Impact of Single Stock Futures Trading on Underlying Stock Market in India

ABSTRACT

This paper examines the price discovery, price-volume relationship of 47 single stock futures (SSFs) and impact of SSFs listing on underlying stock market in the National Stock Exchange of India (NSE). The study periods are November 2001-December 2008 for SSFs first lot (22 SSFs) and December 2006-December 2008 for SSFs last lot (25 SSFs). The study adopts error correction model (ECM) to reveal that spot prices lead futures prices. Further, spot prices contribute, on average, up to 57% and 65% of price discovery process for first and last lot, respectively. Nevertheless, the test suggests that there is no causal relationship between return and volume of SSFs in both directions. The study also suggests the trading volumes drop significantly following the listing of SSFs for the underlying stocks of SSFs first lot, but are not statistically different for the underlying stocks of SSFs last lot. However, the stock return volatility is not statistically different after SSFs listing.

Keywords: Single stock futures, SSFs, Price discovery, Information share, Volume, Volatility

I. INTRODUCTION

India has a vibrant stock market with long history. The Bombay Stock Exchange (BSE) was started in 1875 and currently 7466 stocks are listed and traded in the exchange. The National Stock Exchange of India (NSE) was established with the support of major government sponsored financial institutions and with an objective promoting debt instruments. However, the securities scam in 1992 promoted the government to encourage NSE to play an active role in the equity market with better governance structure and within two years, NSE established nationwide facilities leveraging the developments in the information technology and also ensured transparency in security trading. In a short period of time NSE dominated the stock market trading. The developments in Indian stock trading system would be relevant to understand the popularity of single stock futures (SSFs) in India. Until June 2001, India followed periodic settlement where stocks traded during one week period (earlier two weeks period) are pooled netted and settled. Essentially, it was a one-week (earlier two-weeks) SSFs and it means India had no product other than SSFs during this period. There are several reasons for this periodic settlement system. Two important reasons were stock being held in physical form and poor information technology and infrastructure facilities.

There was also one facility to change the character of one-week SSFs into long-duration SSFs. When derivative transaction was banned in India in 1969 under the Securities Contract (Regulation) Act, 1956, many exchanges allowed indigenous futures transactions. Before the beginning of every new settlement cycle, a separate trading session was allowed. Investors holding a position on the previous settlement can participate in the session and enter into a REPO or reverse REPO transaction to move their position to next settlement. The only difference is these indigenous SSFs were not marked-to-market on daily basis and hence exposed the system to major crisis whenever market moves in a big way. A significant part of volume normally rolls over to next settlement. In other words, Indian investors were familiar with SSFs or rather only with SSFs during this long period.

Several factors have contributed to the abolishment of weekly settlement in the BSE, NSE and other regional exchanges. On the one side, India has quickly moved into dematerialization of stocks and also electronic trading by abolishing floor based trading. On the other hand, a large number of foreign institutional investors (FII) had started investing in Indian market. There was a constant demand from investors for the introduction of derivative products particularly SSFs. Though Securities Contract (Regulation) Act of 1956 was amended removing the ban on derivative trading in India in December 1999, Indian exchanges have introduced derivative trading only in 2000. BSE introduced stock index futures on 9th June 2000 and subsequently NSE introduced stock index future on 12th June, 2000. The market response was lukewarm. When the index option was introduced in June 2001, there was no major change in the derivative market. The market remained low profile even when stock options were introduced in July 2001. The derivative market got full attention once the SSFs was introduced on November 9, 2001 and within a short period of time volume soared. Initially, SSFs was allowed in 31 stocks in November 2001 and subsequently another 12 stocks were added in January 2003. The first lot consists of stocks with high market capitalization and as the list expands, many mid-cap stocks were also included. After the two bunches, the NSE started introducing SSFs periodically and as of September 2006, SSFs is traded on 119 stocks. Among the derivative products, SSFs is the most important segment of the market. The cumulative (2000-01 to 2005-06) volume of trading in terms of number of contracts in derivative segment in India in index futures were 100,607,934; stock futures 172,952,100; index option 18,579,229 and stock options 20,429,550. For the same period the volume of trading (turnover) in index futures amounted to Rs.2,908,147 crores[1]; stock futures Rs.5,919,741 crores; index option Rs.1,052,480 crores and stock option Rs.1,383,180 crores.

The objectives of study are to examine the price discovery, price-volume relationship of 47 single stock futures (SSFs) and impact, in term of trading volume and volatility, of SSFs listing on underlying stock market in the National Stock Exchange of India (NSE). The study periods are

[1] An Indian crore is equal to 10 million.

November 2001-December 2008 for SSFs first lot (22 SSFs) and December 2006-December 2008 for SSFs last lot (25 SSFs).

The error correction model (ECM) strongly reveals that spot prices lead futures prices. Further, spot prices contribute, on average, up to 57% and 65% of price discovery process for first and last lot of SSFs, respectively. Nevertheless, in the price-volume relationship study, the test suggests that there is no causal relationship between return and volume of SSFs in both directions. The study also suggests the trading volumes drop significantly following the listing of SSFs for the underlying stocks of SSFs first lot, but are not statistically different for the underlying stocks of SSFs last lot. However, the stock return volatility is not statistically different after SSFs listing.

The rest of the paper is organized as follows. Section 2 presents literature review. Section 3 shows the brief theoretical framework. Section 4 provides a description of the data. Section 5 through 8 explains the methodology, empirical results, and implications. Section 9 concludes the paper.

II. LITERATURE REVIEW

Futures market plays two important roles, hedging of risks and price discovery. The efficiency of the hedging function is dependent on the price discovery process or how well new information is reflected in price. In general, futures markets are found to respond faster to new information than spot markets since the transaction cost is lower and the degree of leverage attainable is higher. Another important issue on market quality is the contribution to price discovery when the trading of an underlying asset is dispersed over multiple trading systems.

Back (1993) argues that trades in derivatives versus trades in their underlying assets convey different information. This implies that derivative trading can affect underlying security prices because it changes how information is revealed in prices and trading volume.

John, Koticha, Narayanan, and Subrahmanyam (2003) suggest that informed traders prefer trading in derivatives given their advantages over underlying stocks. These advantages stem from the inherent financial leverage in a derivative position, the lower transaction costs associated with establishing a derivative position, and the fact that one can take a bearish position in a derivative without being subject to short sale restrictions that exist on underlying stocks.

Most studies focus on the impact of futures trading on the volatility of underlying asset prices. The results of these studies are mixed, with some finding that futures trading is associated with increases in volatility, and others reporting the opposite result. With respect to the impact of SSFs trading on individual stock volatility, McKenzie et al. (2001) indicate that the introduction of futures trading is associated with a decrease in the underlying stock volatility.

To measure price discovery, there are two main different approaches. The first approach uses lead-lag return regressions, vector autoregressive models (VAR), or vector error correction models (VECM) to explore the temporal precedence or bivariate relationship between paired returns, i.e. futures returns and spot market returns.

In the equities market, Kawaller et al. (1987), and Stoll and Whaley (1990) find that S&P500 futures price lead spot price. Chan et al. (1991) and Pizzi et al. (1999) observe bi-directional causality between S&P500 futures and stock index, but note that the futures market has a stronger lead effect. Min and Najand (1999) report similar empirical findings in the case of Korean stock index futures.

Likewise, commodities futures prices are found to lead spot prices. Silvapulee and Moosa (1999) and Karande (2006) find that the futures prices of crude oil and castor seed lead spot prices. The most common explanation why a lead-lag relationship between the two markets is observed is that it is less costly for traders to exploit information in the futures market since transaction cost is lower and the degree of leverage attainable is higher. A lead in the futures prices implies that price is being discovered first in that market.

The second approach presumes that securities that are based on the same underlying assets must share one or more common factors and thus it is possible to determine the proportion of contribution to price discovery of one security over another. This concept is first discussed in Garbade and Silber (1982) where the authors examine seven types of agriculture and precious metals commodities and show that futures markets account for 75% of new information and dominate spot markets in price discovery. Hasbrouck (1995) use this idea to develop the concept of "information share," which is determined by the proportion of innovation variance that is attributable to a security. Chakravarty, Gulen, and Mayhew (2004) report that the option market contributes on average 17.9 percent of the price discovery in the underlying stocks. These results collectively suggest that trading in options provides information about prices for underlying securities.

Kumar, Sarin, and Shastri (1998) conclude that the listing of options results in improved market quality for underlying stocks. They draw this conclusion from evidence that the introduction of options is accompanied by decreases in stock volatility, bid-ask spreads, and information asymmetry and an increase in quoted depths. Wang et al. (2007) find that the introduction of E-mini futures contracts for S&P500 and NASDAQ 100 indices lead to a deterioration of market depth and an increase in bid-ask spreads of standard futures contracts.

III. Theoretical Framework

The theoretical relationship between price of SSFs and its underlying stock price follows

$$F_t = S_t e^{(r-d)(T-t)} \tag{1}$$

Where F_t is SSFs price at time t, S_t is stock price at time t, r is risk free rate of interest, d is dividend yield of the stock so that (r-d) is net cost of carrying the underlying stocks, T is the expiration date of contract, (T-t) is the time remaining of contract life. The risk free rate and the dividend yield according to this spot and futures parity are assumed to be known, constant, and continuous rate. If futures and spot market are perfectly efficient, continuous and no transaction cost, an arbitrage opportunities should not be happened and the cost of carry model in equation (1) will be held for the all point in time of futures contract life. In such an idealized environment, the contemporaneous rate of index futures return equal net cost of carry (r-d) plus contemporaneous rate of spot index return as follow

$$R_{S,t} = (r-d) + R_{F,t} \tag{2}$$

Where $R_{S,t}$ is $\ln(S_t/S_{t-1})$ and $R_{F,t}$ is $\ln(F_t/F_{t-1})$.

So in perfectly frictionless world, the price movement of the SSFs market and its underlying stock market should be contemporaneous correlated.

However, real world institutional factors such as liquidity, transaction cost, and other market restrictions may violate the cost of carry model in equation (1) and cause lead-lag relationship between price movements of these two markets.

IV. Data

The data set consists of daily closing price and daily trading volume of the first lot listed @ 9 November 2001 and last lot listed @ 29 December 2006 of SSFs traded in the National Stock Exchange of India (NSE) and their underlying stocks. Trading volumes of stocks are the number of shares traded. Trading volumes of SSFs are the number of SSFs contracts traded. The study periods are November 2001-December 2008 for first lot and December 2006-December 2008 for last lot. For last lot, I use 29 December 2006 lot as proxy due to data sufficiency reason from the National Stock Exchange of India (NSE) website, www.nseindia.com. To generate the continuous series, I cut-off the most immediate contract at the start of its delivery month and concatenate the next most immediate contract to the series. After screening the delisted SSFs in first lot and last lot, there remain 18 and 25 companies in first and last lots, respectively. The daily spot returns and futures returns, are derived from the natural logarithm of the ratio S_t / S_{t-1} and F_t / F_{t-1} expressed in percentages.

Table I presents the daily summary statistics of the first lot @ 9 November 2001 and last lot @ 29 December 2006 of single stock futures (SSF) contracts traded in the National Stock Exchange of India (NSE) for the study period. As shown in the table, the futures prices are wholly greater than the spot prices. However, the daily return and return volatility of spot and futures are approximately the same.

In Table II, unit root tests and the optimal number of lags are reported. I report the Augmented Dickey and Fuller (ADF) test statistics of the variables, used in Error Correction Models (ECM) and Vector Autoregressive Models (VAR), i.e. spot price, spot's first difference, futures price, futures' first difference, number of futures contract traded and futures returns at daily frequencies that include trend and intercept in the tests. The results indicate that spot and futures prices have unit roots, but the first differences of those, number of futures contract traded and futures returns do not have unit roots. In other words, they (latter) are stationary. To determine the optimal number of lags, I specify a VAR order p and obtain the optimal numbers of lags according to Schwarz information criterion (SIC).

Table III presents the result of the Johansen Trace Test for cointegration of spot and futures prices. r denotes the number of cointegrating vectors. In this study, there are only two series; as a result, the number of cointegrating vectors can be at most one. From both tests, the test statistic exceeds its critical value (5%) when the null is r = 0, while the test statistic is less than its critical value (5%) when the null is r ≤ 1. The results from trace test indicate one cointegrating equation at the 0.05 level.

V. Price Discovery

METHODOLOGY

In a frictionless market, security prices on the same underlying asset price should be perfectly correlated and that no lead-lag relationship should exist. When the price of security *1* leads the price of security *2*, I say that price is discovered in security *1* as it is the first security to respond to new information. Moreover, the price should be cointegrated, meaning that despite short-term deviations from each other, market forces will bring them back together in the long-run because the random walk component in their efficient prices are driven by the same fundamentals. I examine the price discovery in SSFs and evaluate the short-run and long-run price correction using Error Correction Model (ECM).

$$\Delta S_t = \delta_s + \alpha_s \hat{u}_{t-1} + \sum_{i=1}^{l} \beta_{si} \Delta F_{t-i} + \sum_{i=1}^{l} \gamma_{si} \Delta S_{t-i} + e_{s,t} \tag{3}$$

$$\Delta F_t = \delta_f + \alpha_f \hat{u}_{t-1} + \sum_{i=1}^{l} \beta_{fi} \Delta S_{t-i} + \sum_{i=1}^{l} \gamma_{fi} \Delta F_{t-i} + e_{f,t} \tag{4}$$

In the model above, Δ denotes the first difference operator, S_t and F_t are spot and futures prices. *l* is the numbers of lags; the choice of numbers of lag lengths to use in the tests is optimal number of lags determined according to Schwarz information criterion (SIC). u_{t-1} is the one-period lagged value of the error from the linear combination of spot and futures prices ($u_t = S_t - \alpha - \beta F_t$), and e_t is a random error term.

The ECM in equation (3) and (4) comprise two components, the first term measures how the left hand side variable adjusts to the previous period's deviation from long-run equilibrium. In ECM, the coefficients α_s or α_f is expected to be non-zero and statistically significant, implying that the prices of the spot and futures prices are responsive to last period's equilibrium error. The remaining portions of the equations are the lagged first differences which represent short-run effects of the previous period's change in price. If both α_s and β_s are statistically significant, then the futures price Granger cause spot price. In other words, futures price lead spot price.

EMPIRICAL RESULTS

Table IV presents the results from the ECM for daily futures and spot prices and Granger causality test of both series. I use the optimal number of lags of each company (as in Table II) for the lag length of both series. The results of ECM of each company support the presence for cointegration found earlier in the Johansen Trace test. α_f are positive and statistically significant in 68% of companies in first and last lots, respectively. This means that an increase in the previous period's equilibrium error leads to an increase in the current period futures prices. However, α_s are insignificant. Both error correction coefficients indicate that a sustainable long-run equilibrium is attained by boosting the futures prices to close gap between futures and spot prices. Futures prices rise to meet increases in spot prices whereas spot prices do not move.

The short-run dynamics between spot and futures prices is measured by the coefficients of lagged difference term, β_{si} and β_{fi}. I find that the coefficient β_{fi} is positive and statistically significant to the first lag in 73% of companies in first lots, respectively. This suggests that the change in spot price has significant influence on futures price. Nevertheless, the coefficients of lagged term difference β_{si} are insignificant. The autoregressive coefficients γ_{fi} are negative and statistically significant in 55% of companies in first lots, indicating that futures prices tend to revert the following day.

The causal relationship between spot and futures prices are determined by Granger causality test. The results indicate that there is unidirectional Granger causality running from spot prices to futures prices.

All in all, the results indicate evidences that there is unidirectional Granger causality running from spot prices to futures prices in both long-run and short-run. The closing of the gap between spot and futures prices is clearly dependent on futures price convergence. The results from ECM are inconsistent with the findings of the previous studies. Both α_f and β_f are positive and statistically significant as well as the Granger causality affirm that the spot prices Granger cause futures prices. In other words, spot prices lead futures prices.

VI. Information share

METHODOLOGY

I adopt the information share model in Hasbrouck (1995) to determine the proportion of price discovery of SSFs. The intuition behind the information share is that when two price series are cointegrated, their price innovations share a common component. Thus, the information share is defined as the proportion of contribution of one market's innovation to the innovation in the implicit common price. Consider two cointegrated price series; spot and futures prices, which can be represented in a vector Δp_t. The multivariate price process has a vector error correction model (VECM) representation,

$$\Delta p_t = \alpha z_{t-1} + A_1 \Delta p_{t-1} + \ldots + A_r \Delta p_{t-r-1} + \varepsilon_t \tag{5}$$

where Δp_t is a vector of logarithm of returns, and z_t is the error correction term, which measures the differences in prices between the two securities,

$$\Delta p_t = \begin{bmatrix} p_{1,t} - p_{1,t-1} \\ p_{2,t} - p_{2,t-1} \end{bmatrix} \tag{6}$$

$$z_{t-1} = p_{1,t-1} - \beta_t p_{2,t-1} \tag{7}$$

A_i's are 2× 2 matrix of parameters, r is the lag length determined by Schwarz information criterion (SIC), ε_t, is a 2×1 vector of serially uncorrelated residuals with a covariance matrix, Ω, $\alpha = [\alpha_1 \quad \alpha_2]$ and $\beta = [1 \quad -1]$ are 2×1 matrices consisting of error correction and cointegrating vectors.

To explicate this concept, the VECM in equation (5) can be expressed in the form of a vector moving average (VMA):

$$\Delta p_t = i\psi(\sum_{\tau=1}^{t} \varepsilon_\tau) + \Psi(L)\varepsilon_t \tag{8}$$

where i is a column vector of ones, $\psi = [\psi_1 \quad \psi_2]$ is a row vector, and Ψ is a matrix polynomial in the lag operator. The first term in equation (8) captures the random-walk component that is common to all prices. The second term is the transitory component with zero-mean and stationary covariance.

The information share of a price series *1* is defined as the proportion of market contribution to the total variance given by,

$$IS_1 = \frac{\psi_1^2 \Omega_{11}}{\psi \Omega \psi'} \tag{9}$$

The information share in Equation (9) is under the condition of uncorrelated price innovations across markets. Baille et al. (2002) propose the upper and lower bound of information share performing a Cholesky factorization of $\Omega = MM'$ in case if price innovations are correlated. The lower triangular factorization shown in equation (11) will maximize (minimize) the information share on the first (second) security. By permuting the elements in M, I can create an upper (lower) bound for the second (first) security.

$$\Omega = \begin{bmatrix} \sigma_{1,\varepsilon}^2 & \rho\sigma_{1,\varepsilon}\sigma_{2,\varepsilon} \\ \rho\sigma_{1,\varepsilon}\sigma_{2,\varepsilon} & \sigma_{2,\varepsilon}^2 \end{bmatrix} \tag{10}$$

$$M = \begin{bmatrix} \sigma_{1,\varepsilon} & 0 \\ \rho\sigma_{2,\varepsilon} & \sigma_{2,\varepsilon}(1-\rho^2)^{1/2} \end{bmatrix} \tag{11}$$

I follow the derived information share of Pavabutr and Chaihetphon (2008) from the error-correction coefficients α and the elements of the covariance matrix $\Omega = MM'$. The upper and lower bounds of the first and second security, IS_1, IS_2, are given in equations (12) and (13).

$$IS_1 = \frac{(\alpha_2\sigma_{1,\varepsilon} + \alpha_1\rho\sigma_{2,\varepsilon})^2}{(\alpha_2\sigma_{1,\varepsilon} + \alpha_1\rho\sigma_{2,\varepsilon})^2 + (\alpha_1\sigma_{2,\varepsilon}(1-\rho^2)^{1/2})^2} \qquad (12)$$

$$IS_2 = \frac{(\alpha_1\sigma_{2,\varepsilon}(1-\rho^2)^{1/2})^2}{(\alpha_2\sigma_{1,\varepsilon} + \alpha_1\rho\sigma_{2,\varepsilon})^2 + (\alpha_1\sigma_{2,\varepsilon}(1-\rho^2)^{1/2})^2} \qquad (13)$$

Equations (12) and (13), depict that the upper bound of the first security's information share is comprised of the first series' innovations from $\sigma_{1,\varepsilon}$ and its correlation with another series $\rho\sigma_{2,\varepsilon}$, whereas the lower bound of the second security only consists of the second series' innovations $\sigma_{2,\varepsilon}(1-\rho^2)^{1/2}$.

EMPIRICAL RESULTS

Table V presents the mid-point, upper, and lower bounds of information share. The mid-point between lower and upper bounds are used in implication. The results show that spot prices contribute, on average, up to 57% and 65% of price discovery process for first and last lot, respectively. The high information shares of spot prices correspond to the results of both significantly positive α_f and β_f as well as Granger causality mentioned earlier. It is likely that investors get information from spot market to decide to invest in futures market. The information flows to spot market before futures market.

VII. SSFs price-volume relationship

METHODOLOGY

Granger causality test is adopted to examine the relationship between volume and price changes or returns. By this test, the relation between volume and returns takes into account whether there is a relation between the lagged values of the two series. This linear causality test is based on a bivariate VAR model. The Granger causality regressions are as follows;

$$FVOL_t = \alpha_0 + \sum_{i=1}^{l} \alpha_i FVOL_{t-i} + \sum_{i=1}^{l} \beta_i FRET_{t-i} + \varepsilon_{FVOL,t} \tag{14}$$

$$FRET_t = \gamma_0 + \sum_{i=1}^{l} \gamma_i FVOL_{t-i} + \sum_{i=1}^{l} \delta_i FRET_{t-i} + \varepsilon_{FRET,t} \tag{15}$$

Where $FVOL_t$ is trading volume, $FRET_t$ is the natural logarithm of the ratio F_t / F_{t-1} and l is the lag lengths of $FVOL_t$ and $FRET_t$ using the optimal number of lags (as in Table II).

Based on this model, Granger causality relations between $FVOL_t$ and $FRET_t$ are examined. The null hypothesis of equation (14) is that $FRET_t$ does not Granger cause $FVOL_t$, which is represented by H_0: all $\beta_i = 0$, while the alternative hypothesis is H_1: $\beta_i \neq 0$ for at least one β_i . If the null hypothesis is rejected, it is argued that returns Granger cause volume. Similarly, for equation (15), if all γ_i are not jointly equal to zero, volume Granger causes returns.

EMPIRICAL RESULTS

Table VI reports the results of a vector autoregression (VAR) analysis and Granger causality test of the relation between price changes (returns) and volume (number of contracts traded) of SSFs of each company. Granger causality F-statistics are insignificant in both null hypothesis test that returns do not Granger cause volume (equation (14)) and volume does not Granger cause returns (equation (15)). In other words, there is no causal relationship between return and volume of SSFs in both directions. The finding is consistent with the finding of Karpoff (1988) that investors in futures markets face symmetric costs of assuming long and short positions, and no empirical correlation between relative price changes and trading volumes can be detected.

VIII. Impact of SSFs trading on the underlying stock market

METHODOLOGY

I consider trading volume and return volatility of underlying stocks of SSFs before and after listings on the SSFs market. To normalize the trading volume and return volatility, I calculate the standardized trading volume and standardized return volatility. The standardized trading volume is calculated from the ratio between trading volume of each stock and stock market. Standardized return volatility is calculated from the ratio between standard deviation of stock returns and stock market returns. Stock trading volume of the National Stock Exchange of India (NSE) is used as the proxy of stock market trading volume. The standard deviation of returns of S&P CNX 500 is used as the proxy of standard deviation of stock market returns. The event window starts from 10 days prior to the SSFs listing and the 10 days following the SSFs listing until 250 days prior to the SSFs listing and the 250 days following the SSFs listing.

The mean of standardized trading volume and standardized volatility of the underlying stocks during the pre- and post- SSFs period in which SSFs is available is compared using parametric paired sample t-test.

The median of standardized trading volume and standardized volatility of the underlying stocks during the pre- and post- SSFs period in which SSFs is available is compared using non-parametric Wilcoxon signed ranks test.

EMPIRICAL RESULTS

Table VII compares the standardized trading volume and standardized return volatility for the stock of each company pre- and post- SSFs listing in different event windows. The standardized trading volumes of underlying of SSFs first lot drop significantly following the listing of SSFs. For underlying stock of SSFs last lot, the standardized trading volumes are not statistically different. However, the standardized return volatility is not statistically different.

IX. CONCLUSION

This study has examined the price discovery, price-volume relationship of SSFs and impact of SSFs listing on underlying stock market in the National Stock Exchange of India (NSE). The study periods are November 2001-December 2008 for SSFs first lot and December 2006-December 2008 for SSFs last lot. I find that spot prices lead futures prices. Spot prices contribute, on average, up to 57% and 65% of price discovery process for first and last lot, respectively. It is likely that investors get information from spot market to decide to invest in futures market. The information flows to spot market before futures market. The study shows that there is no causal relationship between return and volume of SSFs in both directions. The study also suggests the trading volumes drop significantly following the listing of SSFs for the underlying stocks of SSFs first lot, but are not statistically different for the underlying stocks of SSFs last lot. However, the return volatility is not statistically different. The implications of the study could help policy maker in SSFs market design.

REFERENCES

Back, Kerry, 1993, Asymmetric information and options, *Review of Financial Studies* 6, 435–472.

Baille R, Booth, GG, Tse Y, Zabotina T, 2002, Price discovery and common factor models, *Journal of Financial Markets* 5, 309-321

Bessimbinder H, Kaufman, HM, 1997, A cross-exchange comparison of execution costs and information flow for NYSE-listed stocks, *Journal of Financial Economics* 46, 293-319.

Blume L, Easley D, O'Hara M, 1994, Market statistics and technical analysis: The role of volume, *Journal of Finance* 49, 153-181.

Pavabutr P, and Chaihetphon P, 2008, Price discovery in the Indian gold futures market, *Journal of Economics and Finance* 12197, 1-13.

Chakravarty, Sugato, Huseyin Gulen, and Stewart Mayhew, 2004, Informed trading in stock and option markets, *Journal of Finance* 59, 1235–1257.

Edwards, Franklin R., 1988a, Does futures trading increase stock market volatility?, *Financial Analysts Journal* 44, 63–69.

Engle R, Granger C, 1987, Cointegration, and error correction representation, Estimation and Testing, *Econometrica* 55, 251-276.

Garbade KD, Silber WL, 1983, Price movement and price discovery in futures and cash markets, *Review of Economics and Statistics* 65, 289-97.

Hasbrouck J, 1995, One security, many markets: Determining the location of price discovery, *Journal of Finance* 50, 1175-1199.

John, Kose, Apoorva Koticha, Ranga Narayanan, and Marti G. Subrahmanyam, 2003, Margin rules, informed trading in derivatives, and price dynamics, Working paper, New York University.

Karande K, 2006, A study of castor seed futures market in India, *Indira Gandhi Institute of Development Research,* Mumbai, India.

Karpoff J, 1988, Costly short sales and the correlation of returns with volume, *Journal of Financial Research* 11, 173-188.

Kawaller IG, Koch PD, Koch TW, 1987, The temporal relationship between S&P 500 futures and the S&P 500 Index, *Journal of Finance* 42, 1309 – 1329

Kumar, Raman, Atulya Sarin, and Kuldeep Shastri, 1998, The impact of options trading on the market quality of the underlying security: An empirical analysis, *Journal of Finance* 53, 717–732.

McKenzie, Michael D., Timothy J. Brailsford, and Robert W. Faff, 2001, New insights into the impact of the introduction of futures trading on stock price volatility, *Journal of Futures Markets* 21, 237–255.

Min JH, Najand M, 1999, A further investigation of the lead-lag relationship between the spot market and stock index futures: early evidence from Korea, *The Journal of Futures Markets* 19, 217–32

Pizzi M, Economopoulos A, O'Neill H, 1998, An examination of the relationship between stock index cash and futures market: A cointegration approach, *Journal of Futures Markets* 18, 297−305.

Silvapulle P, Moosa IA, 1999, The relationship between spot and futures prices: evidence from the crude oil market, *Journal of Futures Markets* 19, 175–93.

Stoll, Hans R., and Robert E. Whaley, 1987, Program trading and expiration day effects, *Financial Analysts Journal* 43, 16–28.

Wang Y, Chung H, Yang Y, 2007, The market fragmentation impact of E-mini futures on the liquidity of open-outcry index futures, *International Research Journal of Finance and Economics* 12, 165-180