Impact Of Oil Price on Stock Market Prices Using Generalised Auto-Regressive Conditional Heteroskedasticity (GARCH) Model

[1]Dr. Kabirdoss Devi, [2]Dr. K. Sampath, [3]Dr. S. Poovizhi

[1] Assistant Professor, Department of Commerce, College of Science and Humanities, SRM Institute of Science and Technology, Ramapuram Campus, Chennai

[2&3]Assistant Professor, Department of Management Studies, St. Joseph's College of Engineering, Chennai.

ABSTRACT

This study attempts to associate the relationship between the volatile oil price and its impact on the stock market prices. Oil prices are increasing in the recent days and it is important to check whether this has any influence over the Indian economy and that of movements of stocks. This study uses the GARCH model to assist changes where the volatility is time dependent and volatility is subject to increase and decrease in the same series. The major objective of the paper is to use GARCH model to estimate the volatility of the daily returns with respect to the oil price of National Stock Exchange. This models was done by using the data from March 2016 to February 2021.

Keywords - GARCH, Oil prices, Stock movement etc.,

Introduction -

Oil is a strong commodity in Indian markets and India is the third largest oil importer and consumer. Indian population is dependent on this vital commodity and its by products for their uninterrupted smooth life style. Being an important product for the day to day living, people of India might forego other expenses but still spend on this fuel. Unlike food, now even fuel items has become staple in the lives of Indian people.

Every individual must have come across in their life about people grumbling on the soaring fuel prices. Stock market is sensitive to the issues related to the factors that attribute to the macro economy. Everything is volatile and associated with the returns on investment. Hence, its imperative to study the oil prices which is the major driving force in the Indian Economy.

Pricing of petrol is not done on the basis of the cost incurred during refinery process by public sectors units like Indian oil,HPCL and BPCL which source, refine and market the crude oil. Then, one must question on the methods of such pricing. It's Trade Parity Price (TPP) method that has been used to price these products. Trade parity price usually converted into rupees and added with other costs and margins, commissions and state & central taxes. Now, the pricing of petrol and diesel is fixed on daily basis considering the 15- day rolling rate internationally. Another major reason for surging is the rupee weakening against dollars over the years. Hence, this forces to study on the cumulative effect of these price impact on stock market. Various studies had been conducted post sub-prime crisis to check on these oil price impact on the stock market movement. The outcome in many cases revealed not a significant positive correlation.This study used conditional hetroskedasticity because of the increased and sensitive volatility on returns.

Review of Literature -

Jones and Kaul (1996), he said that the relationship between oil price and stock returns could positive relationship or negative relationship. However, he justified his theory through the test of cash flow hypothesis. He pointed out that the values of the asset were determined by the expected discounted cash flows. He further adds value to the statement by proving that the increased oil price could increase the cost of production and reduce the future cash flow resulting in less earnings, less or no dividends and hence poor stock performance.

Wan (2005), provided details on the symmetric effects of oil price on the stock returns. He suggested that the companies see their present value and decide on the divided for the share holders. It would be possible only when the expected present value go higher than the certain threshold. He further explained that the increase/ decrease in oil price could effect the decision on the dividend policy. For example, if an increase in oil price resulted in the EPV below the threshold, then the

company would decide not to pay dividend and face the declined stock prices. On the other hand, if the oil price decrease then the firm decide to pay a higher dividend and this would lead to a higher stock price.

Malik and Hammoudeh (2007), studied the volatility of the global oil prices and its relationship with that of the Saudi Arabian stock market, US and European stock markets. They found a negative relationship between oil prices and the stock markets. Whenever the oil prices increased, stock market prices declines. This study was also supported by Park and Ratti (2008).

Park (2009), he explained US stock returns by comparing the aggregate demand and oil specific demand. He said that aggregate demand and oil specific demand were more important than the global oil supply. Hamilton's (2009) contributed that oil shocks weren't any longer important for macroeconomic development.

Kilian and Park (2009), proved that most of the studies failed to consider the time variation. He further added that bubbles in the market might make the negative relationship to become weakened or disappeared. So the earlier positive correlation between the oil price and stock returns would not prove reliable in the existing scenario.

Ono (2011), showed no significant statistical response of stock market price to that of oil price. However, they found asymmetric effect of oil price on Indian market, Russian market and Chinese market.

Talukdarand Sunyaeva (2012), demonstrated the relationship of oil prices and that of the stock market returns in 11 OECD member countries. They found that the effects of oil price on the stock market varied depending upon whether they belong to oil exporters or importers. They concluded that the stock prices showed negative relationship when they were oil importers and positive when they were oil exporters.

Kollias et al. (2013, p.744), suggested the positive correlation between the oil price and the stock returns. He stated that the investors might associate increasing price as a booming economy. He further added along with **Hamilton (2009a)** that oil prices resulted in developing market growth and business confidence.

Wang et.al (2013), carried out their study in those countries where oil played an very important role particularly when they were oil exporting countries. But they concluded their study by exhibiting whether they were importers or exporters, stock markets affected and influenced by the change in the price of oil. It was purely depended on the demand and supply of the oil in the economy.

Objective of the study-
The objective of the study is to model and forecast volatility in financial time series. Performance analysis through any model should give accuracy in computational process and hence Generalized Auto-regressive Conditional Heteroscedasticity model used to find out the stock price movement with respect to the oil price changes. Pricing capital assets, financial assets, securities and portfolios needs thorough investors knowledge on measuring and managing risks accurately to keep them from highly volatile markets. So volatility analysis of stock market is important for the same purpose. GARCH model is accurate and perfect to elicit the volatility both symmetrically and asymmetrically.

Need of the study-
This study helps to understand the relationship between the oil price and the stock market movement. Most of the study as everyone know do not normally comprises of statistical modelling depicting the relationship between the oil price and the stock movement. Other than this reason, empirical study not conducted exclusively for this study and it still revealed to be a grey area. Hence, when we apply this new relevant statistical models, it would be beneficial to support theories that differ from earlier contributions. Why it's important to study the impact on the macro level is to check the consequences of increased oil prices over the businesses that make the goods with the petroleum products. Transportation, manufacturing and fuel result in increased indirect cost due to increase in oil prices in the market. Investors leave the organization and bring down the value of the market share of the company when this reflects on the value available to the investors in terms of the dividends, bonus shares and capital appreciation.

Methodology-

This study used the secondary month wise time series data ranging from March 2016 to February 2021. The variables used are the oil price and the stock price. GARCH uses the heteroskedastic than homoskedastic and it differs majorly based on this process. Its known that GARCH models are used extensively in finance because of their efficiency in modelling asset returns and inflation. This model minimizes the errors basically and predisposes to the accuracy on predictions. Heteroskedasticity is possible when the standard deviations of a dependent variable monitored over a time period and those are non- constant with respect to the different values of an independent variable. This study uses the conditioned heteroskedasticity which identified non-constant volatility on the daily basis.

Analysis and Discussion-

Financial market is the place where investors always look for good news. Unfortunately all of them are exposed to bad news too. How market behaves depends extensively on the information it gets. It could be change in the political climate, change in the governing body, change in policies, announcements in budgets and global influences.

With these symmetric models, good news and bad news due to the volatility of the financial markets could be distinguished extensively. However, symmetric models always let down to demonstrate its efficiency while computing the leverage effect due to conditional variance which fail to respond asymmetrically. That's one of the major reasons why GARCH models proved to be effective to deal with this development.

The analysis has been done step by step where the first step dedicated majorly to the changes in the prices of petrol and diesel. Though the study period was considered to be for five years from 2016 to 2021, the price changes chart would give clear picture over the period.
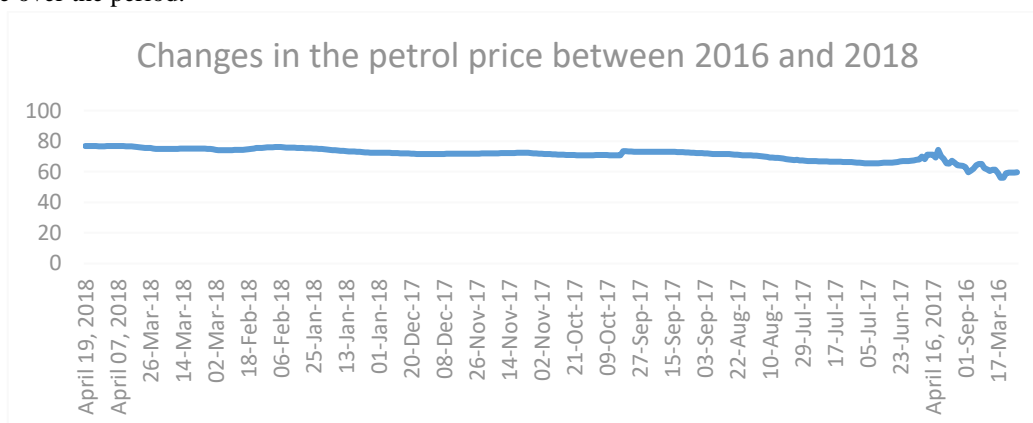
The above chart illustrates the changes in the price of the petrol and diesel between 2016 and 2018. This shows that there is a gradual increase from Rs.59.77 in January 2016 to 76.18 in April, 2018. It is also necessary that we should see the relationship of this price hike to the stock price movement during that particular period.
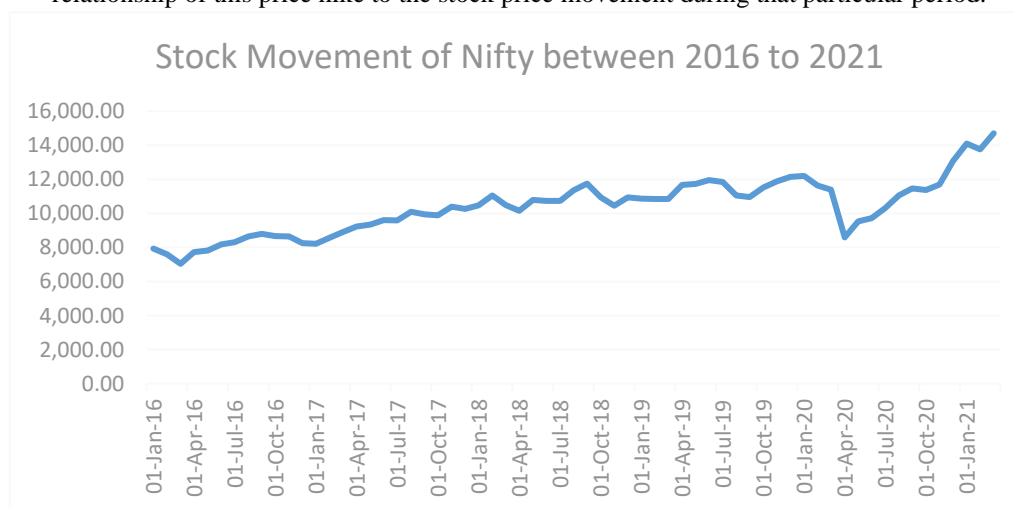
The above chart depicts the stock movement of Nifty Fifty during 2016 and 2021. It can be witnessed there is no increase or decrease in the stock movement of nifty fifty with respect to the changes in the oil price. This shows there is negative relationship between the oil price and stock movement. It further strengthens the argument by showing drastic fall in the stock prices when the prices of oil were increased. This negative correlation may not be absolute since there could be other prevailing factors that resulted in the failing stock movement.

The below table shows the descriptive statistical analysis of the variable of oil and nifty fifty stock movement.

	Mean	Median	Max	Min	Std. dev	Skew	Kurt	Proba	JB
Oil	68.64	72.03	76.84	59.65	3.544	-0.8082	0.31768	0	6008.6
NSE	10794.01	10479.95	14702.5	7038.25	1628.25	0.1847	-0.0062	0.0006	806.7

These results reveal that all variables are not distributed normally and oil has the highest mean value. Their standard deviation shows no correlation and behaves independently. This shows that the stock movements and the oil prices are independent to each other and do not correlate. It further adds that the rise or fall in price would due to effects of other macro economic factors.

The benefits of using conditional heteroskedasticity in finance is due to the existence of pattern seen in the prices of stocks and bonds. But the level of volatility calculation subject to limitation in case of unconditional which is due to the fact that the variables are identifiable for seasonal conditions only.

Price of equities within the portfolio changes if risk factors are triggered due to challenges posed by any of the reason in the prevailing market. Oil prices and the stock market has certain groups of variables within the larger set of variance. Hence the GARCH model found to be an apt model on ruling out the stock market volatility and returns. It yields better results when combined with statistical techniques.

The equation of the regressive linear model considered is as follows-

$Y_t = E(Y_t \ / \ Y_{t-1}) + \mathcal{E}_t$

Where $\mathcal{E}_t$ --- $N(0, \sigma^2)$ and $E \ (\mathcal{E}_t \ \mathcal{E}s) = 0$

If $S \neq t$

$\mathcal{E}_t = Z_t \ \sqrt{h_t}$

$Z_t = N_q \ (0, \sigma^2)$

$$h_t = \alpha_0 + \sum_{t=1}^{q} \alpha_i X^2_{t=i} + \sum_{t=1}^{q} \beta_i X^2_{t=i}$$

With, $\alpha_0 > 0$, $\alpha_i \geq 0$ ¤ $= 1$,

q and $\beta_i \geq 0$, ¤ $= 1$……

Sufficient to guarantee the positivity of $h_{t……}$

The GARCH model considers other variables like inflation and exchange rates along with stock movement and changes in oil price.

$= 139.311 + \ 13.577 \ (SM) - 8.278 \ (IR) - 6.5 \ (ER)$

In the above equation, the stock movement very minimally only reacted to the changes in the oil prices. Oil price changes were negatively co-related with the inflation rate and the exchange rate, in that, oil prices were decreasing with the increase in the rates of inflation and exchange rates and increasing with the decrease in the rates of inflation and exchange rates.

Conclusion-

This study used GARCH model to rule out the relationship between the change in oil price with that of the change in the stock movement. The results of this model exposed that when including the inflation and the exchange rate for the study purpose, it showed the negative relationship with the oil prices and less or no relationship with that of the stock movement. This model proved the general observation that any increase or decrease in the inflation would have direct impact on the prices of the commodity. In this case, the oil price were correlated perfectly. The same study was conducted and supported with the similar outcome by Mpofu, Mirchandani and Agnolucci.

References-

1. Jones, C.M., Kaul, G., 1996.Oil and the stock markets. J. Financ. 51 (2), 463–491.

2. Kilian, L., Park, C., 2009.The impact of oil price shocks on the U.S. stock market. Int. Econ. Rev. 50 (4), 1267–1287.

3. Klüppelberg, C.; Lindner, A.; Maller, R. A continuous-time GARCH process driven by a Lévy process: Stationarity and second-order behaviour. J. Appl. Probab. 2004, 41, 601–622.

4. Levine, R., 1997.Financial development and economic growth: views and agenda. J. Econ. Lit. 688–726.Liu, P.C., 1994.Wavelet spectrum analysis and ocean wind waves. Wavelet Anal. Appl. 4, 151–166.

5. Maghyereh, A., 2004.Oil price shocks and emerging stock markets: a generalized VAR approach. Int. J. Appl. Econ. Quant.Stud. 1 (2), 27–40.

6. Malik, F., Hammoudeh, S., 2007.Shock and volatility transmission in the oil, US and Gulf equity markets. Int. Rev. Econ.Financ. 16 (3), 357–368.

7. Milonas, N. T. , & Henker, T. (2001). Price spread and convenience yield behaviour in the international oil market. *Applied Financial Economics* , 11(1), 23–36.

8. Mirchandani, A. (2013). Analysis of macroeconomic determinants of exchange rate volatility in India. *International Journal of Economics and Financial Issues* , 3(1), 172–179.

9. Mpofu, T. R. (2016). *The determinants of exchange rate volatility in South Africa* (ERSA Working Paper). p. 604.

10. Ogiri, I.H., Amadi, S.N., Uddin, M.M., Dubon, P., 2013.Oil price, stock market performance in Nigeria: an empirical analysis.Am. J. Soc. Manag. Sci. 4 (1), 20–41.Ono, S., 2011.

11. Park, J., Ratti, R.A., 2008.Oil price shocks and stock markets in the US and 13 European countries. Energy Econ. 30 (5),2587–2608.Percival, D.B., Walden, A.T., 2000.Wavelet Methods for Time Series Analysis. Cambridge Series in Statistical and ProbabilisticMathematics.

12. Wagala, A., Nassiuma, D., Islam, A.S. and Mwangi, J.W. (2012) Volatility Modeling of the Nairobi Securities Exchange Weekly Returns Using the Arch-Type Models. International Journal of Applied Science and Technology, 2, 165-174

13. Wakeford, J. J. (2008). The impact of oil price shock on the South Africa macroeconomic, history and prospects. SARB conference.