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Volatility Linkages between Cash and Futures Markets for Individual Stocks

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Abstract

Thisstudy is an attempt to examine the intraday returns volatility relationship between spot and futures markets in India. More specifically, it is examined whether volatility from one market influences the volatility in the other market. The analysis has been performed with two different sample, i.e., full sample and sample after removing overnight returns. For majority of the stocks, it has been found that volatility spillovers take place between both the markets. However, spillovers from futures to spot market are found to be more pronounced. Overall, it is found that price innovations originating in either of the two markets are helpful in predicting the future volatility in the other market.The results of the study indicate strong inter-market linkages in the returns volatility of the spot and futures markets.

Keywords. Volatility Spillover, Futures Market, Spot Market.

Introduction

In efficiently functioning markets new information is reflected in spot (cash) and futures markets simultaneously. However, if the spot and futures markets respond to new information at different times,arbitrage opportunities could exist. Therefore, the issue of price discovery or lead-lag relationship between spot and futures markets is of considerable interest among practitioners, academicians and regulators.Most of the studies which investigate the issue of price discovery in futures and spot markets are primarily concerned with lead/lag of price changes i.e. returns in the two markets. However, linkages between volatility of price changes (return volatility) are equally important. Chan, Chan and Karolyi (1991) pointed out that if returns volatility is time-varying, then ignoring it would amount to specification bias which ultimately would lead to incorrect inferences about lead-lag behavior of the two markets. They also argued that examining returns volatility would provide an alternative way of studying flow of information in the two markets.

This study investigates intraday volatility linkages between spot and futures markets for individual stocks. Section 2presents relevant literature, section 3 describes data and methodology, section 4 provides impirical evidence and section 5 concludes.

2. Literature Review

Chan, Chan and Karolyi (1991) investigated the 5-min intraday temporal relationship between the spot and index futures market of S&P 500 from 1984 to 1989. They found evidence of presence of strong inter market linkage in the volatility of both the markets. Using a bivariate GARCH model with AR (1)-GARCH (1,3) specification, they reported that price innovations in either of the market is helpful in predicting the futures volatility in the other market. Using hourly data from 1986 to 1990, Abhyankar (1995) empirically examined the volatility relationships between FT-SE futures index and the underlying cash index. Using

an EGARCH model, he first estimated two series of conditional variance for cash and futures markets and subsequently used these conditional variance in the framework of multiple regression to examine volatility linkages and predictive power of volatility in one market for volatility in the other market. He reported that there is no evidence of a systematic pattern of lead-lag in volatility. He further concluded that the tests for lead-lag based on the conditional estimates of volatility do not reveal any significant consistent leading behavior of one market over other during varying market conditions.Koutmos (1996) examined the returns and volatility linkages among the four major European stock markets namely, UK, Germany, France and Italy by employing a multivariate VAR-EGARCH model. The major contribution of the study is the extension of univariate EGARCH model into its multivariate counterpart. This model allows for studying the asymmetric influence of standardized Innovations in own as well as cross-markets on conditional volatility in each market. Using daily data from January, 1986 to December, 1991, the study found that there exists asymmetric volatility linkages among the four stock markets.Koutmos and Tucker (1996) examined the second moment linkages, i.e. volatility spillovers between S&P 500 spot and futures indices. They used an error correction model (ECM) and allowed the residuals to follow a bivariate-EGARCH (1,1) process. Using daily data from April, 1984 to December, 1993, they found that volatility spillovers are unidirectional from futures to spot and not vice versa. Besides, volatility in each market was reported to be asymmetric in nature.

Tse (1999) examined the volatility spillover mechanism of six months intraday data of DJIA futures and cash indices. For this purpose, he has used minute-by-minute cash and futures prices data for DJIA for the period from Nov 97 to Apr 98. Tse suggested a two step approach for studying volatility linkages in the two markets. In the first step, he estimated a VECM and obtained residuals. In the second step, he used bivariate-EGARCH with constant

conditional correlations for studying volatility spillovers. Employing bivariate EGARCH, he concluded that both spot and futures markets innovations significantly affect volatility in the other market.Min and Najund (1999) studied returns and volatility relationship between Kospi 200 index and associated futures contracts in Korea. They employed a VAR model and used absolute innovations from the returns equations as proxy for volatility in the two markets. Using 10-min intraday data from May to October 1996, they found that volatility interactions are interdependent in futures and spot markets.

Mukherjee and Mishra (2006) analyzed volatility spillovers between CNX Nifty futures and the underlying index as well as between futures and spot markets for five stocks. Using returns innovations as proxy for volatility in the context of a VAR model, they found that volatility spillovers run in both the directions, however, spillovers from spot to futures market are stronger.Bose (2007) studied the characteristics of volatility in the spot and futures market in India. Volatility is found to exhibit the feature of mean reversion, volatility clustering, asymmetry and persistence in both spot and futures markets. Using daily data in the framework of the threshold GARCH model, she reported the leading role of futures market volatility over volatility in the spot market.Using 1-min data from July to December 2006, Mallikarjunappa and Afsal E M (2008) have studied volatility linkages between futures and spot markets for 12 individual stocks in India. They used VECM-EGARCH (1,1) model and found that there exists bi-directional volatility spillovers between futures and spot markets. Besides, they also reported that volatility shocks are persistent and asymmetric in nature.Karmakar (2009) used a bivariate-BEKK model for studying volatility spillovers between CNX Nifty and associated futures contracts. Using daily data, he reported that persistent volatility spillovers run bi-directionally. Further, he found that past innovations originating in the futures market have significant explanatory power for spot market volatility

but past innovations from the spot market have no predictive power for futures market volatility.Rajput, Kakkar and Batra (2013) used daily data from June, 2000 through March, 2012 to examine volatility spillovers between Nifty and Nifty futures. Employing a bivariate-EGARCH model, the study provided evidence that CNX Nifty leads the Nifty futures in terms of price discovery and volatility spillovers. They reported unidirectional volatility spillovers from spot to futures with persistent volatility being bidirectional. Their results are in sharp contrast to many previous studies. However, they employed daily data and volatility dynamics are best studied with intraday data.

3. Data and Methodology

The present study utilizes data at the frequency of 5-minutes for all the fifty stocks which make up the CNX Nifty index. The data series range from June 01, 2012 to May 31, 2013.

One of the stylized facts of the financial asset returns is that the returns exhibit features of volatility clustering. There is numerous literature which supports that volatility clustering is adequately captured by Autoregressive Conditional Heteroscedasticity (ARCH) and Generalised Autoregressive Conditional Heteroscedasticity (GARCH) type models proposed by Engle (1982) and Bollerslev (1986) respectively. Most of the previous studies have employed one or the other variant of the multivariate-GARCH (MV-GARCH) family of models for studying volatility linkages. However, the present study could not employ the MV-GARCH type models because for a number of stocks, the MV-GARCH model did not converge. Therefore, for examining volatility spillover bivariate vector autoregressive (VAR) model has been used. The following VAR has been estimated and Granger causality test conducted on the estimated VAR.

$$\varepsilon_{s,t}^2 = \phi_s + \sum_{i=1}^{k} \alpha_i \varepsilon_{s,t-i}^2 + \sum_{i=1}^{k} \beta_i \varepsilon_{f,t-1}^2 + \eta_{s,t} \ldots\ldots\ldots\ldots (5.10)$$

$$\varepsilon_{f,t}^2 = \phi_f + \sum_{i=1}^{k} \gamma_i \varepsilon_{s,t-1}^2 + \sum_{i=1}^{k} \delta_i \varepsilon_{f,t-1}^2 + \eta_{f,t} \quad \dots\dots\dots\dots (5.11)$$

Where,

$\varepsilon_{s,t}^2, \varepsilon_{f,t}^2$ = residuals from VECM for spot and futures markets respectively

$\eta_{s,t}, \eta_{f,t}$ = white noise error terms

In the above formulation if all β_i are jointly found to be zero, then it would imply that there is no volatility spillover from futures to spot market. Similarly, if all γ_i are all jointly zero, it would mean that there is no volatility spillover from spot to futures market. Table 5.12 reports the results of pairwise Granger Causality Test for three different samples.

4. Empirical Analysis

Table 1 presents results of Granger causality test for full sample. From the table it can be seen that out of 50 stocks, 41 stocks (38 stocks at 5% level and 3 stocks at 10% level) have significant volatility spillovers from futures to spot market. For BPCL, HINDALCO, HINDUNILVR, INFY, ONGC, SBIN, TATAMOTORS, TATAPOWER, and TATASTEEL volatility does not spillover from futures to spot market. As far as volatility spillover from spot to futures market is concerned, 26 stocks (22 stocks at 5% level and 4 stocks at 10% level) have significant volatility spillover from spot to futures market. Besides, it is found that for 25 stocks volatility spillovers take place in both directions, i.e., from spot to futures market, and from futures to spot market.

Table 1: Granger Causality Test for Full Sample

	Spot does not Granger Cause Futures		Futures does not Granger Cause Spot	
Company	F-test	p-value	F-test	p-value
ACC	26.9462**	0.0000	1.0974	0.3338
AMBUJACEM	5.7704**	0.0000	6.1324**	0.0000
AXISBANK	6.1538**	0.0131	0.9647	0.3260
BAJAJAUTO	8.8822**	0.0000	2.3859*	0.0671

BHARTIARTL	29.07**	0.0000	10.6166**	0.0000
BHEL	7.0348**	0.0000	1.0283	0.3989
BPCL	0.1021	0.7493	0.1109	0.7392
CAIRN	38.9353**	0.0000	977.3589**	0.0000
CIPLA	30.5237**	0.0000	21.0117**	0.0000
COALINDIA	3.0884**	0.0456	4.6563**	0.0095
DLF	3.391*	0.0656	0.8478	0.3572
DRREDDY	4.2659**	0.0389	2.0077	0.1565
GAIL	14.8174**	0.0000	61.5318**	0.0000
GRASIM	107.6625**	0.0000	17.8723**	0.0000
HCLTECH	7.2489**	0.0001	12.3902**	0.0000
HDFC	6.7566**	0.0000	42.227**	0.0000
HDFCBANK	3.8689**	0.0007	7.797**	0.0000
HEROMOTOCO	6.5949**	0.0000	8.171**	0.0000
HINDALCO	0.0163	0.8985	0.0021	0.9633
HINDUNILVR	0.424	0.6544	0.1973	0.8210
ICICIBANK	3.2105*	0.0732	0.0018	0.9663
IDFC	8.7041**	0.0032	2.7448*	0.0976
INFY	2.411	0.1205	2.2764	0.1314
ITC	4.1699**	0.0412	0.0046	0.9459
JINDALSTEL	48.8315**	0.0000	21.8673**	0.0000
JPASSOCIAT	4.0586**	0.0440	1.0568	0.3040
KOTAKBANK	4.1003**	0.0010	0.5806	0.7150
LT	4.0809**	0.0434	0.0001	0.9903
M&M	34.1879**	0.0000	2.2591	0.1045
MARUTI	22.0289**	0.0000	4.8279**	0.0280
NTPC	38.7492**	0.0000	1.8207*	0.0908
ONGC	0.1769	0.6740	0.2212	0.6381
PNB	38.0262**	0.0000	8.2719**	0.0040
POWERGRID	80.4375**	0.0000	1.6994	0.1167
RANBAXY	11.979**	0.0005	2.2116	0.1370
RCOM	4.1807**	0.0003	2.4248**	0.0241
RELIANCE	9.5306**	0.0020	6.4666**	0.0110
RELINFRA	23.4346**	0.0000	10.2582**	0.0000
RPOWER	43.9572**	0.0000	1.6599	0.1976
SAIL	20.0594**	0.0000	2.1518	0.1163
SBIN	2.1417	0.1433	1.8649	0.1721
SESAGOA	46.3841**	0.0000	21.2598**	0.0000
SIEMENS	2.5621*	0.0530	6.5146**	0.0002
STER	26.0966**	0.0000	3.3944**	0.0171
SUNPHARMA	33.5184**	0.0000	14.044**	0.0002
TATAMOTORS	0.0083	0.9274	0.1128	0.7370

TATAPOWER	0.2463	0.6197	0.3977	0.5283
TATASTEEL	1.1463	0.2843	3.2764*	0.0703
TCS	18.6305**	0.0000	2.1771	0.1401
WIPRO	25.7127**	0.0000	23.3894**	0.0000

[Notes: ** and * denote significance at 5% and 10% level respectively]

Overnight returns are larger in magnitude than intraday returns. For this reason, volatility spillovers have also been examined after removing overnight returns. The results of Granger causality test based on VAR are reported in Table 2. The null hypothesis that spot volatility, represented by squares of innovations from the first step VECM, does not Granger cause volatility in the futures market is rejected for 48 (45 stocks at 5% level and 3 stocks at 10% level) out of 50 stocks. TCS and AXISBANK are the only two stocks for which spot market volatility does not Granger cause futures market volatility. Again, the null hypothesis that futures market volatility does not Granger cause spot market volatility is rejected for 46 stocks (45 stocks at 5% level and 1 stock at 10% level). JPASSOCIAT, LT, RELIANCE and SESAGOA are the four stocks for which futures market volatility does not Granger cause volatility in the spot market. Out of 50 stocks, 44 stocks have bidirectional volatility spillovers.

Table 2: Granger Causality Test after Removing Overnight Returns

Company	Spot does not Granger Cause Futures		Futures does not Granger Cause Spot	
	F-test	p-value	F-test	p-value
ACC	5.88**	0.0028	9.2475**	0.0001
AMBUJACEM	68.5435**	0.0000	24.2392**	0.0000

[Notes: ** and * denote significance at 5% and 10% level respectively]

Conclusion

This study is an attempt to examine the intraday returns volatility relationship between spot and futures markets in India. More specifically, it is examined whether volatility from one market influences the volatility in the other market. The analysis has been performed with

two different sample, i.e., full sample and sample after removing overnight returns. For majority of the stocks, it has been found that volatility spillovers take place between both the markets. However, spillovers from futures to spot market are found to be more pronounced. Overall, it is found that price innovations originating in either of the two markets are helpful in predicting the future volatility in the other market.The results of the study indicate strong inter-market linkages in the returns volatility of the spot and futures markets.

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