence on the oil price in the periods of Panel 2 (2001–2003) and Panel 7 (2016–2018) only, while the U.S. Dollar Index took over the OPEC's influencing role in most of the other periods, followed by Iran, the U.S., and China.
- **Bâra, A., Georgescu, I. A., & Cristescu, M. P. (2024)**. In their paper, "*Exploring the Dynamics of Brent Crude Oil, S&P500 and Bitcoin Prices Amid Economic Instability"* mainly investigate three variables from the price volatility point of view: Brent crude oil, S&P500 and Bitcoin (BTCUSD), aiming to underline the impact of price volatility. Brent crude oil accounts for two-thirds of the oil market. Its price volatility has a significant impact on environmental, transportation, mobility, economic and social aspects that affect sustainability. This paper conducts an extensive examination of the forecasting capabilities of various GARCH (Generalised Autoregressive Conditional Heteroskedasticity) models, identifying the most suitable GARCH model for estimating Value at Risk (VaR) for Brent crude oil price. Moreover, understanding the risks associated with oil aids in long-term strategic planning.

- **Berument, H., & Tasc, H. (2002).** In the paper titled "*Inflationary effect of crude oil prices in Turkey*." Have acknowledged that changes in oil prices affect economic welfare in ways that are not entirely reflected in transactions in the oil market. In this article, by using the 1990 input–output table, the inflationary effects of crude oil prices are investigated for Turkey. Under fixed nominal wages, profits, interest and rent earnings, the effect of increasing prices of oil on inflation is limited. However, when wages and the other three factors of income (profit, interest and rent) are adjusted to the general price level that includes the oil price increases, the inflationary effect of oil prices becomes significant. Hence, indexation could have very severe effects on an economy when oil prices increase and, in some cases, could even lead to hyperinflation.
- **Santis, D., Roberto, A., Paper, K. W., Weg, D., & Kiel, D.-. (2000)**. In their paper titled "*Crude Oil Price Fluctuations and Saudi Arabian Behaviour",* seek to explain why crude oil prices fluctuate, the main cause being the quota regime, which characterises the OPEC agreements. Given that the Saudi oil supply is inelastic in the short term, a shock in the oil market is accommodated by an immediate price change. In contrast, a dominant firm behaviour in the long term causes an output change, which is accompanied by a smaller price change. This explains why oil prices overshoot. The results of a general equilibrium model applied to Saudi Arabia support this analysis. They also indicate that Saudi Arabia does not have any incentive in altering the crude oil market equilibrium with either positive or negative supply shocks; and that its behaviour is asymmetric in the presence of world demand shocks, having an incentive (disincentive) in intervening if a negative (positive) demand shock hits the crude oil market. A tax cut would worsen the situation, whereas policies that can increase the price elasticity of demand seem to be very effective.

Objectives of the Study

- To evaluate the pattern of crude oil price movements.
- To analyse the impact of key macroeconomic variables on fluctuations in crude oil prices.

Hypothesis to be Tested

Hypothesis 1: Unit root test for Stationarity of WTI Crude Oil ROC

H_0: WTI CRUDE OIL ROC has a unit root (It is non-stationary).

H_1: WTI CRUDE OIL ROC does not have a unit root (It is stationary).

Hypothesis 2: Impact of EXCHANGE RATE (USD/INR) ROC on WTI CRUDE OIL ROC

H_0: Exchange Rate ROC does not have a significant impact on WTI Crude Oil ROC.

H_1: Exchange Rate ROC has a significant impact on WTI Crude Oil ROC.

Hypothesis 3: Impact of FEDERAL FUNDS RATE ROC on WTI CRUDE OIL ROC:

H_0: Federal Funds Rate ROC does not have a significant impact on WTI Crude Oil ROC.

H_1: Federal Funds Rate ROC has a significant impact on WTI Crude Oil ROC.

Methodology

Scope of the Study

The study investigates how key macroeconomic variables influence their fluctuations. It analyses both short-term and long-term dynamics, including market interdependence, spillover effects, and volatility transmission. The research also examines the response of these markets to global events, providing valuable insights for investors, policymakers, and researchers on price behaviour and market interactions. The analysis is conducted using monthly data from January 2015 to December 2024.

All secondary data were obtained from reliable online sources, including financial websites and official economic databases. The variables considered include crude oil prices (WTI, quoted in U.S. dollars per barrel), exchange rates (quoted as USD/INR), and the Federal Funds Rate (reported in percentage) covering the period from January 2015 to December 2024.

The data for this study have been collected from the following websites, which provide reliable and authentic information on commodity prices and global market trends:

- Investing.com
- World Bank (Commodity Markets & Pink Sheet Data)
- Federal Reserve Economic Data (FRED)

In addition to collecting raw price data from these sources, the Rate of Change (ROC) was calculated in percentage (%) terms to capture the monthly fluctuations in crude oil and other selected macroeconomic variables. By standardising the measurement in percentages, the study ensures consistency and clarity in interpreting both short-term movements and long-term dynamics. Descriptive statistics is the methodology used.

Tools Used

- Descriptive Statistics
- Unit Root Test
- Regression Analysis

Limitations of the Study

- Analysis is restricted to monthly crude oil prices, which may not capture intra-month fluctuations or very short-term market dynamics.
- The impact of unobserved global events or unforeseen shocks beyond the study period may not be fully captured.
- The study focuses on selected macro variables, so other potentially influential factors might not have been included.
- Findings are historical in nature and may not fully predict future market behaviour under different conditions.

Table 1: Showing the Descriptive Statistics of Monthly WTI Crude Oil Prices ($/BBL)

Crude oil WTI($/troy oz)	
N	120
Mean	62.0
Median	59.5
Standard deviation	18.1
Variance	326
Range	98.1
Minimum	16.5
Maximum	115

Interpretation

WTI crude oil prices during the period January 2015 to December 2024 show a monthly average of $62.0 and a median of $59.5, indicating a fairly symmetric distribution. The standard deviation of 18.1 and range of 98.1 reflect high variability in prices, ranging from $16.5 to $115.

Unit Root Test for Stationarity of WTI Crude Oil Rate of Change (WTI Crude Oil ROC)

Hypothesis 1

- **Null Hypothesis (H_0):** WTI CRUDE OIL ROC has a unit root (It is non-stationary).
- **Alternative Hypothesis (H_1):** WTI CRUDE OIL ROC does not have a unit root (It is stationary).

Table 2: Showing the Unit Root Test Results for WTI Crude Oil ROC

Test	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	P-Value	Stationary
Augmented Dickey-Fuller (ADF)	-8.8222	-3.4870	-2.8863	-2.5800	0.0000	Yes
Phillips-Perron (PP)	-10.1661	-3.4866	-2.8861	-2.5799	0.0000	Yes

Interpretation

The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were used to check if the crude oil rate of change is stationary over the period January 2015 to December 2024. In both tests, the statistics were more negative than the 1% critical value and the p-values were below 0.05, leading to rejection of the null hypothesis of a unit root. Such stationarity is essential for ensuring that relationships identified in time series models are reliable, making the crude oil rate of change suitable for further econometric analysis.

Impact of Exchange Rate (USD/INR) ROC on WTI Crude Oil ROC

Hypothesis 2

- **Null Hypothesis (H_0):** Exchange Rate ROC does not have a significant impact on WTI Crude Oil ROC.
- **Alternative Hypothesis (H_1):** Exchange Rate ROC has a significant impact on WTI Crude Oil ROC.

Table 3: Showing the Regression Results of Exchange Rate (USD/Inr) ROC on WTI Crude Oil ROc

Regression Statistics

Statistic	Value
R Square	0.056237
Adjusted R Square	0.048171
Observations	120
F-statistic	6.971789
Prob (F-statistic)	0.009410
S.E. of regression	11.91681
Durbin-Watson stat	1.670226

Coefficients

Variable	Coefficient	Std. Error	t-Statistic	P-value
Intercept (C)	1.720434	1.120918	1.534844	0.1275
Exchange Rate ROC	-2.453879	0.929354	-2.640414	0.0094

Interpretation

The regression results show a negative coefficient (-2.453879) for Exchange Rate ROC, implying an inverse relationship with Crude Oil ROC. The effect is statistically significant ($p = 0.0094$). The explanatory power of the model is low ($R^2 = 0.0562$), indicating that Exchange Rate ROC explains approximately 5.6% of the variation in Crude Oil ROC. Based on the data from January 2015 to December 2024, the regression results show that Exchange Rate ROC has a statistically significant negative impact on WTI Crude Oil ROC ($p = 0.0094$, $R^2 = 0.0562$); therefore, the null hypothesis (H_0) is rejected.

Impact of Federal Funds Rate ROC on WTI Crude Oil ROC

Hypothesis 3

- **Null Hypothesis (H_0):** Federal Funds Rate ROC does not have a significant impact on WTI Crude Oil ROC.
- **Alternative Hypothesis (H_1):** Federal Funds Rate ROC has a significant impact on WTI Crude Oil ROC.

Table 4: Showing the Regression Results of Federal Funds Rate ROC on WTI Crude Oil ROC

Regression Statistics

Statistic	Value
R Square	0.0575
Adjusted R Square	0.0494
Observations	120
F-statistic	7.1379
Prob (F-statistic)	0.0086
S.E. of regression	11.9088
Durbin-Watson stat	1.5693

Coefficients

Variable	Coefficient	Std. Error	t-Statistic	P-value
Intercept (C)	0.306383	1.127273	0.271791	0.7863
Federal Funds ROC	0.111825	0.041856	2.671689	0.0086

Interpretation

The regression results indicate a positive coefficient (0.111825) for Federal Funds Rate ROC, suggesting that an increase in Federal Funds Rate ROC is associated with a slight increase in Crude Oil ROC. This relationship is statistically significant ($p = 0.0086$). The model's explanatory power is low ($R^2 = 0.0575$), meaning that Federal Funds Rate ROC accounts for approximately 5.75% of the variation in Crude Oil ROC. Based on the data from January 2015 to December 2024, the regression results show that Federal Funds Rate ROC has a statistically significant positive impact on WTI Crude Oil ROC; therefore, the null hypothesis (H_0) is rejected.

Conclusion

Crude oil prices respond more sensitively to external shocks and macroeconomic factors such as Exchange Rate movements and the federal fund rate.

Overall, crude oil remains primarily self-driven in the short term, with minimal cross-market effects, but global events and macroeconomic conditions can influence its longer-term dynamics.

Recommendations

- Crude oil traders should monitor macro indicators closely for short-term forecasting.
- Portfolio diversification across commodities like crude oil can reduce investment risk.
- Policymakers can use these insights to anticipate market responses to economic events.

References

Journals

1. Dr Dileep S. (2023). Testing the Impact of Gold & Crude Oil on Stock Market in India. *International Journal of All Research Education and Scientific Methods*, *11*(08), 1554–1563. https://doi.org/10.56025/ijaresm.2023.118231563
2. Huseynli, N. (2023). Analysing the Relationship between Oil Prices and Gold Prices before and after COVID-19. *International Journal of Energy Economics and Policy*, *13*(2), 373–378. https://doi.org/10.32479/ijeep.13820
3. Dhanabhakyam, M. (2018). a Study on Impact of Crude Oil Price in the Price of Gold. *International Journal of Current Research in Multidisciplinary (IJCRM)*, *3*(7), 30–35.
4. Rastogi, S., Kanoujiya, J., & Doifode, A. (2023). Volatility integration of crude oil, gold, and interest rates on the exchange rate: DCC GARCH and BEKK GARCH applications. *Cogent Business and Management*, *11*(1). https://doi.org/10.1080/23311975.2023.2289700
5. Alquist, R., & Gervais, O. (2011). *The Role of Financial Speculation in Driving the Price of Crude Oil The Role of Financial Speculation in Driving the Price of Crude Oil*.
6. Khan, K., Su, C., Umar, M., & Yue, X. (2021). *Do crude oil price bubbles occur ? ☆*. *71*(November 2020).
7. Jang, P. Y., &Beruvides, M. G. (2020). *Time-Varying Influences of Oil-Producing Countries on Global Oil Price*.
8. Bâra, A., Georgescu, I. A., & Cristescu, M. P. (2024). *Exploring the Dynamics of Brent Crude Oil, S&P500 and Bitcoin Prices Amid Economic Instability*. *12*(March).
9. Berument, H., & Tasc, H. (2002). *Inflationary effect of crude oil prices in Turkey*. *316*, 568–580.
10. Santis, D., Roberto, A., Paper, K. W., Weg, D., & Kiel, D.-. (2000). *Crude Oil Price Fluctuations and Saudi Arabian Behaviour, Kiel Institute of World Economics*. *1014*.
11. Hussain, Z. (2023). *Global dynamics: Exploring the nexus between crude oil, gold, and equity market* [eBook].
12. Tamvakis, M. (2020). *Commodity trade and finance* (3rd ed.) [eBook]

Websites

13. https://www.investing.com
14. https://www.worldbank.org/en/research/commodity-markets
15. https://fred.stlouisfed.org
16. https://www.eia.gov/petroleum
17. https://slshetdiamondhouse.

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