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Volume and Return Relationship in the Selected Commodity Futures in India during 2009-13

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Abstract

This paper examines the empirical relationship between return, volume and volatility dynamics of Indian commodity market by using daily data of selected commodities of MCX and NCDEX during the period from July 2009 to June 2013. Soya oil, Chana, Lead, Silver, Crude oil were chosen for the study. The contemporaneous relationship between returns and trading volume and asymmetric relation between level of trading volume and returns is examined. In case of volatility, asymmetric relation is also examined between conditional volatility of return and volume. EGARCH(1,1) model has been used as it measures the volatility clustering along with the information asymmetry. The results supports contemporaneous relationship between volumes and returns only in Chana and Silver but the impact of volume on volatility of returns is significant in all the selected commodities except in Soya oil. Persistence of Volatility and asymmetry is also evident in the results indicate the presence of market inefficiencies. The study proves that the volume not only acts as proxy of information but also provide information about the precision and dispersion of information signals.

Key words: Contemporaneous relationship, Volume return relationship, EGARCH (1,1, Information asymmetry, Volatility Clustering.JEL Classification: G13, G14, C22.

Introduction

Relationship between volume and return has been the fascinating area for the financial economists and analysts. The contemporaneous relationship between the volume and return has been widely documented in the literature. Previous empirical studies have showed strong positive correlations between trading volume and price volatility or absolute returns (Karpoff, 1987). Low liquidity generally implies high volatility and high liquidity implies low variability as the volume of trade contains information in itself which is very important in the traders' viewpoint. Therefore, trading volume reflects information about changes and agreement in investors' expectations (Harris and Ravi, 1993). There are many theories that explain how volume information flows in the market. These theories explain the contemporaneous relationship between return and volume along with the impact of volume information on asymmetry of volatility in the returns.

Mixture-of-Distribution Hypothesis (MDH)

The Mixture-of-Distribution Hypothesis (MDH) pioneered by Clark (1973), Epps and Epps (1976), Tauchen and Pitts (1983), and Bollerslev and Jubinski (1999) has always remained the centre of attention for researchers conducting research on trading volume and returns. MDH explains the positive relationship between price volatility and trading volume as both depend on a common factor - information shock. According to MDH, returns are generated by mixture of distribution and information arrival is the mixing variable. This mixing variable causes impulse in the squared residual of daily returns and hence autoregressive nature of the conditional volatility. As the information arrival is unobserved, trading volume is usually considered as a proxy of information flow into the market. Any unexpected information affects both volatility and volume contemporaneously and, therefore volatility and volume are hypothesized to be positively related.

Sequential Information Arrival Hypothesis (SIAH)

Another popular hypothesis that is advocated in explaining the volume-volatility or absolute return relationship is Sequential Information Arrival Hypothesis (SIAH). This model suggests the information disseminates gradually even before the arrival of final equilibrium, a series of intermediate equilibrium exists (Copeland (1976), Morse (1980), Jennings et al. (1981), and Darrat et al. (2003)). In other words, new information is disseminated sequentially to traders, and traders who are not yet informed cannot perfectly work out the presence of informed trading.

SIAH further explains that traders tend to receive information in a sequential, random manner where all traders revise their expectations accordingly. According to this hypothesis, traders do not receive the information at the same time which creates incomplete equilibrium. To reach the final equilibrium, all traders tend to react to the information signal simultaneously so that current trading volume can be predicted with accuracy. The sequential arrival of new information to the market generates both trading volume and price movements with both increasing during periods characterized by numerous information shocks (Nguyen and Diagler (2006)). While MDH implies only contemporaneous relationship, the SIAH further suggests a dynamic relationship whereby lagged values of volatility may have the ability to predict current trading volume and vice-versa (Darrat et al. (2003)).

Need for the Study

The contemporaneous relationship between the volume and return has been widely documented in the literature. In general, previous empirical studies have noted strong positive correlations between trading volume and price volatility/

absolute returns (Karpoff, 1987). There are many studies explaining the relationship between volume and return relationship in the stock markets. By contrast, relatively little attention has been devoted to this relationship in commodities in India. As the commodities derivatives market in India has recently emerged, there is a need to study the relationship between volume and return in the Indian commodity derivatives market to study the informational efficiency. The GARCH specification allows the current conditional variance to be a function of the past conditional variances. Therefore, the current study investigates return, volume, and volatility relationship in the Indian stock market using symmetric and asymmetric GARCH models.

Objectives of the Study

The main objective of this research is to study the volume and returns relationship of selected commodity derivatives traded in MCX and NCDEX from 2009 to 2013. This study identifies both the impact of volume on the returns and the impact of volume on the volatility of returns. It is also intended to study volatility persistence and information asymmetry in the volume and return relationship.

Review of Literature

A positive relationship between return and volume is widely acknowledged in the financial literature. Ying (1966) suggested that a large volume is usually accompanied by a fall (rise) in price. Karpoff (1987) reviewed previous studies on the price-volume relation and concluded that there is a positive correlation between volatility and volume. The results from Cornell (1981) and Tauchen and Pitts (1983) also supported MDH. Cornell (1981) showed a positive correlation between the changes in average daily volume and changes in the standard deviation of daily log price relatives for 14 of the 18 commodities. Also, Tauchen and Pitts (1983) supported the MDH and showed that the joint distribution of changes in price and volume are modelled as a mixture of bivariate normal distributions.

On the other hand, Mestal et al. (2003), Mishra (2004), Henryk et al. (2005) found evidence of unidirectional granger causality from return volatility to volume. Otavio and Bernardus (2006) reported the bidirectional causality between the variables, which implied that the strong form of market efficiency holds since private information is reflected on stock prices.

Bessembinder and Seguin (1993) divided volume into expected and unexpected components to examine the relation between price volatility and trading volume for futures markets. In general, the results show a positive relation between volume and volatility. They identified that 'the effect of unanticipated volume shocks on volatility is asymmetric'.

Sharma et al. (1996) took into consideration the assumption of conditional normality and conditional t-distribution. The results suggested that volume may contribute significantly in explaining the GARCH effects. In other words, the introduction of volume does not eliminate the GARCH effects completely. However, the coefficient of volume is found to be positive and statistically significant. Sarika and Balwinder (2009) identified that the volume provides information on the precision and dispersion of information signals, rather than serving as a proxy for the information signals itself (Sarika and Balwinder, 2012). There is not significant reduction in volatility persistence even after inclusion of volume in variance equation. Simultaneous trading participation of informed and un-informed traders increases information asymmetry because later trades on noise rather than on information induce jumps in the price changes and results into volatility clustering.

Chen et al. (2001) find persistence of volatility is not eliminated when trading volume is used in the GARCH model. As cited in Ahmed and Nasir (2005), financial time series behave in such a way that does not conform to the normality distribution. Herbert (1995) and Ciner (2002) found that lagged trading volume contains predictive power for current price volatility. These empirical results provide evidence against the mixture of distributions hypothesis and instead, support the sequential information arrival hypothesis. Wang and Yau (2000) also explained that the current volume and lagged volume helps in explaining price volatility.

Methodology

Analytical method is used for the current study. It is a quantitative method which determines the relationship between one thing [an independent variable] and another [a dependent or outcome variable]. The analytical method involves the application of various tools and techniques for the analysis of the data already available which is the secondary data in nature, and drawing conclusions based on the analysis. The time period from July 2009 to June 2013 is considered for the data analysis of the present study. This study period represents the post-economic crisis period. Log normal values are considered for analysis in order to avoid methodological errors.

Five commodities have been chosen for the present study viz., Soya oil, Chana, Silver, Lead, and Crude oil. The individual commodities have been chosen based on their trading volume (Forward Market Commission Annual Report-2013-14) and the variety.

Model Specification

Financial time series such as stock prices often exhibit the phenomena of volatility clustering. To observe this phenomena, ARCH model introduced by Engle (1982) and Bollerslev's (1986) generalized ARCH (GARCH) model are used. The GARCH specification allows the current conditional variance to be a function of past conditional variances, allowing volatility shocks to persist over time (Ahmed and Nasir, 2005). GARCH methodology is also instrumental in supporting or refusing the Mixture of

Distribution Hypothesis (MDH). According to the MDH, a serially correlated mixing variable measuring the rate at which information arrives to the market explains the GARCH effect in the returns. This relationship has been documented for the U.S. stock market by Lamoureux and Lastrapes (1990), Andersen (1997) and Gallo and Pacini (2000), and the UK stock market by Omran and McKenzie (2000). In general, the bulk of empirical studies has found evidence that the inclusion of trading volume in GARCH models for returns results in a decrease of the estimated persistence or even causes it to vanish. This finding generally interpreted as empirical evidence in favor of the MDH (Sharma et al. (1996) and Brailsford (1996).

In General, to test whether the positive contemporaneous relationship between trading volume and returns exists, the following GARCH(1,1) model is estimated. Thus, in order to investigate whether trading volume explains the GARCH effects for returns, GARCH(1,1) model with a volume parameter is estimated.

However the results based upon GARCH(1,1) may again be doubtful because it does not take into account for asymmetry and non-linearity in the conditional variance. Thus it would be more appropriate to apply asymmetric GARCH model. Engle and Ng (1993) developed an asymmetric GARCH model which allows asymmetric shocks to volatility. Thus, among the specifications, which allow asymmetric shocks to volatility, the EGARCH(1,1) or Exponential GARCH(1,1) model is estimated proposed by Nelson (1991).

In this model specification, ‘$^{3}_{2}$’ is the ARCH term that measures the effect of news about volatility from the previous period on current period volatility. ‘$^{3}_{3}$’ measures the leverage effect. Ideally ‘$^{3}_{3}$’ is expected to be negative, implying that bad news has a bigger impact on volatility than good news of the same magnitude. A positive ‘$^{3}_{4}$’ indicates volatility clustering, implying that positive stock price changes are associated with further positive changes and vice-versa. The parameter ‘$^{3}_{5}$’ measures the impact of volume on volatility and all these values are obtained using the following equations:

Volume in the Mean Equation:

$$R_t = \alpha + \sum_{i=1}^{p} \beta_i R_{t-i} + \gamma_0 V_t + \varepsilon_t$$

$$h_t = \gamma_1 + \gamma_2 \left|\frac{\varepsilon_{t-1}}{h_{t-1}}\right| + \gamma_3 \frac{\varepsilon_{t-1}}{h_{t-1}} \omega + \gamma_4 h_{t-1} + e_t$$

Volume in the Volatility Equation:

$$R_t = \alpha + \sum_{i=1}^{p} \beta_i R_{t-i} + \varepsilon_t$$

$$h_t = \gamma_1 + \gamma_2 \left| \frac{\varepsilon_{t-1}}{h_{t-1}} \right| + \gamma_3 \frac{\varepsilon_{t-1}}{h_{t-1}} \omega + \gamma_4 h_{t-1} + \gamma_5 V_t + e_t$$

Analysis and Interpretation

The volumes and returns of all the selected commodity futures have been tested with Augmented Dickey-Fuller test and Phillips-Perron test to identify the unit root problem. The significant 'p' values show that all the selected commodity volumes and returns do not have unit root problem and all the volumes and returns of selected commodities are stationary. GARCH(1,1) and EGARCH(1,1) have been used to identify the relationship between return and volumes in the futures market of the selected commodities during the study period (2009-2013).

Table 1 : Unit root test results of returns and volumes of selected commodities

Commodity	Augmented Dickey-Fuller test statistic		Phillips-Perron test statistic	
	t-Statistic	Prob.*	t-Statistic	Prob.*
Soya Oil volume	-2.332094	0.1620	-22.45388	0.0000
Soya Oil Returns	-29.49169	0.0000	-29.97635	0.0000
Chana Volume	-4.519886	0.0002	-20.69399	0.0000
Chana Returns	-28.90439	0.0000	-28.98051	0.0000
Silver Volume	-5.077556	0.0000	-38.2311	0.0000
Silver Returns	-23.59307	0.0000	-27.72704	0.0000
Lead Volume	-3.885577	0.0022	-38.66151	0.0000
Lead Returns	-22.97167	0.0000	-25.41416	0.0000
Crude Oil Volume	-5.021598	0.0000	-38.13681	0.0000
Crude Oil Returns	-22.7311	0.0000	-25.99515	0.0000

The unit root test results of select commodities results indicate that the volumes and return of all Augmented Dickey-Fuller test and Phillips-Perron test(see table-1). The significant p values show that the series is not having unit root problem and all the volumes and returns of select commodities are non stationary. In case there is a difference the ADF and PP tests, PP test results are considered as it has better power to test the unit root problem (Yin and Kon, 1997).

Table 2: Results of EGARCH(1,1) Model (Volume is an independent variable in the mean equation)

Commodity	Statistics	γ_0	γ_1	γ_2	γ_3	γ_4
Soya Oil	Coefficient	0.00043	-0.45796	0.18557	-0.03204	0.9681
	P value	0.2464	0.0001	0	0.0122	0
Chana	Coefficient	0.00151	-0.60347	0.22639	0.0122	0.95321
	P value	0.0028	0.0001	0	0.4284	0
Silver	Coefficient	-0.00101	-1.07955	0.44242	-0.00031	0.91519
	P value	0.0003	0	0	0.9871	0
Lead	Coefficient	-0.00039	-0.25844	0.15644	-0.01105	0.98416
	P value	0.208	0	0	0.2102	0
Crude Oil	Coefficient	0.0465	1.01827	-1.14422	-1.26676	0.47714
	P value	0.1041	0	0	0	0

Table 3 : Results of EGARCH(1,1) Model (Volume is an independent variable in the variance equation)

Commodity	Statistics	γ_1	γ_2	γ_3	γ_4	γ_5
Soya Oil	Coefficient	-0.80307	0.18626	-0.03363	0.95913	0.02154
	P value	0.0002	0	0.014	0	0.0553
Chana	Coefficient	-16.2019	0.38192	-0.04178	0.18296	0.70586
	P value	0	0	0.299	0.0053	0
Silver	Coefficient	-6.87896	0.41435	-0.05226	0.66098	0.47845
	P value	0	0	0.0897	0	0
Lead	Coefficient	-6.61902	0.51784	-0.0479	0.57866	0.22921
	P value	0	0	0.1379	0	0
Crude Oil	Coefficient	0.42297	-1.14387	-1.27939	0.47811	0.1595
	P value	0.0001	0	0	0	0

Volume and Return Relationship in the Soya oil Futures

EGARCH(1,1) model results indicate that in the Soya oil futures, no contemporaneous relationship exists between the return and volumes (p value 0.2464). The positive sign of the volume coefficient (0.000425) indicates that the higher volume leads to higher returns. The significant volatility persistence coefficient (p value (0.0000) indicates that the past volatilities are influencing the present volatilities. Significant asymmetry coefficient indicates (p value 0.000) the existence of asymmetric response to the information. Negative sign of directional asymmetry coefficient indicates that the negative information is having more impact on volatility than that of the positive information (see table-2).

When Soya oil volume is considered in the volatility equation of EGARCH(1,1) model, volume coefficient is not significant (p value 0.0553) indicating that volume has no significant impact on the volatility of returns. Significant asymmetry coefficient (0.0000) and negative sign of directional asymmetry coefficient are also observed after the inclusion of volume in the variance equation (see table-3). Volume has absorbed small portion of persistence of volatility after inclusion in the volatility equation (0.968098 to 0.959131).

Volume and Return Relationship in Chana Futures

EGARCH(1,1) model results indicate that in Chana futures market, contemporaneous relationship exists between the return and volumes (p value-0.0028). The positive sign of the volume coefficient (0.001509) indicates that higher volume leads to higher returns. The significant volatility persistence coefficient indicates that the past volatilities are influencing the present volatilities (p value 0.0000). The positive information is having more impact on volatility than that of the negative information which is observed from significant asymmetry coefficient (p value-0.0000) with the positive sign of asymmetry sign coefficient (see table-2).

When Chana's volume is considered in the volatility equation of EGARCH(1,1) model, the volume coefficient is significant (p value-0.0000) indicating that volume has significant impact on the volatility of returns. Significant asymmetry coefficient (p value-0.0000) and negative sign of directional asymmetry coefficient (-0.041775) are also observed after the inclusion of volume in the variance equation (see table-3). Volume has absorbed huge portion of persistence of volatility after inclusion in the volatility equation (0.953213 to 0.182964).

Volume and Return Relationship in Silver Futures

EGARCH(1,1) model results indicate that, in Silver futures market, a contemporaneous relationship exists between the return and volumes (p value-0.0003). The negative sign of the volume coefficient (-0.001013) indicates higher volume leads to lower returns. The significant volatility persistence coefficient (p value-0.0000) indicates that the past volatilities are influencing the present volatilities. Significant asymmetry coefficient (p value-0.0000) and negative sign of asymmetry sign coefficient indicate that negative information is having more impact on volatility than that of the positive information (see table-2).

When Silver volume is included in the volatility equation of EGARCH(1,1) model, volume coefficient is significant (p value-0.0000) indicating that volume has a significant impact on the volatility of returns. The significant asymmetry coefficient (p value-0.0000) and negative sign of asymmetry sign coefficient indicate that the negative information is having more impact on volatility than that of the positive information (see table-3). Volume has absorbed considerable portion of persistence of volatility after inclusion in the volatility equation (0.915194 to 0.660983).

Volume and Return Relationship in Lead Futures

EGARCH(1,1) model results indicate that in Lead futures market, no contemporaneous relationship exists between the return and volumes (p value-0.2080). The negative sign of the volume coefficient (-0.000389) indicates that higher volume leads to lower returns. The significant volatility persistence coefficient (p value 0.0000) indicates that the past volatilities are influencing the present volatilities. Significant asymmetry coefficient (p value-0.0000) and negative sign of asymmetry sign coefficient indicate that the negative information is having more impact on volatility than that of the positive information (see table-2).

When Lead volume is included in the volatility equation of EGARCH(1,1) model, the volume coefficient is significant (p value-0.0000) indicating that volume has significant impact on the volatility of returns. The significant asymmetry coefficient (p value 0.0000) and negative sign of asymmetry sign coefficient indicate that the negative information is having more impact on volatility than that of the positive information (see table-3). Volume has absorbed large portion of persistence of volatility after inclusion in the volatility equation (0.984159 to 0.578656).

Volume and Return Relationship in Crude oil Futures

EGARCH(1,1) model results indicate that in Crude oil futures market, no contemporaneous relationship exists between the return and volumes (p value-0.1041). The positive volume coefficient (0.046501) indicates that higher volume leads to higher returns. Significant persistence coefficient (p value-0.0000) indicates that the past volatilities are influencing the present volatilities. Significant asymmetry coefficient (p value-0.0000) and negative sign of the asymmetry sign coefficient indicate that negative information is having more impact on volatility than that of the positive information (see table-2).

When Crude oil volume is included in the volatility equation of EGARCH(1,1) model, the volume coefficient is significant (p value-0.0000) indicating that volume has a significant impact on the volatility of returns. Significant asymmetry coefficient (p value-0.0000) and negative sign of the asymmetry sign coefficient indicate that the negative information is having more impact on volatility than that of the positive information (see table-3). Volume has not absorbed any portion of persistence of volatility after inclusion in the volatility equation (0.477139 to 0.478110).

The positive contemporaneous relationship between volume and return are consistent with most of the studies including Mestal et al. (2003), Mishra (2004), Henryk et al. (2005) supported the

MDH. There is no considerable absorption of persistence in volatility, after including volume in the volatility equation which is supported by Sarika and Balwinder (2009), indicate that there are many other variables beside the volume, which contribute to the heteroscedasticity in returns. The lagged trading volume contain predictive power for current price volatility is consistent with Herbert (1995), Chen et al(2001) and Ciner (2002), which is the indication of volatility clustering and that it is not the sign of efficient market.

Implications

The results of the study will be useful to the financial researchers - analysts, practitioners of derivative market participants whose success depends on the ability to forecast the movements in the commodity market. Participants in the commodity derivative markets can predict the price and volatility based on the volume movements as well as volatility clustering. These also indicate the lack of free information flow in the market. Policy makers may take initiative to reduce the inefficiencies in the market by introducing options in the commodity derivative market to reduce the information inefficiencies. Encouraging more participants into the market also improves the liquidity and market efficiency.

Limitations

The results of the study are influenced by various extraneous variables that are beyond the scope of the present study. The markets in developing economies improve their efficiency over the time, and the study results have short-term validity. Only five commodities from two markets (MCX, NCDEX) have been studied, and the results cannot be generalized to the entire commodity market.

Conclusions

The study partially supports the Mixture of Distribution Hypothesis but the evidence of Sequential Information Hypothesis is prominent. Volatility clustering in the returns indicates informational inefficiencies in the market. Volume does not completely absorb the volatility clustering after inclusion in the variance equation, indicates the volatility in the returns are not completely caused by volumes and persistence of volatility can be attributed to the existence of substantial speculative trading and low level of market depth.

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Some praise at morning what they blame at night;
But always think the last opinion right.

Alexander Pope
Sceptical Essay