Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 7, July, 2021:1840 – 1850

Predicting the volatility between the exchange rate and stock market

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Abstract: Commodities play a significant role in the economic progression of developing countries like India. Investment in stock and election of appropriate stock for the investment that will achieve profit for the investors. In this perspective, the article has depicted the correlation dynamically among the prices of gold and the exchange rate in the Indian market. The data acquired from the Indian stock market is analyzed by the statistical models. This model is utilized in the estimation of volatility and return across the stock market. From the investigation of stock market data and the correlation examination by DCC-GARCH, it is identified that gold is a proficient hedging commodity for the investors of Indian stock than other variables. The asymmetric impression of covariance is perceived among the Nifty 50 and some other variables. The article also emphases on supporting the stock investors and diversifiers of the portfolio during the decision-making process of investment.

Keywords: Stock market, exchange rate, gold price, correlation analysis, DCC-GARCH, and volatility.

1. Introduction

The capital market has two key functions, funding for a business entity that is a source for funding and medium of investment for the investors in numerous instruments, for instance, stock, mutual funds, bonds, etc. Amongst these instruments, stocks are the commonly traded instrument, which is a simple instrument for trading and also gives high returns. The progression of stocks in India takes place at National Stock Exchange (NSE) [1] and Bombay Stock Exchange (BSE) [2] where the analysis of the stock exchange is accomplished via numerous aspects.

The volatility of the stock is investigated for the estimation of the potentials of profit and loss, which is highly noted by the investor before investing in a certain stock. The stock selection is attained by the calculation of the statistical volatility of the stocks. The rate of volatility can create uncertainty risk that generates a positive or negative impression on the interest of an investor's investment [3]. However, numerous investors are still showing interest in stocks having huge volatility. Although, the investors are fascinated towards high risk and they will attain high profit over the stock.

The volatility rate of the stock is influenced by numerous factors that may lead to huge risks. However, USD exchange and price of gold are considered as macroeconomic factors, which shows the

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impact on the volatility of the stock price. One of the significant commodities is gold and it is traded internationally [4]. Gold is utilized as an alternate deal because it is not influenced by the pressure of inflation and inclines to be risk-free [5]. Gold is an expensive metal and it is a safe asset to hold for a long-run duration because it has better durability [6]. Additionally, it is an efficient divergence tool within the portfolio to minimize the risk [7].

Research about the price of the stock and the relation of the value of gold, which is estimated by the Granger test of causality [8]. The outcome of the gold price and the index of industrial stock performance has an irrelevant relationship. Moreover, the dynamic correlation of sharia stock and gold

prices depicts the negative correlation among sharia stock and gold prices [9]. The correlation among the sharia stock and the precious metal is investigated by utilizing pedroni panel cointegration that efficiently identifies the correlation among the sharia stock and precious metals [10]. The panel vector Autoregression technique discovers the interrelation of stock and gold prices that is illustrated via sentiment of stock price and gold market investors [11].

The stock prices correlate with other variables that are other than the price of the gold in the stock. The exchange of USD/IDR is considered in the stock exchange and it has fascinated numerous researchers in the field of the economy specifically capital markets. The stock prices and exchange rate (ER) plays a prominent role in influencing the country's economy and this relationship is often utilized in the essential analysis for movement of the stock prices and exchange rate in the future [12]. Research on the exchange rate is examined by researchers and it utilizes numerous stock-related variables in India [13, 14].

This article focuses on the correlation among the variables of the ER, gold price, and stock of India in a time-varying domain. The correlation among these variables is limited to series of aspects in the return and show progression in the stock market. This article mainly focuses on the co-volatility and volatility in the Indian evolving market. Both the volatility and returns are monitored by utilizing the non-linear approach to suit the heteroscedasticity and performance of time-based clustering. Further, the relationship among the variables is not examined widely from 2014, slowdown of the global market, and onset slump of the commodity. Understanding these correlations between the proposed variable delivers valuable implications for both the investors and policymakers that will assist in the identification of suitable decision-making in portfolio selection and hedging.

The remaining of the article is systemized as follows: diversified studies in the stock exchange and gold price are discussed in Section 2, materials and methods incorporated in this article is given in Section 3, the discussion of result is accomplished in Section 4 and the article is concluded in Section 5.

2. Literature Review

In this section numerous studies and models utilized for statistical examination with the stock information is discussed.

The herding performance of Indian stock market with a sample of data is enlisted on NSE of India during 2003 to 2017 is investigated. The behavior of herding is utilized in the investigation of declining and rising nature of stock data. The global crisis of financial information influence the nature of stock market and the crisis is categorized into three varieties that is before, after and during the crisis. The unit root is monitored with the estimated statistical value of ADF. In this research, the nature of herding is not identified in the stock data of Indian market [15].

The reaction of trading data and stock market information of thirty four country is considered, which is examined by the statistical estimation. The stock split has substantial impact on the stock data that is attained by the ratio analysis. In Indian stock market, stock split has negative impact on the return and minimizes ratio of stock data [16]. The NSE, BSE, and Calcutta Stock Exchange (CSE) is considered for the investigation of volatility of stock information. Volatility is a measure of statistical information of return of dispersion for the market index and security return. Generally, volatility has huge risk that is correlated with the security [17].

The relationship among the volatility of stock return and sentiment of investor is explored with the monthly information of NSE. The index of sentiment is constructed with 7 market data with the assistance of Principal Component Analysis (PCA). From the study, it is identified that sentiments have both positive and negative impacts that also shows the bi-directional causality in the data [18]. With the data of BSE, volatility patterns are formulated especially for the Indian banking that is BANKEX. The econometric model GARCH (1,1) is incorporated to acquire the leptokurtosis and clustering of volatility. The volatility provide assistance in the identification of actual stock values [19].

Generating models with the time-varying volatility of the Indian stock data examines the impact of financial crisis and also influence of volatility can be identified. The symmetric and asymmetric model of GARCH suggest the persistence of returns volatility. The volatility of the stock during the crisis is effectively identified by the ARCH and GARCH models. It also acquired the steady convergence path. Though, this approach is poor when it considers the out-of-sample forecasting data. [20]. The financial contagion or crisis to Indian stock is in analyzed with the DCC-GARCH. The financial investigation incorporates bivariate generalized autoregressive conditional heteroscedasticity (GARCH) and dynamic conditional correlation (DCC) for the analysis of financial crisis. From the investigation of data from 2008-2011, incidence of contagion among United States and India. Furthermore, this model improved the correlation eliminate the international difference and outperforms the aspects in long run due to the minimized volatility [21].

The portfolio risk assessment with the effect of gold price on BSE is identified with the GARCH model. The author has concentrated on allocation of maximum return, issue of global minimum variance and allocation of Markowitz portfolio by incorporating multiple GARCH approach. The dependency of gold returns with BSE is identified by this model [22]. The inter-linkages among the commodities and the reliance of stock market is reviewed by the author. The challenges faced by the investors and opportunities reside in the approach is discussed additionally [23].

The volatility relationship among the commodities and stocks are investigated for twelve year of period by incorporating the BEKK-GARCH and GARCH models. Existence of dynamic correlation among the data is identified for the forecasting of financial crisis. The interrelation among the commodities like gold, zink, crude oil, lead and nickel offers significant benefits to the investors and also minimized the correlation in the stock market data. Absence of financialization offered numerous opportunities to the investors [23]. A rescaled analysis is accomplished with the data of BSE and NSE. The persistence of long range is analyzed for the period of 2005 to 2017. The statistical investigation depict the incidence of long range run in the data [24]. The correlation and volatilities among the commodities are examined by the DCC, ADCC and GO-GARCH model. Outcome of the model is best choice for refitting, assumption distribution and length forecasting of stock data [25].

3. Materials and Methods

This article utilizes the secondary data of stock information from 2014 April to 2021 March, which is incorporated in the study of stock. The statistical estimation and computations are performed via R. The natural logarithmic value for every algorithm is taken into consideration. The series of variables stationarity is estimated by Phillip Perron Test and Augmented Dickey Fuller. The variables utilized in this study is given in Table 1.

Table 1. Variable list utilized in this study

S.No	Variable	Source	Symbol
1.	Nifty 50 Index	nseindia.com	Nifty 50

2.	Gold Price troy ounce/USD	World Gold Council	Gold
3.	Exchange rate of USD vs INR	rbi.org.in	USD/INR

Generally, GARCH-BEKK is indicated as follows;

$$H_t = C'C + Y'H_{t-q}Y + X'\varepsilon_{t-p}\varepsilon'_{t-p}X$$

where the residuals is indicated as ε_{tp} and innovations among the market is indicated as p and q.

The conditional correlation across different time is calculated by the variables and the multivariate DCCGARCH scheme is utilized for the estimation. The issue of dimensionality in the stock information is handled by this model, which encompasses more parameter and variable into this model. The influence of asymmetric correlation along the volatility is handled by ADCC-GJR-GARCH and DCC-GJRGARCH. The DCC-GARCH model's [26] mean equation is given as follows,

$$er_t = v_t + \lambda 1 r_{t-1} + \varepsilon_t$$

where the nifty return, gold price, exchange rate are indicated by er_t, which is over the period of time t, the constant vector is indicated as v_t that is conditioned on $\phi_{t-1,}$ covariance-conditional variance matrix is indicated as h_t, and lag in the covariance is indicated as λ1.

The DCC model is estimated in two steps, the coefficient value of GARCH is calculated in initial step and subsequently correlations are calculated. The h_t is equated as,

$$h_t = d_t er_t d_t$$

Where the standard deviation's matrix is denoted as $d_t = dia(Z_{pt}^{1/2})$, conditional correlation matrix is denoted er_t and the conditional volatility specification on GARCH (1,1) is denoted as $Z_{pt.}$ The univariate specification of GARCH (1,1) is utilized for DCC-GARCH.

$$Z_{pt} = v + \alpha_p \varepsilon_{p,t-1}^2 + \beta_p Z_{p,t-1}$$

The univariate specification of GARCH (1,1) in GJR is utilized for DCC-GARCH and ADCC-GARCH (Model 2).

$$Z_{pt} = v + \alpha_p \varepsilon_{p,t-1}^2 + \beta_p Z_{p,t-1} + \delta_p\{(min\varepsilon_{p,t-1}, 0)\}^2$$

The computation for the correlation is signified as, $\rho_{pq,t} = J_{pq,t}/(J_{pp,t}J_{qq,t})^2$ and the er_t is given as I_t=$J_{pt,t}$ as follows,

$$er_t = (dia(I_t))^{-1/2} I_t (dia(I_t))^{-1/2}$$

$I_t = (1 - X - Y)I + X\varepsilon_{t-1}\varepsilon_{t-1}^T + YI_{t-1}$ is a square matrix in symmetric form and $I = Cov[\varepsilon_t\varepsilon_t^T]$= E$[\varepsilon_t\varepsilon_t^T]$, which is a standard error covariance matrix of unconditional information. $p = \frac{1}{T}\sum_{t-1}^{T}\varepsilon_t\varepsilon_t^T$ and X+Y<1.

Furthermore, with ADCC [26] the process of I_t is depicted as,

$$I_t = i + X * (\varepsilon_{t-1}\varepsilon_{t-1}^T - i) + Y * (I_{t-1} - i) + Z * (v_{t-1}v_{t-1}^T - V)$$

where the variables X,Y, and Z denote the square matrix with positive symmetric value and the product using hadamard is denoted as *. $v_t = \min(\varepsilon_{t,}0)$, and $U = E[u_t u_t^T]$.

$$V = \frac{1}{T}\sum_{t=1}^{T} v_t v_t^T$$

The tests are accomplished to calculate the models utilizing log-likelihood function. The coefficient of j is d_t and i is er_t where the function is signified as,

$$L(j,i) = L_u j + L_z i$$

where

$L_u(j) = -\frac{1}{2}\sum_t(\log(2\pi)) + 2\ln|d_t| + er_t d_t^{-2} er_t)$ is considered as volatility term and

$L_v(i) = -\frac{1}{2}\sum_t(-\varepsilon_t^T \varepsilon_t) + \ln|er_t| + -\varepsilon_t^T er_t^{-1}\varepsilon_t)$ is considered as correlation term.

The main objective of this terms are maximize the function of log-likelihood and the values are estimated by the above equation.

4. Result and Discussion

4.1. Descriptive statistics

The standard deviation value of exchange rate is 4.01% that is least volatile than Gold and Nifty. The index value of Nifty 50 is positively skewed than the values of Gold and exchange rate. The highest mean return value is attained by the Nifty 50. The incidence of non-normality and fattails are identified by the positive kurtois value. The Jarque-Bera indicates the variables that re distributed normally by identifying the characteristics of outcome [27]. The existence of heteroscedasticity for every series with serial correlation and ARCH test is identified with Ljung-Box test. From the observation, it is identified that the all the series has heteroscedasticity and issue of correlation that rejects the hypothesis significance level 1%. The overall outcome of variables and their characteristics are given in Table 2.

Table 2. Distribution Variable Characteristics

Performance Measure	Nifty	Exchange_Rate	Gold
Median	9.0355	4.17	7.127
Mean	9.055	4.17	7.1177
Minimum	8.8022	4.0681	6.961
Maximum	9.3371	4.331	7.323
Standard Deviation	0.11	0.031	0.0599
Variance	0.021	0.0055	0.0041
Kurtosis	-0.443	-0.6387	-0.2851
Skewness	0.3475	-0.4977	-0.6505
ARCH	9231.4	9333.51	8700.51
p-value	(0.00)*	(0.00)*	(0.00)*
Jarque-Bera	28.441	56.314	71.781
p-value	(0.00)*	(0.00)*	(0.00)*

Sample taken	991	991	991
LB(12)	10855	11128	10137
p-value	(0.00)*	(0.00)*	(0.00)*

Variable's correlation coefficient is depicted via parentheses () and the p-value is shown where the level of significance 1% that is denoted by *.

4.2. Unconditional correlation matrix

The matrix of correlation and their relevant p-value is given in Table 3. From the statistical outcome, it is inferred that the USD/INR correlation with Nifty 50 is significant and positive as the value of p is less than five percent and the hypothesis is rejected. The correlation of Gold with exchange rate is significant and negative. The correlation outcome are necessarily reaffirmed via refined econometric tests.

Table 3. P-values and correlation of variable

Variables	Nifty	Exchange_Rate	Gold
Nifty	1		
	(NA)		
Exchange_Rate	0.091	1	
	(0.0043)*	(NA)	
Gold	0.37	-0.22	1
	(0.00)*	(0.00)*	(NA)

Variable's correlation coefficient is depicted via parentheses () and the p-value is shown where the level of significance is 1% that is denoted by *.

4.3. Unit Root Test

The incidence of spurious correlation between the variable may distort the statistical outcome and variables stationary has to be ensured. This process is accomplished by Phillip Perron Test and Augmented Dickey Fuller that is given in Table 4.

Table 4. Outcome of Phillip Perron Test and Augmented Dickey Fuller

Variables	Phillip Perron		Augmented Dickey Fuller		Level of integration
	Level	Initial Difference	Level	Initial Difference	
Nifty	-9.2565	-848.31	-2.2565	-10.671	P(1)
	(0.599)	(0.01)*	(0.5223)	(0.01)*	
Exchange_Rate	-5.2134	-931.76	-1.623	-9.4446	P(1)
	0.8230	(0.01)*	(0.7451)	(0.01)*	
Gold	-12.589	-1021.7	-2.764	-1027.8	P(1)
	(0.4071)	(0.01)*	0.4071	(0.01)*	

Variable's correlation coefficient is depicted via parentheses () and the p-value is shown where the level of significance is 1% that is denoted by *.

4.4. DCC-GARCH Model

The outcome of the DCC-GARCH for the three variables Nifty, Exchange_Rate and Gold. The outcome of the DCC parameters X and Y depicts the significance that also exposes co-movement of varied time and the huge level of summation value that compromises the non-negative condition of DCC model. The persistence of short run is indicated by X and long run is indicated by Y. The coefficients of ARCH is insignificant with positive and GARCH is significant with positive where the volatility is influenced by the squared residuals and variance of the preceding information. The high persistence exist in volatility that is indicated by alpha and beta. This process effectively acquire the process of GARCH (1,1). The estimated outcome of DCC-GARCH is given in Table 5.

Table 5. Estimated outcome of DCC-GARCH

Variable	Return Equation			Variance Equation		
	μ	λ1	φ	α	β	α+β
Nifty	0.000064	0.116026	0	0.051554	0.44831	0.99671
	(0.146)	(0.00041)	(0.9956)	(0.6397)	(0.0000)*	
Exchange_Rate	0.0000011	0.057781	0	0.030031	0.978123	0.996351
	(0.9989)	(0.1376)	(0.9971)	(0.1917)	(0.0000)*	
Gold	0.000026	0.019056	0	0.077564	0.908565	0.990161
	(0.3185)	(0.6356)	(0.9989)	(0.25577)	(0.0000)*	
DCC in the form of Multivariate						
DCC Parameters	Coefficients		t		p	
X	0.019267		[3.067658]		(0.0022356)*	
Y	0.932336		[45.918787]		(0.0000)*	

Variable's correlation coefficient is depicted via parentheses () and the p-value is shown where the level of significance is 1% that is denoted by *.

The outcome of DCC-GARCH-GJR (model 1) us depicted in Table 6 and variable's volatility is asymmetrically affects the variable return. The positive significance is noted only in Nifty with conditional volatility that enlighten the fact of Nifty returns to positive and negative shocks in the exchange data. None of the other variables doesn't expose the important shocks in asymmetric stock data and the terms of ARCH is not significant. The terms of GARCH are significant in whole variable has high persistence level with conditional volatility. Finally comparison is accomplished among the specification of DCC with GJR and Asymmetric DCC model decides the nature of variables in ADCC model. The parameter Z is insignificant in capturing dynamic correlation and also drop the possibility of identifying the condition via ADCC model. The parameters X and Y in the DCC-GARCH-GJR shows high persistence level both in short as well as long run.

Table 6. Estimated outcome of DCC-GARCH-GJR

Variable	Return Equation			Variance Equation			
	μ	λ1	φ	α	β	Δ	α+β

Nifty	0.000067	0.100569	0	0.018651	0.94051	0.065289	0.95911
	(0.0441)***	(0.00139)*	(0.9881)	(0.5068)	(0.0000)*	(0.002062)*	
Exchange_ Rate	0.0000178	0.01301	0	0.065631	0.933324	-0.02569	0.99891
	(0.4471)	(0.7562)	(0.9897)	(0.1159)	(0.0000)*	(0.28712)	
Gold	0	0.020376	0	0.041899	0.953587	-0.105232	0.99564
	(0.9981)	(0.8077)	(0.9992)	(0.90399)	(0.00037)*	(0.9534)	
	Model 1				Model 2		
DCC in the form of Multivariate							
	Coefficients	t	p		Coefficients	t	P
X	0.019169	[3.4246]	(0.0007)*	X	0.019198	[3.43201]	(0.0007)*
Y	0.931472	[52.845]	(0.000)*	Y	0.929801	[50.1563]	(0.000)*
				Z	0.001602	[0.36382]	(0.724)

Variable's correlation coefficient is depicted via parentheses () and the p-value is shown where the level of significance is 1%, 5%, 10% that is denoted by *,**,***, respectively.

The better model is identified from the outcomes in the Table 7 where the HQ and AIC is minimum in favor of DCC-GARCH-GJR model. The value of log-likelihood is calculated and depicts the huge value DCC-GARCH-GJR. It indicates the better fit among all the models. The DCCGACRH-GJR model shows diagnostic outcome and it is given in Table 8. It is identified that the model is free from the correlation of serial data using the Ljung-Box of every uni-variate series.

Table 7. Selection of Model

Model	Log-likelihood	Hannan-Quinn Information Criteria	Akaike Information Criteria
Model 1	20153.31	-41.139	-41.124
Model 2	20169.34	-41.159	-41.231

Table 8. Diagnostics of elected GARCH model

	Nifty	Exchange_Rate	Gold
ARCH	0.9912	0.1651	36.5702
p-value	(0.3311)	(0.7243)	(0.0593)
LB(12)	12.029	7.898	12.795
p-value	(0.4431)	(0.1658)	(0.37931)

From the statistical analysis, correlation and volatility among the three variables are estimated and analyzed. The above analysis determines the volatility and return value between the variables.

5. Conclusion

Commodities has a substantial role in the progression of economy in numerous countries. Investing amount in stock and selection of suitable stock for the investment that will attain profit for the investors. In this perspective, article exposes the USD/INR of ER is not volatile. The correlation matrix in the unconditional state depict that every variable is correlated significantly. The impact of GARCH is highly robust than the effect of ARCH. The determination of variables and they correlated over certain duration is identified by the DCC-GARCH-GJR that is considered as the best model and mean reverting. The conditional correlation is identified among the variables over a period of time. The outcome of the hedging decisions and portfolio diversification is based on the nature of correlation between the variables. The correlation of nifty, gold and ER are crucial for the policy makers as well as authorities of monetary. An efficient strategy is necessary for framing policies and decision making, which will enrich the rate of volatility. In future the same strategies can be accomplished with some other commodities and soft computing algorithms.

Reference

[1]. Kumar, G., & Misra, A. K. (2018). Commonality in liquidity: Evidence from India's national stock exchange. *Journal of Asian Economics*, *59*, 1-15.

[2]. Nisha, N. (2015). Impact of macroeconomic variables on stock returns: evidence from Bombay Stock Exchange (BSE). *Journal of Investment and Management*, *4*(5), 162-170.

[3]. Kumari, J., Mahakud, J., & Hiremath, G. S. (2017). Determinants of idiosyncratic volatility: Evidence from the Indian stock market. *Research in International Business and Finance*, *41*, 172-184.

[4]. Singh, N. P., & Sharma, S. (2018). Phase-wise analysis of dynamic relationship among gold, crude oil, US dollar and stock market. *Journal of Advances in Management Research*.

[5]. Husnul, H. M., Hidayat, R. R., & Sulasmiyati, S. (2017). Analisis pengaruh inflasi, kurs (IDR/USD), produk domestik bruto dan harga emas dunia terhadap indeks harga saham gabungan (studi pada Indonesia periode 2008-2016). *Jurnal Administrasi Bisnis*, *53*(1), 66-74.

[6]. Robiyanto, R. (2017). The volatility-variability hypotheses testing and hedging effectiveness of precious metals for the Indonesian and Malaysian capital market. *Gadjah Mada International Journal of Business*, *19*(2), 167-192.

[7]. Tuna, G. (2019). Interaction between precious metals price and Islamic stock markets. *International Journal of Islamic and Middle Eastern Finance and Management*.

[8]. Choudhry, T., Hassan, S. S., & Shabi, S. (2015). Relationship between gold and stock markets during the global financial crisis: Evidence from nonlinear causality tests. *International Review of Financial Analysis*, *41*, 247-256.

[9]. Irfan, M., Kassim, S., Dhimmar, S., Zahid, M., & Fuadi, N. F. Z. (2021). REACTION OF ISLAMIC STOCK MARKET TO MACROECONOMIC VARIABLES: A STUDY OF INDIA AND INDONESIA. *JEBIS (Jurnal Ekonomi dan Bisnis Islam)| JOURNAL OF ISLAMIC ECONOMICS AND BUSINESS*, *7*(1), 148-162.

[10]. Alam, M., Rabbani, M. R., Tausif, M. R., & Abey, J. (2021). Banks' Performance and Economic Growth in India: A Panel Cointegration Analysis. *Economies*, *9*(1), 38.

[11]. Mishra, B. R. (2019). The size of fiscal multipliers in India: A state level analysis using panel vector autoregression model. *Global Business Review*, *20*(6), 1393-1406.

[12]. Ahdika, A., Rosadi, D., & Effendie, A. R. (2021). Measuring dynamic dependency using time-varying copulas with extended parameters: Evidence from exchange rates data. *MethodsX*, *8*, 101322.

[13]. Gay, R. D. (2016). Effect of macroeconomic variables on stock market returns for four emerging economies: Brazil, Russia, India, and China. *International Business & Economics Research Journal (IBER)*, *15*(3), 119-126.

[14]. Singh, G. (2015). Relationship between exchange rate and stock price in India: An empirical study. *The IUP Journal of Financial Risk Management*, *12*(2), 18-29.

[15]. Satish, B., & Padmasree, K. (2018). An empirical analysis of herding behaviour in Indian stock market. *International Journal of Management Studies*, *3*(3), 124.

[16]. Patel, M., Dave, M., & Shah, M. (2016). Stock price and liquidity effect of stock split: Evidence from Indian Stock Market. *International Journal of Management Research and Reviews*, *6*(8), 1030.

[17]. Yadav, S. (2017). Stock Market Volatility-A Study of Indian Stock market. *Global Journal for Research Analysis*, *6*(4), 629-632.

[18]. Naik, P. K., & Padhi, P. (2016). Investor sentiment, stock market returns and volatility: evidence from National Stock Exchange of India. *International Journal of Management Practice*, *9*(3), 213-237.

[19]. Birău, R., Trivedi, J., & Antonescu, M. (2015). Modeling S&P Bombay Stock Exchange BANKEX index volatility patterns using GARCH model. *Procedia Economics and Finance*, *32*, 520-525.

[20]. Tripathy, T., & Gil-Alana, L. A. (2015). Modelling time-varying volatility in the Indian stock returns: Some empirical evidence. *Review of Development Finance*, *5*(2), 91-97.

[21]. Chittedi, K. R. (2015). Financial crisis and contagion effects to Indian stock market:'DCC–GARCH'analysis. *Global Business Review*, *16*(1), 50-60.

[22]. Trabelsi, N., Gozgor, G., Tiwari, A. K., & Hammoudeh, S. (2021). Effects of Price of Gold on Bombay Stock Exchange Sectoral Indices: New Evidence for Portfolio Risk Management. *Research in International Business and Finance*, *55*, 101316.

[23]. Jhunjhunwala, S., & Suresh, S. (2020). Commodity and stock market interlinkages: Opportunities and challenges for investors in Indian market. *Global Business Review*, 0972150920946413.

[24]. Kumar, L. V., & Balaguru, R. Rescaled Range Analysis–A Comparative Study on Bombay Stock Exchange and National Stock Exchange.

[25]. Basher, S. A., & Sadorsky, P. (2016). Hedging emerging market stock prices with oil, gold, VIX, and bonds: A comparison between DCC, ADCC and GO-GARCH. *Energy Economics*, *54*, 235-247.

[26]. Hemche, O., Jawadi, F., Maliki, S. B., & Cheffou, A. I. (2016). On the study of contagion in the context of the subprime crisis: A dynamic conditional correlation–multivariate GARCH approach. *Economic Modelling*, *52*, 292-299.

[27]. Kumar, S., Pradhan, A. K., Tiwari, A. K., & Kang, S. H. (2019). Correlations and volatility spillovers between oil, natural gas, and stock prices in India. *Resources Policy*, *62*, 282-291.