Volatility, Open Interest, and Trading Volume in Indian Futures Markets

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Abstract

Purpose : The paper's objective was to scrutinize the impact of trading volume and open interest on the volatility of selected futures contracts of Indian markets. The change in notional behavior and size of such behavior was examined, and the contribution of trading volume and open interest in the behavior of the futures contract prices were investigated.

Methodology and Approach : This study included a sample of daily prices for the period from 2011 – 2019 for 33 futures contracts from Indian futures markets, which included stock and commodity indices, commodities, government securities, and currencies. This study involved a two-stage methodology. In the first part, the E-GARCH model was used to investigate the disproportionate volatility response to various types of shocks. The second part of the methodology focused on investigating the coexistent relations between open interest, trading volume, and volatility using multiple regression analysis.

Findings : The results showed that trading volume and open interest affected volatility, but the direction and quantum of impact depended on various variables. It was also found that trading volume and volatility had positive coexistent relations for most futures contracts.

Practical Implications : These findings have substantial inferences and repercussions for portfolio managers, analysts, and investors for investment assessments and decisions regarding asset allocations in futures markets. Higher volatility will lead to a higher level of fretfulness among market participants and investors, which will push them to be more risk-averse. The results of the study also have pertinent effects for policymakers with respect to the Indian stock market and global countries.

Originality/Value : The author believes that these results would magnify the volatility relations among different futures contracts.

Keywords : futures contracts, E-GARCH, volatility, trading volume, open interest

JEL Classification Codes: C12, C31, G13, G15

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Since the financial crisis in the year 2008, the business of derivatives came into attention for the worry about the risks associated with derivatives due to the observations of the few disaster stories, but on the contrary, there were people who began to understand derivatives and used derivatives as a hedging tool and mitigating risks. The Indian financial markets are expected to lead position and grow more vibrant in the global financial system. As per the changes in the Indian derivatives market, with the introduction of new products, it is expected that the new product range will be able to nurture the needs of a wide class of investors. The relationship of volatility with variables like trading volume and open interest is crucial in the futures market (Martinez & Tse, 2008).

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Trading volume can be adopted as the source for formulating a trading strategy (Moosa et al., 2003). It is broadly considered an important portion of the degree to which the information arrives (Sutcliffe, 2006). It has been observed as a substitute for any new information, which is consistent with the sequential information model (Copeland, 1976) and the mixture of distributions hypothesis (MDH) (Clark, 1973). These theories predicted a positive relationship between trading volume and volatility, supported by Gannon's empirical results (2005).

Open interest is another crucial factor used as a substitute for the distribution of beliefs, and it is also a significant variable that determines volume (Mougoué & Aggarwal, 2011). Open interest shows the total number of outstanding futures contracts. There had been contradictory views regarding the role and impact of open interest in futures markets.

The relationship between volatility, open interest, and trading volume is considered close to the perception of liquidity of futures markets. This accepts homogeneity in investment avenues, and the stakeholders across different markets will be able to make investments in a wide range of securities. The impact of open interest and trading volume and their relationship with volatility significantly impact futures trading. There has been a lot of discussion on the conceptual relationship, but the magnitude of impact has not been analyzed and discussed. Few studies have been conducted with respect to foreign and developed futures markets, but there is still a vacuum with respect to the Indian futures markets. Few previous studies in this area with context to the Indian market were conducted, but they were limited to stock futures contracts only. There is a gap regarding the futures contracts of commodities, currencies, bonds, and interest rates which this study addresses.

Sari et al. (2012) concluded that trading volume was crucial for cultivating predictions of variations in futures prices. The relationship between volatility, open interest, and trading volume was significant as it provided comprehensions regarding the market structures and price speculations. Sutcliffe (2006) concluded that futures trades have three types of effects on open interest: an increase in the open interest due to a number of contracts traded by creating a new position or a decrease in the open interest due to a number of contracts traded by closing an existing position or there is no change in open interest during the creation of a position and exit from a position happen simultaneously.

The findings of this paper will contribute to investment assessments and decisions regarding asset allocations in futures markets. Higher volatility will lead to a higher level of fretfulness among market participants and investors, which will push them to be more risk-averse. The study results will also have pertinent effects for policymakers with respect to the Indian futures market.

Literature Review

Bessembinder and Seguin (1993) concluded the correlation between volatility, open interest, and trading volume in various futures markets. They separated trading volume and open interest into anticipated and unanticipated components. Adopting anticipated and unanticipated futures trading, Bessembinder and Seguin (1993) observed the relationship in major futures contracts. They concluded that as open interest can be considered as a substitute for market depth, it can be anticipated that it may alleviate volatility. On the contrary, the trading volume is related to speculation and was predicted to be positively correlated with volatility.

Ripple and Moosa (2009) studied crude oil futures contracts and found that open interest and trading volume were the factors that determined volatility. They also concluded that trading volume had a positive impact on volatility and open interest had a negative impact on the volatility of crude oil futures prices. Mougoué and Aggarwal (2011) concluded that there was a negative correlation between trading volume and volatility, which implied that there was a lack of support for the mixtures of distributions hypothesis.

Srinivasan (2010) assessed the dynamic relationship between price volatility, trading volume, and market depth for selected stock futures contracts and identified a suitable model to forecast volatility for stock futures contracts in India and concluded that volatility was part and parcel of capital markets and had a significant effect on derivatives market fluctuations, which was due to the key determining factors like inflow of foreign capital into the country, exchange rate, balance of payment, and interest rates. There was also a significant positive relationship between return volatility, expected trading volume, and expected open interest. Unexpected volume and open interest had a greater impact on volatility from the expected trading volume and on open interest; whereas, the market depth did not have any effect on volatility.

Susheng and Zhen (2014) investigated the dynamic relationship between volatility, volume, and open interest in CSI 300 futures market using an asymmetric GARCH model. ARMA-EGARCH model was employed, and it was observed that both contemporaneous and lagged volume indicated positive relation to volatility; open interest had a positive effect on volatility, while lagged open interest had a negative effect.

Gulati (2012) examined the relationship between the closing price and open interest in the Indian index futures market and concluded that open interest information could be used to predict future prices in the long run.

Pati and Rajib (2010) examined the relationship between futures trading activity and price volatility in the Indian stock index futures market. The study investigated the homogeneity of the trading activity on volatility by dividing the series of volume and open interest into expected and unexpected components using ARMA-GARCH and ARMA-GJR-GARCH models and concluded that futures price volatility was positively related to both expected and unexpected components of volume. Conversely, unexpected volume had a greater impact on volatility than expected volume. The relation to expected interest of that of volatility was negative, and the coefficient of unexpected open interest was found to be statistically significant.

Rajan (2011) developed various mathematical models to model the volatility of the stock market using different heteroskedastic models, which could be applied to the Indian context to capture the irregular behavior of the market and different variables.

Gupta et al. (2015) examined the relationship between price volatility, volume, and open interest in eight Indian commodity futures using the GARCH (1,1) model. They emphasized examining the volatility persistence in commodity futures return volatility considering the asymmetric effect. They also used ARMA(1,1) – EGARCH(1,1) model for estimating the volatility. They concluded that trading volume reduced the volatility persistence more than lagged volume, and the trading volume and open interest were ineffective in explaining the GARCH effect for energy commodities.

Floros and Salvador (2016) studied the relationship between volatility, trading volume, and open interest for 36 international futures markets using the E-GARCH model and concluded that market depth affected the volatility, but the direction of the effect was dependent on various factors. Their conclusion supported the empirical studies that there was a positive relationship between trading volume and futures volatility.

Mattack and Saha (2016) studied if the options and futures contracts impacted the volatility or not. They used ARMA-GARCH models and found that the volatility of most of the stocks in the sample decreased after the introduction of equity options and futures.

Dikshita and Singh (2019) studied the different volatility estimators and determined the most efficient volatility estimator using close-to-close, Parkinson, Garman – Klass, Rogers – Satchell, and Yang – Zhang methods. ARIMA was used for estimation. They investigated the efficiency and bias of volatility estimators and concluded that the Parkinson estimator was the most efficient volatility estimator.

Kaur and Singh (2019) studied volatility clustering and asymmetrical features of the Indian index futures markets using GARCH and TGARCH models. They used the NIFTY and MCX futures indices and found conditional volatility and leverage effects in the sample indices. The results showed that positive or negative information had no impact on the volatility.

Khanna and Kumar (2020) studied the flow of information between the U.S. stock market and emerging Asian stock markets from 2000 – 2017 and concluded that information transmission from the U.S. market to other markets was significant during 2007 – 2010, which showed the increased dependency of the markets and the volatility persistence was also found to be significant.

The main objective of this paper is to investigate the empirical relationship between volatility, open interest, and trading volume in futures markets using daily data. The purpose is to capture the magnitude and variation in speculative performance in futures markets by observing the role of variables like open interest and trading volume in the performance and behavior of futures prices of 33 futures markets (currencies, commodities, stock indices, interest rates, and bonds) for the period from 2011– 2019.

Data Sources

For studying the relationship between volatility, open interest, and trading volume, the data considered were the closing prices, the number of outstanding futures contracts, and the number of trades for respective contracts. In order to construct a continuous series of futures contracts, the assumption of the rollover period was made. The data used in the study were for the nearby month contracts having the closest settlement data as trading is most active for nearby months than the far months.

A sample of 33 futures contracts traded in India was taken. These futures contracts are classified into four major categories. These contracts include four currencies futures contracts, six index futures contracts, two government securities contracts, and 21 commodities futures contracts. The commodities futures contracts were further classified into four metal commodities contracts, two energy commodities contracts, seven spices and materials commodities contracts, five pulses commodities contracts, and three spices commodities contracts. This sample and data set are quite unique to investigate the relationship between volatility, trading volume, and open interest.

Table 1 provides a detailed description of each one of the futures contracts used in this study. All contracts cover a time span from January 2011 – December 2019. The data were obtained from the official website of the exchanges where these contracts are traded.

Table 1. ***Futures Contracts Selected in the Study***

Series	Market
Panel 1 : Index Futures Contracts	
NIFTY 50 Futures	NSE
NIFTY BANK Futures	NSE
NIFTY IT Futures	NSE
MCXENERGY	MCX
MCXAGRI	MCX
MCXMETAL	MCX
Panel 2 : Metals Futures Contracts	
Gold	MCX
Silver	MCX
Aluminum	MCX
Copper	MCX
Panel 3 : Energy Futures Contracts	
Crude Oil	MCX
Natural Gas	MCX

Panel 4 : Seeds and Materials Futures Contracts	
Black Pepper	MCX
Cardamom	MCX
Castor Seed	MCX
Cotton	MCX
Crude Palm Oil	MCX
Kapas	MCX
Mentha Oil	MCX
Panel 5 : Pulses Futures Contracts	
Chana	NCDEX
Barley	NCDEX
Bajra	NCDEX
Wheat	NCDEX
Moong	NCDEX
Panel 6 : Spices Futures Contracts	
Turmeric	NCDEX
Coriander	NCDEX
Jeera	NCDEX
Panel 7 : Government Securities Futures Contracts	
Govt. Securities Futures	NSE
91 - Day T Bill Futures	NSE
Panel 8 : Currencies Futures Contracts	
American Dollar (USD)	NSE
British Pound (GBP)	NSE
Japanese Yen (YEN)	NSE
Euro (EURO)	NSE

Methodology

The study is divided into two major parts. The first part deals with measuring volatility estimates using GARCH specifications, which were found to be very effective in previous studies. Volatility measurement includes the variables like open interest and trading volume, which provide significant information regarding the liquidity of futures contracts. In this paper, the relationship between these two variables was considered along with the volatility of price returns. The second part of the analysis includes a regression framework to examine the contemporaneous relationships between volatility, trading volume, and open interest.

Estimates for Conditional Volatility

In this study, the exponential GARCH model (E-GARCH) is adopted. The E-GARCH model can be generalized to describe more lags in the conditional variance. The non-negativity constraints on the parameters are not there in the E-GARCH model. The ARCH term will be categorized into two independent variables, which indicate the sign effect of shocks on volatility and the size (magnitude) effect of shocks on the volatility.

In the E-GARCH model, the logarithm of variance is modeled. Therefore, an implicit assumption is made that the variance is positive at any point in time. The E-GARCH model simplifies the optimization process as there are no restrictions on the coefficients, and it considers the asymmetric response of volatility to shocks of different signs.

The following AR (1) – E-GARCH (1, 1) model is employed to measure the conditional volatility for the returns of futures contracts. The returns are modeled by adopting the equation used by Xekalaki and Degiannakis (2010) for capturing the non-synchronous trading effect.

$$r_t = \log(P_t / P_{t-1}) \quad (1)$$

where, r_t = logarithmic returns = Natural logarithm of price changes

$$r_t = a_0 + a_1 r_{t-1} + \varepsilon_t \quad (2)$$

$$\log(\sigma_t) = \omega + \alpha\left(\left|\frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}}} - \sqrt{\frac{2}{\pi}}\right| + \gamma\left(\frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}}}\right)\right) + \beta\log(\sigma_{t-1}) \quad (3)$$

In the above model, σ_t is the conditional variance of the error term ε_t of the E-GARCH (1, 1) model. Parameters a_0, a_1, ω, α, β, and γ are obtained by using the maximum corresponding likelihood function. The vectors of these parameters are used to estimate θ. The variables α and β in the model show the impact of shocks and previous volatility to total volatility, and γ represents the asymmetric behavior of volatility.

Analysis for the Relationship Between Volatility, Open Interest, and Trading Volume

After obtaining the conditional volatility for the sample, multiple regression is used to investigate the synchronous relation between volatility, open interest, and trading volume. In order to enumerate the proportion of volatility instigated by open interest and trading volume, the estimated volatilities are regressed on these variables.

$$\sigma^2_t = \alpha_0 + \alpha_1 \textit{Open Interest}_t + \alpha_2 \textit{Trading Volume}_t + \varepsilon_t \quad (4)$$

In the above equation, σ^2_t shows the volatility, α_0 represents constant, and α_1 and α_2 show the coefficients of open interest and trading volume, respectively.

Analysis and Results

Results of the E-GARCH Model

The results in Table 2 show the parameters for the E-GARCH model. Before implementing the E-GARCH model, the descriptive statistics are done for all 33 futures contracts in the sample, and the results show that the futures return for all the contracts possess financial attributes like I.O. (1), kurtosis, skewness, etc.

The results of the E-GARCH model show that most of the variables in the model for the variance equation are significant. The results show that the model is able to obtain the volatility behavior over the years in the most appropriate manner. The β value of more than 0.95 and close to 1 in a few futures contracts reflects that there is a very high level of volatility persistence in all futures contracts. Another variable, γ, which represents asymmetric effect, is also found to be significant for the majority of contracts in the sample, but it cannot be used to specify this kind of volatility effect as a conventional characteristic of futures contracts. The asymmetric effect is found to be positive in some contracts and negative in others. Out of 33 contracts in the sample, the asymmetric effect is found positive in 15 contracts and negative in the remaining contracts. These results support the findings of McKenzie et al. (2001) that the futures contracts are gold and are found to have significant symmetric effects.

Table 2. *Results of the E-GARCH Model for Estimating Conditional Volatility*

Series	a_0	a_1	Ω	α	β	Γ
Panel 1 : Index Futures Contracts						
NIFTY 50 Futures	–4.95E-05	–0.017	–0.1045	0.1541	0.9912	0.0811
	(1.77E-05)	(0.0162)	(0.0136)	(0.0096)	(0.018)	(0.0051)
NIFTY BANK Futures	–2.25E-05	–0.0213	–0.2301	0.1311	0.9814	0.1401
	(1.31E-05)	(0.0154)	(0.0195)	(0.0099)	(0.0023)	(0.0066)
NIFTY IT Futures	–2.07E-05	–0.0243	–0.1977	0.1305	0.9818	0.1323
	(1.27E-05)	(0.0159)	(0.0171)	(0.0102)	(0.0021)	(0.0068)
MCXENERGY	–1.08E-04	–0.0460	–0.2703	0.1602	0.9732	0.0752
	(1.91E-04)	(0.0158)	(0.0302)	(0.0112)	(0.036)	(0.0065)
MCXAGRI	–2.03E-04	–0.0339	–0.1428	0.1278	0.9933	0.1018
	(1.28E-04)	(0.0156)	(0.0114)	(0.0075)	(0.0023)	(0.0066)
MCXMETAL	–2.34E-04	–0.0265	–0.0857	0.0853	0.9961	–0.0693
	(1.05E-04)	(0.0148)	(0.0169)	(0.0072)	(0.0021)	(0.0046)
Panel 2 : Metals Futures Contracts						
Gold	–1.62E-04	–0.0010	–0.1020	0.1426	0.9889	–0.0283
	(1.31E-04)	(0.0155)	(0.0132)	(0.0044)	(0.0021)	(0.0039)
Silver	–2.11E-04	0.0191	–0.0633	0.1202	0.9958	–0.0181
	(2.31E-04)	(0.0139)	(0.0105)	(0.0074)	(0.0022)	(0.0041)
Aluminum	–5.98E-04	0.1032	–0.1603	0.1865	0.9704	–0.0011
	(1.99E-04)	(0.0119)	(0.0131)	(0.0037)	(0.0007)	(0.0029)
Copper	2.44E-04	–0.0593	–0.0841	0.1231	0.9864	0.0039
	(2.21E-04)	(0.0129)	(0.0151)	(0.0057)	(0.0012)	(0.0027)
Panel 3 : Energy Futures Contracts						
Crude Oil	–4.89E-04	–0.0049	–0.0529	0.1023	0.9901	0.0436
	(2.13E-04)	(0.0118)	(0.0119)	(0.0067)	(0.0006)	(0.0034)
Natural Gas	–4.92E-04	–0.0302	–0.1072	0.1694	0.9796	–0.0124
	(4.11E-04)	(0.0138)	(0.0159)	(0.0103)	(0.0016)	(0.0026)
Panel 4 : Seeds and Materials Futures Contracts						
Black Pepper	–1.84E-04	0.0459	–0.5711	0.1902	0.9311	0.0179
	(2.90E-04)	(0.0142)	(0.0501)	(0.0133)	(0.0078)	(0.0068)
Cardamom	1.87E-04	0.0402	–0.0838	0.1004	0.9923	0.0149
	(2.58E-04)	(0.0163)	(0.0147)	(0.0081)	(0.0037)	(0.0077)
Castor Seed	–2.49E-04	–0.0050	–0.0702	0.1305	0.9946	–0.0009
	(2.68E-04)	(0.0158)	(0.0126)	(0.0082)	(0.0027)	(0.0056)

Cotton	–8.97E-04	0.1694	–1.7499	0.2692	0.7786	0.0899
	(2.33E-04)	(0.0222)	(0.1794)	(0.0201)	(0.0191)	(0.0101)
Crude Palm Oil	–3.77E-04	0.0484	–0.1891	0.2302	0.9825	–0.0513
	(1.78E-04)	(0.0142)	(0.0234)	(0.0076)	(0.0054)	(0.0081)
Kapas	–2.01E-04	0.033	–0.1500	0.1541	0.9822	–0.0014
	(3.55E-04)	(0.0162)	(0.0188)	(0.0847)	(0.0047)	(0.0067)
Mentha Oil	–4.03E-04	0.0152	–0.0813	0.1486	0.9907	–0.0053
	(2.44E-04)	(0.0166)	(0.0103)	(0.0079)	(0.0024)	(0.0072)
Panel 5 : Pulses Futures Contracts						
Chana	3.51E-04	–0.0041	–0.0501	0.0881	0.9966	0.0239
	(2.52E-04)	(0.00148)	(0.0123)	(0.0072)	(0.0033)	(0.051)
Barley	1.94E-04	0.0351	–0.1641	0.1672	0.9801	0.0083
	(2.25E-04)	(0.0160)	(0.0192)	(0.0073)	(0.0034)	(0.0060)
Bajra	–2.99E-04	0.0001	–0.0899	0.1776	0.9847	–0.0231
	(1.77E-04)	(0.0137)	(0.0151)	(0.0069)	(0.0012)	(0.0037)
Wheat	–7.81E-04	–0.0018	–0.1587	0.1301	0.9814	–0.0393
	(2.71E-04)	(0.0168)	(0.0219)	(0.0076)	(0.0037)	(0.0062)
Moong	2.07E-04	–0.0173	–0.0613	0.1136	0.9937	–0.0013
	(3.02E-04)	(0.0146)	(0.0062)	(0.0074)	(0.0022)	(0.0049)
Panel 6 : Spices Futures Contracts						
Turmeric	4.29 E-05	0.0342	–0.0199	0.0903	0.9977	–0.1074
	(5.83E-05)	(0.0158)	(0.0169)	(0.0054)	(0.0021)	(0.0053)
Coriander	–8.56E-05	–0.0046	–0.0489	0.0631	0.9929	–0.0056
	(7.38E-05)	(0.0139)	(0.0141)	(0.0069)	(0.0009)	(0.0033)
Jeera	–4.75E-05	0.0164	–0.0893	0.0926	0.9893	–0.0039
	(5.13E-05)	(0.0138)	(0.0128)	(0.0072)	(0.0008)	(0.0028)
Panel 7 : Government Securities Futures Contracts						
Govt. Securities Futures	–1.11E-05	–0.0427	–0.0702	0.0714	0.9962	–0.0091
	(9.33E-05)	(0.0150)	(0.0209)	(0.0070)	(0.0023	(0.0048)
91 - Day T Bill Futures	–1.29E-05	0.0052	–0.0512	0.0813	0.9979	–0.0073
	(3.33E-05)	(0.0149)	(0.0093)	(0.0059)	(0.0010)	(0.0036)
Panel 8 : Currencies Futures Contracts						
USD	–1.73E-05	–0.0253	–0.1053	0.1202	0.9904	0.0295
	(9.59E-05)	(0.0151)	(0.0133)	(0.0077)	(0.0017)	(0.0048)
GBP	–4.42E-05	0.0041	–0.1093	0.0829	0.9910	0.0123
	(7.12E-05)	(0.0155)	(0.0177)	(0.0075)	(0.0021)	(0.0046)
YEN	6.67E-05	–0.0065	–0.1971	0.1242	0.9823	–0.0256
	(8.85E-05)	(0.0146)	(0.0239)	(0.0084)	(0.0028)	(0.0055)
EURO	3.62E-05	–0.0191	–0.0561	0.1276	0.9967	0.0203
	(5.67E-05)	(0.0153)	(0.0160)	(0.0093)	(0.0023)	(0.0056)

Note. –4.95E-05 means 4.95 times ten to the minus five power, or –0.0000495. As the number is so small, therefore, the numbers are shown in the shorter format for the proper formatting of the table.

Table 3. ***Results Showing the Relationship Between Volatility, Open Interest, and Trading Volume***

Series	Constant	α_1	α_2	R^2
Panel 1 : Index Futures Contracts				
NIFTY 50 Futures	–0.0156	–0.0132	0.0207	0.1965
	(0.1962)	(0.0049)	(0.0027)	
NIFTY BANK Futures	–0.0696	0.0042	0.0011	0.035
	(0.3433)	(0.0021)	(5.0132e-05)	
NIFTY IT Futures	0.0235	–0.0019	0.0015	0.414
	(0.0903)	(0.0004)	(2.1291e-04)	
MCXENERGY	0.0509	–0.0077	0.0057	0.0203
	(0.3451)	(0.0069)	(0.0021)	
MCXAGRI	–0.0042	–0.0041	0.0062	0.0411
	(0.1017)	(0.0029)	(0.0023)	
MCXMETAL	0.0417	–0.0039	10.0159e-04	0.2133
	(0.0069)	(4.4571e-05)	(8.1394e-05)	
Panel 2 : Metals Futures Contracts				
Gold	–0.0467	0.0032	0.0039	0.1131
	(8.7462e-05)	(1.2538e-05)	(3.7159e-05)	
Silver	0.0311	–0.0104	0.0143	0.0912
	(0.0272)	(2.7163e-05)	(2.4195e-05)	
Aluminum	0.1121	–0.0113	0.0046	0.0289
	(0.0018)	(4.5638e-05)	(2.0389e-05)	
Copper	0.2703	–0.0275	0.0092	0.0504
	(0.0218)	(1.7592e-05)	(3.0158e-05)	
Panel 3 : Energy Futures Contracts				
Crude Oil	0.2986	–0.0418	2.0357e-04	0.0351
	(0.0195)	(4.5294e-05)	(2.3840e-04)	
Natural Gas	0.5803	–0.0261	0.0159	0.0717
	(0.0399)	(6.4293e-05)	(4.3297e-04)	
Panel 4 : Seeds and Materials Futures Contracts				
Black Pepper	0.0276	0.0028	9.3469e-05	0.0054
	(0.0019)	(1.8703e-05)	(2.0361e-05)	
Cardamom	–0.0210	0.0087	0.0046	0.0212
	(0.0037)	(3.1208e-05)	(1.6837e-05)	
Castor Seed	0.0168	6.1397e-05	9.8627e-05	0.0068
	(8.2349e-05)	(2.3684-e05)	(5.6728e-05)	
Cotton	0.5512	–0.0503	4.0167e-05	0.2249
	(0.0146)	(3.2764e-05)	(9.1573e-05)	
Crude Palm Oil	0.1049	–0.0097	0.0047	0.0083
	(0.0093)	(2.3259e-05)	(9.6207e-05)	
Kapas	0.2237	–0.0057	0.0105	0.0539

	(0.0132)	(3.0349e-05)	(2.1372e-05)	
Mentha Oil	0.3611	–0.0342	0.0356	0.0603
	(0.0051)	(8.0751e-05)	(4.6149e-05)	
Panel 5 : Pulses Futures Contracts				
Chana	0.1647	–0.0091	0.0037	0.0535
	(0.0063)	(4.8931e-05)	(1.6813e-05)	
Barley	–0.0961	9.4173e-05	0.0118	0.0971
	(0.4179)	(7.1937e-05)	(0.0059)	
Bajra	0.0065	–0.0109	0.0149	0.0317
	(0.0078)	(9.8375e-05)	(7.5821e-05)	
Wheat	–0.0732	0.0036	0.0088	0.0811
	(0.0032)	(4.0294e-05)	(3.5719e-05)	
Moong	0.0419	6.1962e-05	10.2581e-05	0.0297
	(0.0044)	(6.3789e-05)	(4.9473e-05)	
Panel 6 : Spices Futures Contracts				
Turmeric	0.0067	–3.1865e-04	1.6239e-05	0.0493
	(2.5731e-04)	(5.3289e-05)	(3.0203e-05)	
Coriander	0.0259	–10.4156e-04	7.2152e-05	0.0564
	(0.0135)	(8.1129e-05)	(2.3873e-05)	
Jeera	0.0129	–9.6419e-04	4.3783e-05	0.1058
	(4.9639e-04)	(2.3195e-05)	(3.8367e-05)	
Panel 7 : Government Securities Futures Contracts				
Govt. Securities Futures	0.0393	–0.0023	6.0394e-05	0.1521
	(0.0036)	(3.3157e-04)	(2.0364e-05)	
91 – Day T Bill Futures	0.0028	–10.3724e-05	5.1364e-05	0.0312
	(9.0491e-04)	(2.3792e-05)	(8.6413e-05)	
Panel 8 : Currencies Futures Contracts				
USD	0.0283	–0.0048	0.0033	0.0603
	(0.0205)	(0.0014)	(8.4529e-05)	
GBP	0.0131	–0.0024	8.9410e-04	0.1126
	(0.0039)	(3.4212e-05)	(7.8139e-05)	
YEN	0.0199	–0.0041	0.0028	0.1719
	(0.0112)	(1.3162e-05)	(2.0329e-05)	
EURO	0.0309	–0.0036	4.9637e-04	0.1047
	(0.0092)	(8.6358e-05)	(1.3972e-05)	

Note. 5.0132e-05 means 5.0132 times ten to the minus five power, or 0.000050132. As the number is so small, therefore, the numbers are shown in the shorter format for the proper formatting of the table.

OLS regression method (Table 3) is adopted to check the relationship between volatility, open interest, and trading volume. The regression equation is used to estimate the determinants of volatility based on independent variables like open interest and trading volume. The volatility of futures contracts in the sample is regressed on open interest and trading volume as per the regression equation.

The regression analysis results show that the trading volume has a positive β coefficient with volatility and is significant at 1%. The trading volume explains the futures markets volatility and has an explanatory power for conditional volatility for all the futures contracts in the sample. These results suggest that an increase in the trading volume leads to increased volatility in the futures markets. It shows that if there are more trades on a futures contract, it increases price volatility. These findings support the literature like sequential information model (Copeland, 1976) and the mixture of distributions hypothesis (MDH) (Clark, 1973), which predicted a positive relationship between volatility and trading volume. These theories concluded that the investors received the information in the market at different time. Some investors might receive information earlier than others, and few may not receive the information at all. Due to the absence of availability of concurrent information to all, there will be an increase in trading volume, which will lead to increased volatility chronologically based on information arrival. This also results in a positive correlation between trading volume and volatility.

On the other side, the relationship of open interest with volatility is significant at 1%, but the β coefficient with volatility is negative for most of the futures contracts in the sample. The sample has seven futures contracts like NIFTY bank futures, gold, black pepper, castor seeds, cardamom, barley, and wheat, where the β coefficient is positive and significant. These results support the findings of Watanabe (2001), who found a negative relationship between open interest and volatility for stock indices, government securities, energy commodities like crude oil, and interest rates. He concluded that with an increase in open interest, the volatility diminishes. The results reflect that the market depth represented by open interest has a significant impact on the futures volatility, but this impact is dependent on the nature of the futures contract and market characteristics. Generally, an increase in open interest leads to increased liquidity for the futures contracts, which leads to more stable prices and decreased volatility.

Conclusion

The study analyzes the relationship between volatility, open interest, and trading volume in futures markets for 33 futures contracts of indices, currency, commodities, metals, and government securities. The first part of the study shows the parameters of the E-GARCH model. We can conclude that most of the variables are significant, and the model is able to attain the behavior of volatility for a long-time frame in a proper manner. The results also show that all futures contracts in the sample replicate a very high volatility persistence, and most of the futures contracts show a significant asymmetric effect.

Another part of the study focuses on the relationship between these variables using open interest and trading volume as explanatory variables and adopting regression analysis. The results show that the trading volume has a positive and significant relationship with volatility. It explains the futures markets volatility and has an explanatory power for conditional volatility for all the futures contracts in the sample. These results suggest that an increase in the trading volume leads to increased volatility in the futures markets. On the other side, the relationship of open interest with volatility is significant but is negative for most of the futures contracts in the sample. The results of R^2 show that open interest and trading volume contribute up to 23% of volatility for futures contracts, and they are significant variables triggering volatility.

Managerial and Theoretical Implications

This study contributes in the following ways. First, the relationship between volatility, open interest, and trading volume is considered companionable to the perception of liquidity of futures markets. This accepts homogeneity in investment avenues, and the stakeholders across different markets will be able to make investments in a wide range of securities.

These findings have substantial inferences and repercussions for portfolio managers, analysts, and investors for investment assessments and decisions regarding asset allocations in futures markets. Higher volatility will lead to a higher level of fretfulness among market participants and investors, which will push them to be more risk-averse. The results of the study also have pertinent effects for policymakers with respect to the Indian stock market and the global countries.

Further, these results are recommended to policymakers, regulators, and researchers on the one hand and firms' managers as well as investors on the other. FIIs ; HNIs ; individual, institutional, and public investors can make decisions regarding their trades in futures markets based on these results.

Limitations of the Study and Scope for Future Research

This study is constructed on the secondary data of futures contracts which included daily closing prices. This study does not involve the weekly or monthly prices, which can be used for further analysis, such as seasonality in futures markets.

Another limitation of the study is that it includes the nearby month contracts having the closest settlement data as trading is more active for nearby months than the far months. But it may be possible for some futures contracts that trading may be active for far months contracts, and the relationship may be different from what is found for nearby months. This study consists of 33 futures contracts from different Indian futures markets only.

This study has shown the relationship between open interest, trading volume, and volatility. The results show a significant relationship of open interest and trading volume with volatility. Further research can analyze the factors behind the positive or negative relationship of trading volume and open interest, respectively with volatility.

This study has used the E-GARCH model and OLS regression analysis to study the relationship between open interest, trading volume, and volatility. A similar kind of study can be done using other models or methodologies like impulse response function for causal analysis, which may disclose the contribution of open interest or trading volume in explaining volatility.

This study consists of 33 futures contracts from different Indian futures markets only. A similar kind of study can be done using different futures contracts from various international markets or similar kinds of futures contracts from different international markets.

Author's Contribution

Dr. Nisarg A. Joshi conceived the idea and developed the quantitative methodology to undertake the empirical study. He mined empirical literature and extracted the concepts relevant to the study. The numerical computations were done by Dr. Joshi using E-views 10.0 Enterprise Edition. He is the sole author of the manuscript and wrote and edited the final manuscript.

Conflict of Interest

The author certifies that he has no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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