Theoretical and Applied Economics
Volume XXVIII (2021), No. 1(626), Spring, pp. 289-296

A pragmatic evaluation of the interconnection between currency futures return volatility, open interest and volume

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Abstract. *In an efficiently functioning market, the exchange rate and return from the currency futures contract should be perfectly contemporaneously correlated. In this article, the authors investigated the interconnection between volatility and trading activity (open interest and volume) during January 2012 to March 2020 in Indian currency futures market. Data on three variables are used: trade settlement rates, open interest, and trading volumes for each one of the currency futures contracts. The paper found the corroboration of time-varying volatility, which exhibits high persistence and predictability in the Indian futures market. The results imply that the speculative activities, as proxied by the volumes, tend to increase the futures volatility from the GARCH (1,1) model and trading volumes have a positive relationship with volatility, while open interests have a negative relationship with volatility. The ramifications imply that futures volatility from the GARCH (1,1) model increases based on speculative activities which are proxied by the volume. Thus, Open interests have a negative impact with volatility, but trading volumes have the exact opposite relationship.*

Keywords: currency futures, volatility, volume, and open interest.

JEL Classification: C58, G12, G13.

Introduction

For a long time, the edifying role of trading activity in futures exchanges on price volatility has created a lot of interest. Especially, in emerging exchanges, where the trading activity is comparatively low with high price volatility; the relationship between trading activity and price changes are crucial. Relatedness is formed between volatility, trading volume and the quality of information flow based on the trading volume received by traders. Positive interdependence between trading volume and price volatility is comprehensively documented, including Karpoff (1987) citing 18 studies leading to the same volatility-volume relationship. A hedger's expectations, his demands, differences in trader's opinions and market dept impact the Futures trading volume and open interest. It is pertinent to explore the interdependence of volatility with liquidity variables such as open interest and trading volume.

The competence and development of price discovery is determined by the subtle change in volume and volatility tie-ins. The traditionally developed financial markets have been the subject of numerous empirical studies on this relationship. Hardly a few studies have focused on the emerging markets, predominately using commodity futures and index data and never really concentrated on currency futures. The current study will contribute to the fledging literature on price discovery in emerging capital markets, with focal point at firm level.

The study investigates the correlation between volatility in return and trading activity during 2012 to 2020 in Indian currency futures market. The reminder of the article is organised as follows: Section 2 discusses review of literature. Section 3 presents the methodology used to analyse the relationships between volatility, open interest, and trading volume and describes the dataset. Section 4 discusses the empirical results for the combined relationships between volatility in return, opens interest and trading volume. Finally, section 5summarises and concludes the study.

A review: Volatility, volume and open interest

For any market in a single trading day the numbers of contract changing hands or amount of trading activity is "Volume". Substantial amount of trading during a market session leads to higher trading volume. Volume is linearly and positively related to absolute value of price change. Outstanding contracts that are held by traders at the end of each day determine the open interest. The volume measures the intensity behind a price trend and the open interest measures the flow of money into the futures market.

Parallels between price variability and the trading volume for futures and equities have been investigated extensively. A large number of empirical studies show that there is a positive correlation between trading volume and price variability in equities and futures markets. Epps and Epps (1976), Clark (1973), Cornell (1981), and Tauchen and Pitts (1983) find a positive relationship between price variability and trading volume. Karpoff (1987) finds a positive relationship between an absolute price change and volume in both

equities and futures markets. The relationship between open interest and volatility on the futures market had always been of experimental attentiveness. Kamara (1993) and Bessembider and Seguin (1993) both considered open interest as a vital parameter for the purpose of market depth and hedging. Fung and Patterson (1999) based on developed market, reveals that open interest reduces volatility while volume increases volatility in currency futures markets.

Girma and Mougoue (2002) found that contemporaneous (lagged) volume and open interest provide a significant explanation for futures spreads volatility when entered separately. The lagged volume and lagged open interest have a greater effect on volatility and substantially reduce the persistence of volatility. Gagnon and Karolyi (2003) findings reveal a significant short-run dependence in returns and volatility and the return spillovers are very sensitive to interactions with trading volume.

Omran (2009) found that the persistence in volatility is not eliminated when contemporaneous trading volume is incorporated and anticipated information shocks can have a negative impact on the volatility of return. It documented that, when the volume is further broken down into its expected and unexpected components, volatility persistence decreases. Eaves and Valero (2009) states the volume–volatility link is positive and stays constant or strengthens as traders' beliefs about value become more precise. Ferris et al. (2002) found that index futures market volatility increases when investors sell off their futures positions with relatively larger drops in futures prices. Pati and Rajib (2010) results indicate that inclusion of both contemporaneous and lagged trading volume reduces the persistence in volatility, but contemporaneous volume provides a greater reduction than lagged volume.

Kumar and Pandy (2010) found positive relationship between volatility and volume. It reveals open interest does not proxy for information. Overall, most literature confirmed the positive relationship between volume and volatility, while the relationship between volatility and open interest is still ambiguous. Salvador (2016) proved open interest helps explain futures market volatility and trading volume contributes positively and significantly in explaining the conditional volatility of futures markets. Desai and Joshi (2018) reported futures market volatility influenced by depth of the market but the influence depends on the type of contract.

Research methodology

In this study, we measure volatility using a time-series model, GARCH specifications which have been very apt (Engle, 2001). The volume and open interest provide information that accounts for liquidity characteristics of futures contracts. Volume is usually measured as the total number of contracts traded during a day. Further, one can obtain the volatilities of futures returns and we analyse the relationships between three variables (open interest, trading volume and return volatility).

Data

For the empirical analysis, data on three variables are used: trade settlement rate, open interest and trading volumes for the currency futures contracts. For the present analysis, we have collected data on the currency futures of USD-INR (United States Dollar-Indian Rupee), EUR-INR (Euro-Indian Rupee), JPY-INR (Japanese Yen- Indian Rupee), and GBP-INR (Great Britain Pound-Indian Rupee). We use data from the nearby month contracts, i.e. the contracts with the closest settlement date. Trading is usually most active for these contracts as compared to deferred contracts. All contracts cover a time span from January 2012 to March 2020 (1,812 observations). The data was obtained from NSE. For empirical analysis all the collected data have been converted into natural logarithm.

Estimating conditional volatility

For estimating the conditional volatility, we applied Autoregressive Conditional Heteroskedasticity (ARCH) model. This model was introduced by Engle (1982) and modelled as GARCH (Generalized ARCH). GARCH models and its applications are widely used in time series analysis (Bollerslev et al. (1992), Bollerslev et al. (1994)). The GARCH (p,q) model captures the tendency in financial data for volatility clustering and heteroskedasticity into the estimation procedure.

Firstly, returns for currency were calculated as following:

$Rt = ln(Pt / Pt\text{-}1)$

To identify the model return series and lag length, the Schwarz information criterion (SIC) were calculated for lags one to six and lag order of 1 was found appropriate. In this study the researcher used GARCH formulation:

$R_t = b_o + b_1 return_{t-1} + \varepsilon_t \sim (0,\sigma_t)$

$$\sigma_t^2 = \delta + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2$$

Result and discussions

The empirical results begin with the descriptive statistics of the currencies (open interest, trade volume, and futures return) selected for the study as shown in Table 1. The mean return for EURFR and GBPFR is almost zero percent. The highest mean return is observed in case of GBPFR followed by EURFR. The standard deviation as a measure of volatility is highest for GBPFR followed by EURFR, USDFR, and JPYFR. So, the risk and return relationship is positive for the four currency pairs. The volatility measures are larger than the mean values. The results show that the return series of the currency futures have positive skewness for all currencies and all return series are leptokurtic. Also, Jarque-Bera (JB) statistics rejects the null hypothesis of normality. The result reveals that the currency futures market is not informationally efficient for the currency pairs.

Table 1. Descriptive statistics for open interest trading volume and futures return

Variable	Mean	Std. dev	Skewness	Kurtosis	Jarque-Bera
EUROI	48264.34	23975.02	1.027402	4.634005	509.7351
EURFR	0.000168	0.000249	12.14617	212.6889	3301119
EURVOL	66600.82	34774.12	1.298244	7.036996	1703.932
GBPOI	32801.24	18650.05	0.716112	3.354422	160.9985
GBPFR	0.144380	0.311041	4.527662	26.40038	46641.15
GBPVOL	74658.17	57982.37	3.219459	30.29491	58166.15
JPYOI	19330.37	12408.93	0.968882	3.359389	287.2608
JPYFR	6.19E-05	8.24E-05	9.353829	121.4685	1065671.
JPYVOL	31712.79	20095.22	1.935884	10.90359	5728.611
USDOI	1420375	603282.5	0.527453	3.692834	117.8042
USDFR	2.15E-05	2.04E-05	4.235291	26.14558	45003.32
USD VOL	1891525	942539.5	1.097098	4.409842	503.0755

Source: Authors estimation.

Test of stationarity and price discovery process

The currency futures data series are indicated in logarithm form and tested by using augmented Dickey Fuller (ADF). ADF test confirms the presence of unit root and shows stationarity at first difference. There is high volatility in the currency futures return it's proved by the low mean and high standard error. The researcher tested autocorrelation to know the impact of past value which affects the future returns and the result shown in |Table 2.

Table 2. *Autoregressive result*

Variable	AR(1)	SIGMASQ	R-squared	Schwarz criterion	Durbin-Watson stat
EURVOL	-0.40047	0.176775	0.160402	1.117723	2.219129
EUROI	-0.27823	0.183661	0.077365	1.155886	2.111352
EURFR	-0.09108	0.000174	0.008303	-5.80721	2.059463
JPYVOL	-0.40207	0.201653	0.161807	1.249397	2.227275
JPYOI	-0.25339	0.14261	0.064151	0.902896	2.087962
JPYFR	-0.19879	8.57E-05	0.03956	-6.5146	2.016163
USDVOL	-0.34492	0.153706	0.11899	0.97786	2.172811
USDOI	-0.1255	0.04776	0.015751	-0.19106	2.036744
USDFR	0.007896	.21E-05	0.000062	-7.88031	1.999355
GBPVOL	-0.42184	0.162478	0.176433	1.0334	2.226616
GBPOI	-0.27075	0.181865	0.072326	1.146057	2.089877
GBPFR	-0.20196	7.03E-05	0.040734	-6.71264	2.007995

Source: Authors estimation.

To investigate whether a GARCH model is appropriate for modelling, several tests are carried out. To check the presence of ARCH effect in the data series the researcher considered Ljung-Box (LB) Q-stat of the squared residual obtained. LB Q-stat for the various lags is significant, suggesting the presence of ARCH effect. A more formal test for the presence of the ARCH effect is done using the ARCH LM test. To capture this time varying heteroskedasticity we proceed to run the model using the most suitable ARCH model. After all these tests; heteroskedasticity needs to be modelled. GARCH (1,1) models, it is able to model the time varying heteroskedasticity parsimoniously.

Table 3. *Generalized autoregressive conditional hetroskedasticity result*

Variable	RESID(-1)^2	GARCH(-1)	R-squared	Durbin-Watson stat	p-value
EURVOL	0.311165	0.116639	0.160034	2.245557	0.015
EUROI	2.971618	-0.00178	0.029388	2.464522	0.1342
EURFR	0.218826	0.357416	5.97E-03	1.9984	0.0001
JPYVOL	0.1204	0.305275	0.161349	2.241404	0.0001
JPYOI	1.570908	-0.00434	0.047754	2.300908	0.5001
JPYFR	0.199639	-0.04664	0.022016	2.272159	0.415
USDVOL	0.134414	0.185463	0.117051	2.23398	0.0001
USDOI	2.307521	-0.00072	0.009571	2.168539	0.4480
USDFR	0.037491	0.954017	0.000016	2.006219	0.0001
GBPVOL	0.191847	0.330005	0.175549	2.26403	0.0001
GBPOI	0.566027	-0.02269	0.070314	2.144483	0.003
GBPFR	0.210976	-0.07568	0.017338	2.307571	0.382

Source: Authors estimation.

The relationship between open interest and the trading volume for currency futures market was investigated. And the effect of trading volume and open interest on volatility in return was observed in futures markets. Table 3 presents the estimate of the GARCH (1, 1) model for currency futures return with current open interest and trading volume. Return is the dependent variable, while open interest and trading volume are used as explanatory variables in the conditional variance function. The futures return volatility shows a high level of persistence. The findings show that current open interest and trade volume has marginal explanatory power for the currency future return volatility. The coefficient of the contemporaneous open interest in the conditional variance equation, is statistically significant at 1 percent level. Investors emphasize the information of open interest for various objectives and motives. It had been observed that an increasing or upward trend is confirmed when the open interest increases with an increase in price. Moreover, open interest is a crucial parameter in technical analysis. The open interest measures market depth. The researcher's present time series plots of variables along with the distribution plots in Figures 1-4. The data series show that the most volatile series is GBP and it shows fluctuations throughout the study period.

Figure 1. *Volatility in return (USD/INR)*

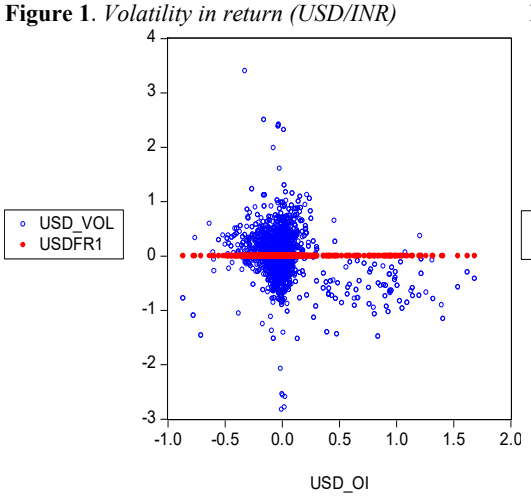


Figure 2. *Volatility in return (JPY/INR)*

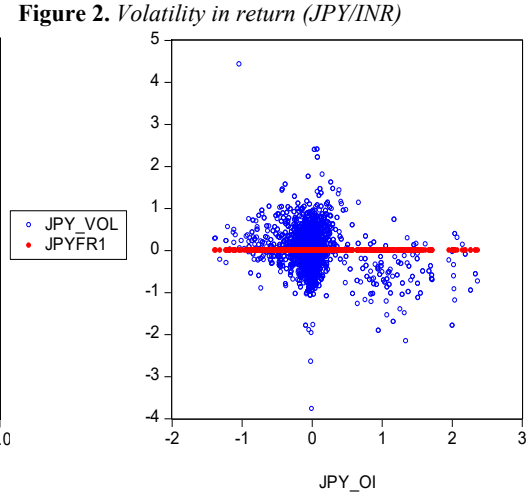


Figure 3. *Volatility in return (GBP/INR)*

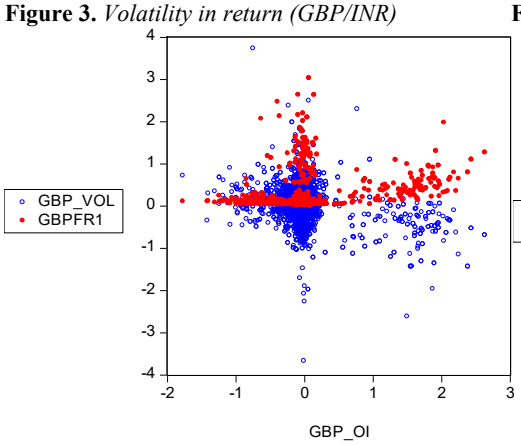
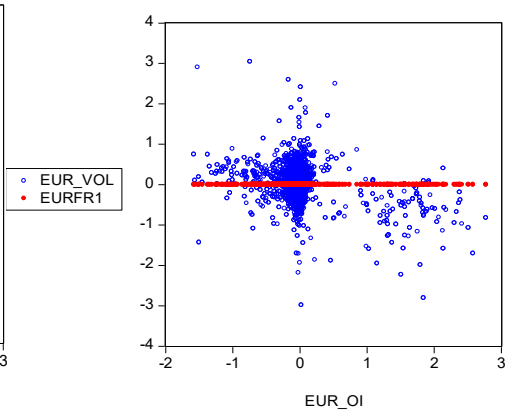


Figure 4. *Volatility in return (EUR/INR)*



Conclusion

This paper analysed trading activity implications by considering open interest and trading volume on return volatility in Indian currency futures markets. The open interest and trading volume effects on price volatility, it reflects market information for investors. The researchers applied GARCH (1,1) model study on the impact of open interest and trading volume on volatility. We found the evidence of time-varying volatility, which exhibits high persistence, and predictability in the Indian futures market. The result imply that the speculative activities, as proxied by the volumes, tend to increase the futures volatility From the GARCH (1,1) model, trading volumes have a positive relationship with volatility, while open interests have a negative relationship with volatility. Open interest can mitigate price volatility in Indian currency futures exchanges. The results of this study would be of economic significance and have important implications for the traders, regulatory bodies, and practitioners. If the volume-price volatility relationship is positive, it implies that the futures contract will be successful only to the extent that there is enough price uncertainty associated with the underlying asset. Increased trading volume causing increased volatility may suggest the need for greater regulatory restrictions.

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