

Effect of Crude Oil and Exchange Rate Volatility on Nifty 50 during Crisis Period: Evidence from India

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(Received February 24, 2021; Accepted March 10, 2021)

ABSTRACT

*The uncertainty in financial markets influence the market participants to reallocate their capital among stock, commodities (crude oil) and Forex (dollar) market. Understanding of stock market during major crisis of crude oil, Exchange rate would help the market participants. **Purpose:** The study aims to investigate the behaviour of Indian stock market during the crude oil and currency (USD/INR) crisis periods. The work extensively covers daily returns of Crude oil, USD/INR rate and Nifty50 during time frame of the crisis period. **Methodology:** The study employed Garch (1, 1) and E-Garch models to analyse the effect of volatility of crude oil and USD/INR Exchange rates returns on Nifty 50 during major crude oil and exchange rates crisis period. **Findings:** GARCH (1, 1) model confirmed the volatility of USD/INR rates during 2013 exchange rate depreciation crisis and its influence on nifty50. Further, it's found no influence of US Fed Reserve hike crisis on nifty50. During both the crude oil crisis it is confirmed the influence of crude oil returns volatility on nifty 50. The study examined the leverage effect by using E-Garch model. Overall, the study found that the presence of leverage effect only during 2010s Oil Glut crisis. The result signals that any negative shocks will increase the volatility of Nifty 50 more than positive shocks during Oil Glut crisis. **Implications:** The study implies that any raise in crude oil and USD/INR rates can greatly influence the volatility in Indian stock market. **Originality:** In majority of studies reported on one single crisis and for only one time period was examined using different tools for analysis. This paper covers all the crisis of crude oil and USD/INR rates within time frame of 2010 to 2020 which was undiscovered area of research in India.*

Keywords: Volatility, Crude oil, USD/INR, Nifty 50, GARCH (1, 1) and Leverage effect.

INTRODUCTION:

The stock market is a very important capital market segment in the economy. The size and structure of any stock market represent a high portion of the gross domestic product (GDP). Prices of stock shares can change in any time since the stock market responses to the demand and supply of stocks and to external factors such as economic policies, information, commodity prices, events, risk, and speculation. The prediction of stock market returns and volatility considered as the principal role for investors. There are numerous economic factors which influence the exchange rate and crude oil during the crisis period. This paper tries to analyse the volatility and how Indian stock market performs during the crisis period. Oil crisis, an abrupt rise in the cost of oil that is frequently joined by diminished supply. Since oil gives the fundamental source of energy for advanced industrial economies, an oil emergency can imperil economic and political strength all through the global economy. The importance of oil as a world fuel source is hard to overdramatize. The development in energy production during the 20th century was remarkable, and

expanding oil production has been by a wide margin the significant contributor to that development. Starting in June 2014, the nominal Brent price of crude oil started a quick decay, falling from \$112 in June to \$62 in December, a 6-month decrease of 44%. The value kept on falling in 2015 and 2016, arriving at a low of \$31 in January 2016, an aggregate reduction of over 70%. West charges halfway value a US based crude oil price expressed by world bank.org. In 2020 the worldwide oil market experienced a phenomenal time of disturbance. Oil costs dropped to a 17-year low as the questions looming over the Saudi-Russia supply deal continue to linger on, and the Covid continues to emphatically hit total demand due to the rigid regulation measures. Theory proposed by Hotelling (1931) can be connected especially to the relationship between oil price and securities exchange. In the theory they recommended that proprietors of non-renewable resources will only produce that resources if it will yield more value than others financial instruments available in the market. The drivers behind a long history of price variations-including the decline of oil price is well summarized by Banumesiter and Killan (2016).

Exchange rate, like any commodity, is determined by its demand and supply in the international market. At the point when the supply of a currency builds, its value will fall. The contrary remains constant when demand for currency increments. Exchange rate of an economy is influenced by a variety of elements prevailing at a given time. Probably the main components influencing currency price by and large incorporate interest rates, global exchange, inflation, and political steadiness and so on the higher the instability in exchange rate, higher will be trouble in settling on investment and international business decisions which shows a higher exchange rate risk. On August 28th 2013 when rupee shut to 68.80 against dollar, the dread of Indian economy getting back to 1991 situation was discussed.

Crude oil, one of the incredibly important fuel is a price determinant for various commodities in the present scenario. The world banks states that, Crude oil prices during crisis period of 2014-2016, 70% price declined. It is the 3rd biggest declines since World War 2. The RBI states that 2013 exchange rate volatility on fears of tightening of quantitative facilitating by the US fed took care of and Excess exchange rate volatility forces real expenses on the economy through its consequences for global trade and Investment and also complicate conduct of monetary policy. So, understanding of Crude oil prices and Exchange rates during major crisis period play an important role in formulating investment decisions for investors and it also helps the investor to diversify their portfolio so that investors can take better decisions.

REVIEW OF LITERATURE:

Albulescu (2020) the study aims to explore the effect of Covid-19 numbers on Crude oil prices, while controlling for the effect of monetary volatility and the United States economies policy uncertainty. The were found using Autoregressive Distributed Lag models that Coronavirus daily reported instances of new diseases contrarily affect the crude oil prices over the long run. Zhang (2013) infers that despite the fact that there is a steady connection between the prices of crude oil and the estimation of the US dollar in real terms, the relationship is dependent upon underlying breaks over the long run. R.K. Jana (2020) the paper explores the time-fluctuating connections between gold and oil markets to assess whether gold is a position of place of safe resource for worldwide crude oil market during the COVID-19 period. The outcomes got with the assistance of DCC-GARCH model and it recommend that gold is a place of safe resource for worldwide crude oil markets and furthermore portfolio risk is limited when investor include oil and gold for their portfolio. Trivedi and Apte (2016) the paper utilizes GARCH structure to study how intervention impact exchange rate volatility. The outcomes show that intervention in the spot market expands volatility while that in the forward market decreases volatility. Jishuang and Yongxiu (2020) the study aims to investigate the nonlinear relationship between gold and the dollar using threshold vector correction model (VECM). From the study found that that short run positive correlation among's gold and the dollar under extraordinary market situations and furthermore supporting property of gold is affected by the gold-dollar threshold measure. Alharaib (2018) from the examination found that there is relationship between securities exchanges and oil price changes in most chose nations and regions and market risk was high for most chose nations before the financial crisis and low after the financial crisis. Prest (2018) In this study the author propose an variety of diagnostics to evaluate how predictable this attribution is with the information to find that the information are comprehensively conflicting with the cases that acknowledge the shale revolution for the decrease in oil costs and find that the information are more predictable with a "demand side" of weakening worldwide economic conditions. Grigoli & Herman (2017) from the study found that countries with more macroeconomic methodology space (monetary and cash related) persevered through the stock

better, recommending either that these countries had the choice to participate in counter-repeating approaches, or strong fundamentals certainty, buffering the impact on utilization and investment and stock's effect was lower in nations with more satisfactory reserve buffers, proposing they added to soften the greatness of the stock's effect. [Dev1 & Chaubey \(2016\)](#) from the study found that in April, 2016 that China has outperformed the United States as the world's biggest oil importer and China's decreased crude development craving, principal shifts in Chinese currency and home-grown consumption techniques highlight long term development in Chinese hydrocarbon utilization for the most part. [White \(2018\)](#) the study investigates the effect of communications by the Federal Reserve on financial market returns when the financial crisis. From that study found that statistically significant coefficients for specific positive and negative tone types than there were before the crisis, which indicates that communication plays a more pronounced role during and after the financial crisis. [Partalidou and Sariannidis \(2016\)](#) in study inspects the effect of monetary and financial factors on the industrial DJIA utilizing daily data sample period March 1995-May 2014. The Results of the model GJR demonstrated that the purchase of gold, of decade bonds and the US Dollar/Yen exchange rate affect, negatively, the returns of DJIA. [Balwinder and Kriti \(2016\)](#) the study shows that crude oil, gold, and crude oil futures altogether affect stock exchange instability in India. [Awartani & Tziogkidis \(2017\)](#) this research examined on volatility overflows and cross – hedging between gold, oil and equities: Evidence from Gulf cooperation Council Countries. DCC-GARCH model is utilized to estimate the dynamics correlations and hedge ratios. The study results shows that significant spill overs from oil to equities, featuring the substantial dependence of the neighbourhood economies on oil. [Ingalhalli \(2016\)](#) the study aims to underscore that impact of one market on another market is certainly not another thing, yet the varieties in the level of effect and co-developments between the markets should be inspected. [Bouri & Jalkh \(2019\)](#) in the study consider single and combination copulas to more readily represent the dependence between the Paris of variable under study. The results show that both crude oil and gold are weak safe-haven assets for clean energy indices. [Khaled Guesmi et al \(2016\)](#) This study distinguished strong proof of fragmentary co-integration among oil and financial exchange indices, the outcomes proposing the presence of a connection that governs their long-run joint movements. [Adugh kuhe \(2019\)](#) the study examined on the Dynamic connection between crude oil price and stock market Price volatility in Nigeria: A co-integrated VAR-GARCH Model. Study utilizes Granger causality test and standard GARCH model. The examination results shows that variables are integrated of order, no long run stable relationship was found to exist between crude oil price and securities exchange price in Nigeria. [Nautiyal \(2020\)](#) study examined on Dynamic co-developments across forex, gold, crude oil and Indian equity market. The study uses ARDL- Unrestricted error correction model. The results shows that equity indicates are co-integrated and has a relationship for a since a long run with gold and Currency Exchange. The above literature review look into the effect of Crude oil, USD/INR on Stock market. In majority of studies one single crisis and for only one time period was examined using different tools for analysis. This paper covers all the crisis of crude oil and USD/INR rates within time frame of 2010 to 2020 which was undiscovered area of research in India. This gap truly urged to do a study on behaviour of Indian Stock market during crisis period of crude oil and USD/INR and to examine the leverage effect.

OBJECTIVES OF THE STUDY:

- To analyse the effect of volatility of crude oil return on nifty 50 during major crude oil crisis period.
- To assess the effect of USD/INR Exchange rate volatility on nifty 50 during major currency crisis period.

RESEARCH METHODOLOGY:

The research is experimental in nature and the samples were gathered on a judgmental basis. The Quantitative research type has been done. The variables choose for the study are Crude oil, Exchange Rate, Nifty50. In that Crude oil, Exchange Rate are independent variable and Nifty50 is dependent variable. The daily price observations of the samples viz. Nifty50, Crude oil and USD/INR were collected. The study period is fixed based on crisis period which major impact.

For data assortment different sources were relied. The historical daily closing price on Nifty50 got from www.nseindia.com. The day by day price observation of crude oil were obtained from Multi Commodity Exchange of India Ltd. (www.mcxindia.com). The USD/INR rate is collected from the Reserve Bank of India website (www.rbi.org.in).

Hypothesis:

H₀: There is no significant impact of Major crisis of crude oil and exchange rate volatility on Nifty50.

H₁: There is significant impact of Major crisis of crude oil and exchange rate volatility on Nifty50.

Initially log returns of the sample data was registered in Microsoft excel by utilizing the following equation;

$$R = \ln (P1/ P0)*100 \tag{1}$$

In the above condition 1 R means return, P1 addresses current day's price and P0 addresses price of the previous day. Through Ln we assume that the returns are log normally distributed.. In order to test the presence of unit root the well-established measures like Augmented Dickey Fuller Test. To order the satisfy objective at examining crude Oil and USD/INR impact on NIFTY50; further GARCH (1, 1) and EGARCH Modelling were utilized.

Table 1: Variables Explanations

| Time Period | Variable Name | Crisis Name | Cause of Crisis | Impact of Crisis on Stock Market |
|--|---------------|--|---|---|
| August, 4 th 2014 – May, 27 th 2016 | Crude Oil | 2010s Oil glut | Oversupply as US and Canadian shale oil creation arrived at basic volumes. | The world price of oil was above US\$125 per barrel in 2012, and remained commonly strong above \$100 until September 2014, after which it entered a sharp dropping bending, falling underneath \$30 by January 2016. |
| 2020, 1 st March – 2020, 30 st June | Crude Oil | 2020 Russia-Saudi Arabia Oil Price War | Saudi Arabia because of Russia's refusal to lessen oil production to save price for oil at moderate level. | Stock exchanges worldwide revealed significant misfortunes thanks partially to a mix of price war and the Russian ruble fell 7% to a 4-year low against the U.S. dollar. |
| 2013, 1 st February – 2013,30 th September | USD/INR | 2013 Depreciation | Record high current account deficit and policymakers have consistently struggled to come up with measures that can convince markets they can stabilize the currency | Capital outflows by FIIs pulling out the debt (obligation) and equity markets and demand for dollars by the corporates. |
| 2017,1 st March – 2017, 31 st December | USD/INR | US Fed Reserve Hike | Three further increases in rates because of raising the cost of borrowing. | Rising interest rates will further strengthen the dollar and thereby may put further pressure on Indian rupee and on Stock market. |

Augmented Dickey Fuller (ADF) Test:

Testing unit root has become a concern for econometric exhibiting and estimating. This examination followed the statistical model suggested by Dickey and Fuller (1979, 1981) and by Dickey (1984) for checking stationary of the time series data. The test is typically done with the understanding that "the time series data isn't stationary". In the event that the test statistics is discovered to be with in critical value the possibility for rejection of null hypotheses is higher. .

$$\Delta y_t = \alpha + \beta y_t + \gamma y_{t-1} + \dots + \delta_{p-1} \Delta y_{t-p+1} + \varepsilon_t \tag{2}$$

In equation 2 Where Y_t addresses time arrangement to be tried, α is a constant, β the coefficient on a time period pattern and p the lag order of the autoregressive cycle and ε_t is the white noise term. Forcing the objectives $\alpha = 0$ and $\beta = 0$ identifies with modelling a random walk and using the constraint $\beta = 0$ contrasts to showing a random walk and a drift.

GARCH Model – It is the extension Arch Model to check the randomly shifting volatility effect GARCH (1,1) - first number intends to the number of autoregressive lags, or ARCH terms, second number refers to the numbers of moving typical lags are indicated or Garch term.

$$\sigma_t^2 = \alpha_0 + \omega(L) \varepsilon_{t-1}^2 + \omega(L) \sigma_{t-1}^2 \tag{3}$$

In equation 3 Where $\omega(L)$ and $\omega(L)$ represent polynomial lags, L is the lag operator. Since σ_t^2 is the one-time frame ahead forecast change dependent on past data, it is known as the contingent variance.

The contingent variance condition indicated is an element of three terms viz. a consistent term: $\omega(L)$ news about volatility from the past period, estimated as the lag of the squared residual from the mean equation: ε_{t-1}^2 (the ARCH expression). Furthermore, last period's forecast variance: σ_{t-1}^2 (the GARCH expression).

E-GARCH Model:

This models are suitable when positive and negative shocks of equivalent magnitude but it might not contribute equally to volatility. EGARCH models give a explanation to the leverage effect. It means unexpected price drop increases volatility more than a Comparable unexpected price increase.

$$\ln(\sigma_t^2) = \alpha_0 + \beta \ln(\sigma_{t-1}^2) + \gamma \frac{u_{t-1}}{\sqrt{\sigma_{t-1}^2}} + \alpha \left[\frac{|u_{t-1}|}{\sigma_{t-1}^2} - \sqrt{\frac{2}{\pi}} \right] \tag{4}$$

Explanation of the variables utilized in equation 4 α_0 is the intercept for the difference and β is the coefficient for the logged GARCH term. $\ln(\sigma_t^2)$ is the logged GARCH term, γ is the size of the asymmetric volatility, $\gamma \frac{u_{t-1}}{\sqrt{\sigma_{t-1}^2}}$ is the last time frame's shock which is standardized.

$\left[\frac{|u_{t-1}|}{\sigma_{t-1}^2} - \sqrt{\frac{2}{\pi}} \right]$ is the parameter that considers the total estimation of last period's volatility stock it replaces the regular Arch term.

The E-Garch Model captures the asymmetric volatility through the variable gamma (γ). The indication of the gamma decides the size of the asymmetric volatility and if $\gamma = 0$, for example no asymmetric volatility and $\gamma < 0$ negative stocks will increase the volatility more than positive stocks. $\gamma > 0$ positive stocks increment the volatility more than negative stocks.

DATA ANALYSIS AND RESULTS:

Table 2 & 3 below exhibits the descriptive statistics regarding time series data of Crude Oil, USD/INR and nifty50 during crisis period on its daily returns, standard deviation, skewness, Kurtosis, Jarque-Bera test results with its significance.

Table 2: Descriptive statistics

| Statistics | Crude Oil 2014 – 2016 | Crude Oil 2020 | USD/INR 2013 | USD/INR 2017 |
|------------|-----------------------|----------------|--------------|--------------|
| Mean | -0.0009 | 12.9641 | 0.0008 | -0.0001 |
| Median | -0.0022 | 0.0041 | 0.0009 | -0.0001 |
| Maximum | 0.1478 | 1.3530 | 0.0394 | 0.0099 |
| Minimum | -0.0690 | -0.9993 | -0.0271 | -0.0101 |

| Statistics | Crude Oil 2014 – 2016 | Crude Oil 2020 | USD/INR 2013 | USD/INR 2017 |
|-------------|-----------------------|----------------|--------------|--------------|
| Std. Dev. | 0.0262 | 1.3099 | 0.0084 | 0.0027 |
| Skewness | 0.8105 | 9.9503 | 0.5096 | -0.2353 |
| Kurtosis | 5.6033 | 100.0097 | 6.0583 | 4.9213 |
| Jarque-Bera | 185.7565 | 41679.41 | 82.707 | 31.14282 |
| Probability | 0.0000 | 0.0000 | 0.0000 | 0.0000 |

Table 3: Descriptive statistics

| Statistics | Nifty50 2014 - 2016 | Nifty50 2020 | Nifty50 2013 | Nifty50 2017 |
|-------------|---------------------|--------------|--------------|--------------|
| Mean | 0.00018 | 0.0005 | 0.0001 | 0.0006 |
| Median | 0.0002 | 0.0033 | 0.0003 | 0.0006 |
| Maximum | 0.0336 | 0.0876 | 0.0380 | 0.0170 |
| Minimum | -0.0591 | -0.1298 | -0.0408 | -0.0155 |
| Std. Dev. | 0.0099 | 0.0288 | 0.0121 | 0.0057 |
| Skewness | -0.5750 | -1.0743 | -0.0828 | -0.1070 |
| kurtosis | 5.8585 | 7.6380 | 4.2455 | 3.0854 |
| Jarque-Bera | 175.6316 | 107.7826 | 12.564 | 0.4340 |
| Probability | 0.0000 | 0.0000 | 0.0018 | 0.8049 |

If we observe the mean scores in the above Tables 3 it is clear that nifty has generated the maximum average daily return of 0.000184, 0.000572, 0.000196, 0.000682 with standard deviation of 0.009979, 0.028836, 0.012135, 0.005722 and 1.309972. if we see in Table 2 among Crude oil and USD/INR factors Crude oil alone provided a positive average return of 12.96417 during 2020 Russia-Saudi Arabia Oil Price War crisis. If we see negative mean scores of -0.000918 percent and -0.000195 percent reported respectively for USD/INR and crude oil during 2010S OIL GLUT and US Fed Reserve Hike Crisis 2017 accordingly. During the study period crude oil returns during 2020 Russia – Saudi Arabia oil Price War crisis exhibited the greater variability with the highest standard deviation of 1.309972 percent. The return series for USD/INR reported to have a negative skewness -0.235328 and Nifty50 negative skewness of -0.575004, -1.074399, -0.082858, -0.107053 suggesting that these distributions have since a long left tail.

To examine the stationary of the time series distributions, Augmented Dickey Fuller (ADF) Test was employed. The test was carried on the assumption that the return series data information is regularly distributed. Underneath charts gives clear proof that the probability values got for all return series in Augmented Dickey Fuller (ADF) Test is Statistically Significant at 5 percentage level of Significant (p - values 0.00 <0.05). This is a tendency towards volatility clustering.

Tables 4: ADF Stationery Check

| Variables – Returns series | t-Statistic | Prob. Value |
|----------------------------|-------------|-------------|
| CRUDE OIL 2014 – 2016 | -21.6680 | 0.0000 |
| CRUDE OIL 2020 | -8.8403 | 0.0000 |
| USD/INR 2013 | -14.1299 | 0.0000 |
| USD/INR 2017 | -14.2151 | 0.0000 |

| Variables – Returns series | t-Statistic | Prob. Value |
|----------------------------|-------------|-------------|
| Nifty50 2014 – 2016 | -19.2506 | 0.0000 |
| Nifty50 2020 | -10.5088 | 0.0000 |
| Nifty50 2013 | -12.2041 | 0.0000 |
| Nifty50 2017 | -12.2217 | 0.0000 |

From table 4 we can see that ADF test produced t-values which is below the critical values at corresponding significance level 1%, 5%, 10%. So, we can reject the null hypotheses and it points that the time series data is stationary. Moreover, the Probability values is also under 0.05 level.

Graphs of Volatility Pattern:

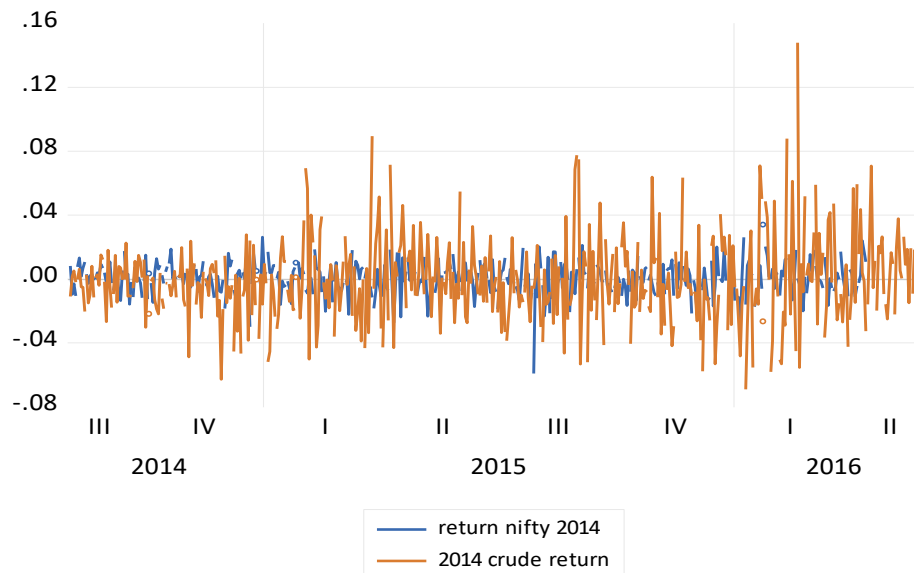


Fig 1: Volatility pattern of nifty 50 and crude oil during 2010s Oil glut crisis

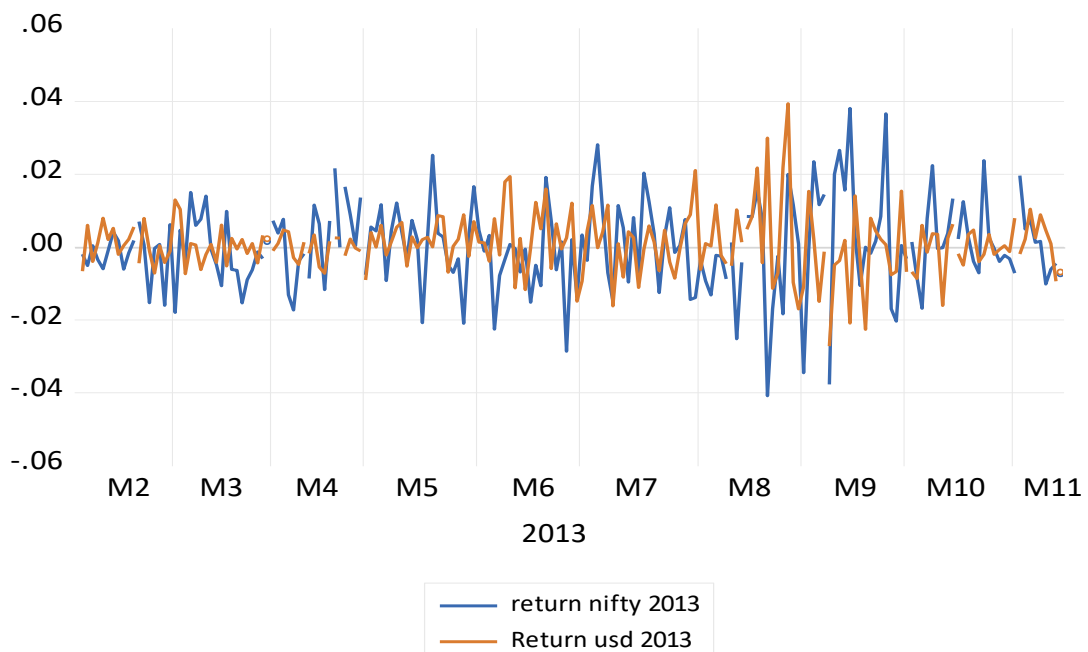


Fig 2: Volatility pattern of nifty 50 and USD/INR during 2013 Depreciation crisis

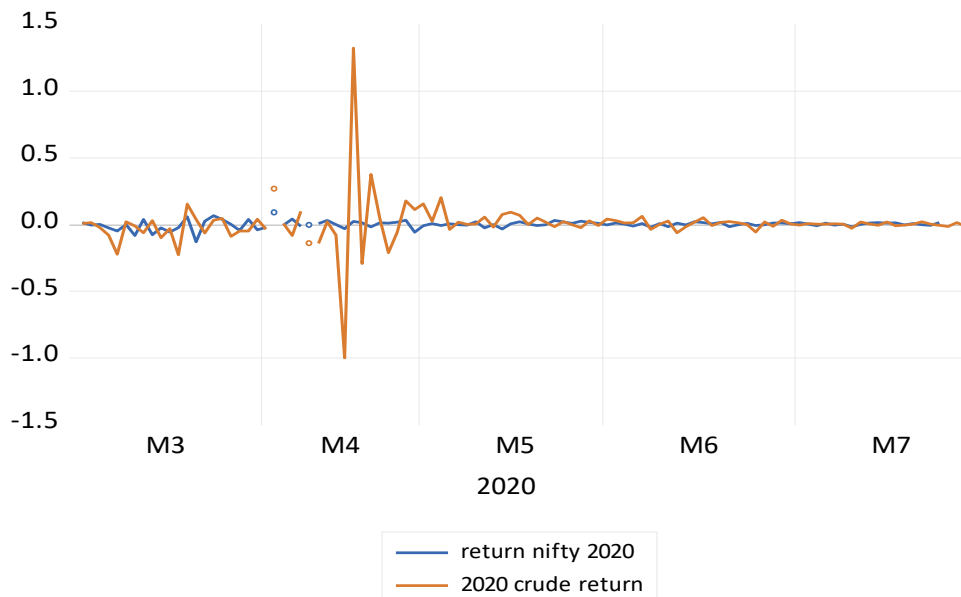


Fig 3: Volatility pattern of nifty 50 and crude oil during 2020 Russia-Saudi Arabia Oil Price War crisis

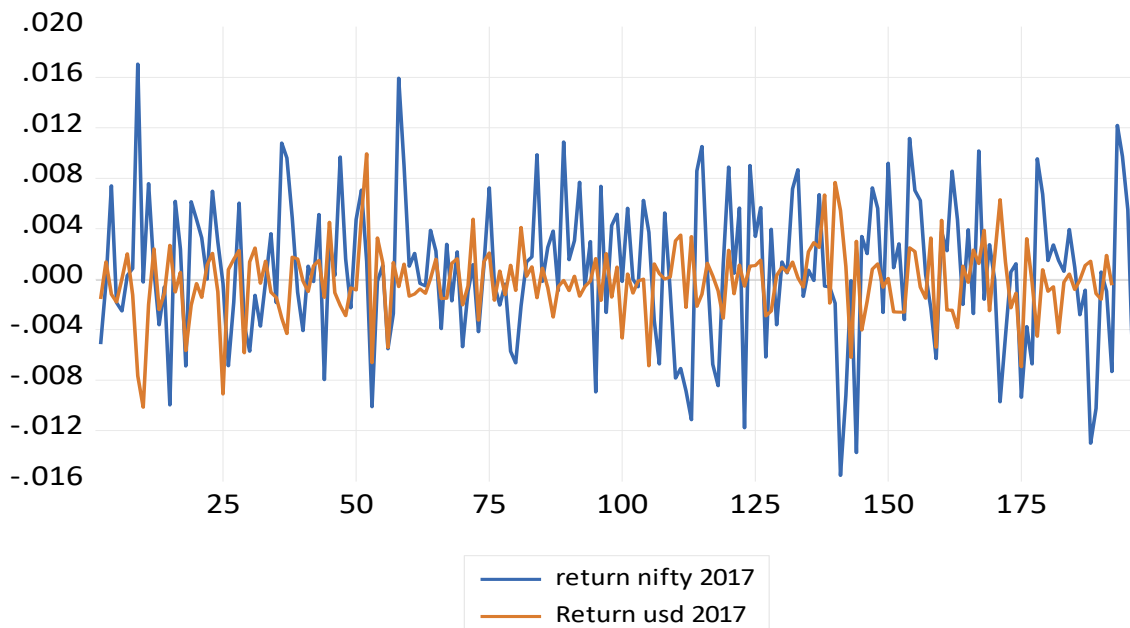


Fig 4: Volatility pattern of nifty 50 and USD/INR during US Fed Reserve Hike crisis

Above figures from 1 to 4 certifies volatility clustering as it can observe that small fluctuations are flowed by small fluctuations and large changes are tending to follow large changes for a long period.

Table 5: Heteroskedasticity check

| Crisis Name | t-statistic | F-statistic | Chi. Square | AIC | SIC | p. Value |
|--|-------------|-------------|-------------|----------|----------|----------|
| US Fed Reserve Hike Crisis 2017 | 2.941 | 8.6499 | 0.0038 | -19.3485 | -19.3143 | 0.0037 |
| 2013 Depreciation USD/INR Crisis | 2.2849 | 5.2209 | 0.0235 | -14.6594 | -14.6252 | 0.023 |
| 2010S Oil Glut Crude Oil Crisis | 3.4142 | 11.6572 | 0.0007 | -10.1610 | -10.1537 | 0.0007 |
| 2020 Russia-Saudi Arabia Oil Price War | 2.8887 | 3.7898 | 0.0370 | -9.2429 | -9.1821 | 0.0377 |

As we see in above table 5 during all the crisis period data is having Probability Value less than 0.05 so we can say that data is Heteroskedasticity and we can see that T-statistics value are more than 2 for the all crisis. So, we further proceeded with GARCH and EGARCH.

Table 6: Garch Model (1, 1)

| | Us Fed Reserve Hike Crisis 2017 | | 2013 Depreciation USD/INR Crisis | | 2010s Oil Glut | | 2020 Russia-Saudi Arabia Oil Price War | |
|-------------------|---------------------------------|-------------|----------------------------------|-------------|----------------|-------------|--|-------------|
| | Co efficient | Prob. Value | Co efficient | Prob. Value | Co efficient | Prob. Value | Co efficient | Prob. Value |
| C(intercept) | -0.04 | 0.1577 | 0.0249 | 0.4837 | 0.0002 | 0.5652 | 1.59E-05 | 0.9994 |
| RETURN_USD | -0.0002 | 0.1999 | 0.0007 | 0.1631 | - | - | - | - |
| RETURN_Crude oil | - | - | - | - | 0.0023 | 0.967 | 0.0018 | 0.4188 |
| Variance Equation | | | | | | | | |
| C | 3.28E-06 | 0.0206 | 1.94E-06 | 0.1741 | 7.73E-06 | 0.1585 | 2.05E-06 | 0.7181 |
| α - ARCH | 0.2133 | 0.0032 | 0.169 | 0.0022 | 0.0564 | 0.0001 | 0.1603 | 0.0272 |
| β - GARCH | 0.3663 | 0.0829 | 0.9175 | 0.0000 | 0.9367 | 0.0000 | 0.8332 | 0.0000 |
| AIC | -8.948 | | -6.96 | | -4.5683 | | -4.3311 | |
| SIC | -8.8628 | | -6.8749 | | -4.5222 | | -4.18 | |

In above Table 6 mean equations generates co-efficient of -0.000261, 0.0007, 0.0023, and 0.0018 for all the crisis period. Further it is observed that the above mean scores are not found to be significant at five percent level of significance (as p. values > 0.05).

The GARCH (1, 1) model generates α coefficient of 0.213326, 0.1690, 0.0564, and 0.1603 for all the crisis period. This refers that nifty generated a positive return over USD/INR and Crude oil return factors during the study period. These abnormal returns further signified by obtained probability values of 0.0032, 0.0022, 0.0001, and 0.0272 for USD/INR and Crude oil return falling very much within five percent level of significance.

In variance equation the obtained conditional variances (β) found to be above one. Additionally it is observed that the obtained β is statistically not significant at five percent level of significance as obtained prob. values 0.0829 for Us Fed Reserve Hike Crisis 2017, signalling towards there is no existence of GARCH effect. The above results confirms that the past fluctuations in USD/INR rates during US Fed Reserve Hike crisis 2017 cannot influence stock market volatility i.e. on Nifty50. And if we observe for all the crisis that the obtained β is statistically significant at five percent level of significance as obtained prob. Values 0.0000, 0.0000, 0.0000 respectively. Signalling towards the existence of GARCH effect. The GARCH effect confirms that the past fluctuations in USD/INR rates and Crude oil return during Crisis period can influence present stock market volatility i.e. on Nifty50.

Table 7: E-Garch Model

| | Us Fed Reserve Hike Crisis 2017 | | 2013 Depreciation USD/INR Crisis | | 2010s Oil Glut | | 2020 Russia-Saudi Arabia Oil Price War | |
|------------------|---------------------------------|-------------|----------------------------------|-------------|----------------|-------------|--|-------------|
| | Coefficient | Prob. Value | Coefficient | Prob. Value | Coefficient | Prob. Value | Coefficient | Prob. value |
| C(intercept) | -0.0513 | 0.0934 | -0.0154 | 0.7195 | 0.0471 | 0.6409 | 0.0023 | 0.1648 |
| RETURN_USD | -7.78E-05 | 0.6843 | 0.0014 | 0.0001 | - | - | - | - |
| RETURN_Crude oil | - | - | - | - | -0.0023 | 0.0143 | 1.77E-05 | 0.8425 |

| | Us Fed Reserve Hike Crisis 2017 | | 2013 Depreciation USD/INR Crisis | | 2010s Oil Glut | | 2020 Russia-Saudi Arabia Oil Price War | |
|--------------------------|---------------------------------|-------------|----------------------------------|-------------|----------------|-------------|--|-------------|
| | Coefficient | Prob. Value | Coefficient | Prob. Value | Coefficient | Prob. Value | Coefficient | Prob. value |
| Variance Equation | | | | | | | | |
| α_0 | -3.9985 | 0.0213 | -0.0552 | 0.273 | -0.0822 | 0.0006 | -0.12632 | 0.6205 |
| α_1 | 0.3957 | 0.0000 | -0.0908 | 0.0204 | 0.0297 | 0.1164 | -0.0405 | 0.7263 |
| γ (Asymmetry) | 0.2071 | 0.0069 | 0.2390 | 0.0000 | -0.076 | 0.0000 | 0.3541 | 0.0028 |
| β | 0.6872 | 0.0000 | 0.9864 | 0.0000 | 0.9912 | 0.0000 | 0.9852 | 0.0000 |
| AIC | -8.9599 | | -7.0888 | | -4.6006 | | -4.0573 | |
| SIC | -8.8577 | | -6.9867 | | -4.5453 | | -3.876 | |

From above Table 7 it is evident that the coefficient γ (Asymmetry) obtained for US Fed reserve Hike crisis 2017 and for 2020 Russia-Saudi Arabia Oil Price War is 0.2071 & 0.3541 respectively which is positive and Significant probability values obtained falling within five percent significant level i.e. 0.0069 & 0.0028 which is more than Zero so positive shocks increase the volatility more than negative shocks. If we observe for 2013 Depreciation USD/INR Crisis the coefficient value is positive i.e. 0.2390 and Significant probability values obtained falling within five percent significant level i.e. 0.0000 which is Equal to Zero so, no asymmetric volatility and for 2010s Oil Glut as we can see that coefficient value is negative. i.e. -0.076 and Significant probability values obtained falling within five percent significant level i.e. 0.0000 so we can say that there is leverage effect is presence in this crisis.

DISCUSSION AND FINDINGS:

Crude oil and USD/INR are considered by Indian investors as a perfect alternative for hedging their investment portfolio. From the analysis it is observed the stock market generated a better return than crude oil and USD/INR during crisis period. It is also observed that Volatility of USD/INR rates during 2013 depreciation crisis has influence on nifty50 and during US Fed Reserve Hike crisis it won't have influence on nifty50. During both the crude oil crisis it is confirmed that crude oil return volatility has influence on nifty50. So volatility fears attributed to nifty50 due to Crude oil and USD/INR rates are continuing to exist for a sizeable period of time. The study will help the investors to understand how stock market performs during the crisis period and it will help them to diversify their portfolio in order reduce risk.

Further it is observed that crisis of crude oil is the most powerful factor that influencing stock market volatility. This finding can be inferred as any fluctuation in crude oil rates can bring massive change in the price level of the stock market. This finding will contribute to the existing literatures of [Dev1 & Chaubey \(2016\)](#), [Grigoli Et.al \(2017\)](#) as these studies agrees that during the crisis of crude oil rates can make a significant influence on the stock market volatility. From the above findings we can also be suggested the crude oil can be considered as best alternative for hedging the investment portfolio since it give good return when compare to USD/INR. This study also observed a leverage effect is presence only during 2010s Oil Glut crisis i.e. negative shocks will increase the volatility more than positive shocks and for rest of the crisis period presence of leverage effect is not there. Leverage effect refers that volatility increases with increasing price levels. It refers that any increase in crude oil tends the investors to revise their portfolio through asset reallocation, and results in transferring capital from stock market to commodity/currency market. So volatility in stock returns gets enhanced.

CONCLUSION:

The study summarize that any raise in crude oil and USD/INR rates can greatly influence the volatility in Indian stock market. The study results can help the policy makers and government agencies to control the prices level through proper market intervention. GARCH (1, 1) model confirmed the volatility of USD/INR rates during 2013 exchange rate depreciation crisis and its influence on nifty 50. Further, during both the crude oil crisis it is confirmed the influence of crude oil returns volatility on nifty 50. Overall, the study found that the presence of leverage effect only during 2010s Oil Glut crisis. The result signals that any

negative shocks will increase the volatility of Nifty 50 more than positive shocks during Oil Glut crisis. The market participants and policy makers can take timely decisions to stabilize the stock market during crisis periods.

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