IRJA-Indian Research Journal, Volume: 1, Serious: 2. Issue: March,2014 ISSN: 2347 – 7695
Online Available at www.indianresearchjournal.com

A Study on Impact of Derivative Trading On the Stability of Equity Index

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Abstract

The effect of futures trading on the stability of index returns is studied by taking a case of BSE Sensex stock index (India). The stability of BSE Sensex returns (measured by unconditional volatility) is examined by using two statistical tests namely Kolmogorov Smirnov 2-sample test and Wilcoxon Rank Sum test, and by use of daily observations on the BSE SENSEX index over the period of study is from Jan 1996 to Dec 2007. The conditional volatilities of monthly returns in the pre and post futures periods are examined after adjusting for major macroeconomic factors. Controlling for the effects of macroeconomic variables this study finds no evidence, apart from the month of May 2004 and May 2006, which monthly BSE Sensex index volatility has increased after inception of the BSE Sensex Futures market. Further, the volatility of daily returns in the post futures period was higher than in the pre futures period but the volatility of monthly returns remained unchanged.

Keywords: Stock market, BSE Sensex, Futures trading, Parametric test

1. Introduction

In the late nineties, many emerging and transition economies have introduced derivative contracts, raising interesting issues unique to these markets. Emerging stock markets operate in very different economic, political, technological and social environments than markets in developed countries like the USA or the UK. This paper explores the impact of the introduction of Futures trading on cash market volatility in an emerging capital market like India. The study uses a leading stock index in India namely, BSE Sensex on which futures trading. The impact of futures introduction on the conditional and unconditional volatilities of the underlying stock index (BSE Sensex) is examined during pre-futures and post-futures period. Apart from this, the post-futures volatility is studied excluding the months on which Sensex crashed namely May 2004 and May 2006. The Indian capital market has witnessed a major transformation and structural change from the past one decade as a result of ongoing financial sector reforms. Gupta (2002) has rightly pointed out that improving market efficiency, enhancing transparency, checking unfair trade practices and bringing the Indian capital market up to a certain international standard are some of the major objectives of these reforms. Due to such reforming process, one of the important step taken in the secondary market is the introduction of derivative products in two major Indian stock exchanges (viz. NSE and BSE) with a view to provide tools for risk management to investors and also to improve the *informational efficiency* of the cash market. The Indian capital markets have experienced the launching of derivative products on June 9, 2000 in BSE (Bombay Stock Exchange) by the introduction of BSE Sensex index futures. Just after one year, index options were also introduced to facilitate the investors in managing their risks. Later stock options and stock futures on underlying stocks were also launched in July 2001 and November 2001 respectively. In India, derivatives were mainly introduced with view to curb the increasing volatility of the asset prices in financial markets and to introduce sophisticated risk management tools leading to higher returns by reducing risk and transaction costs as compared to individual financial assets. Though the onset of derivative trading has significantly altered the movement of stock prices in Indian spot market, it is yet to be proved whether the derivative products has served the purpose as claimed by the Indian regulators.

Two main bodies of theories exist in literature about the relationship between derivatives market and underlying spot markets and both are contradictory to each other. Theses theories are: a) A 'Destabilizing forces" hypothesis that predicts increased volatility caused by more highly levered and speculative participants; and b) A 'Market completion' or 'Non-destabilization' hypothesis , that says futures market provides an additional route by which information can be transmitted and therefore will reduce volatility in spot. The effect of the inception of stock index futures contracts on the underlying stock markets is a principal concern of the regulatory agencies, exchanges, and investors. The issue is important because corporations raise equity capital by issuing shares. Regulatory agencies might conclude that restrictions on futures trading are in the public interest if, in fact, futures trading increase the stock market and if this increased volatility increases the expected return required by investors to hold stocks. The results of this study are crucial to investors, stock exchange officials and regulators. Futures contracts and derivatives play a very important role in the price discovery process and in completing the market. Their role in risk management for institutional investors and mutual fund managers need hardly be overemphasized. This role as a tool for risk management clearly assumes that derivatives trading do not increase market volatility and risk. The results of this study will throw some light on the effects of Index futures introduction on the efficiency and volatility of the underlying cash markets.

2. Literature review

The spot and futures markets provide investors with an opportunity to trade in the same underlying security. It is quite logical, therefore, to anticipate a trading induced dynamic relationship between the two markets. A salient aspect of this relationship is the question: Does futures trading impact spot market volatility? In other words, does futures trading stabilize or destabilize the spot market. Theoretically, one may find justification for both the stabilizing propositions. Seemingly opposite views about the impact of futures trading on spot market arise from the complex, interdependent nature of the relationship between the two markets. Research evidence has not been conclusive either. The studies of Harris, 1989; Brorsen, 1991; Lee and Ohk, 1992; Kamara et.al., 1992; Antoniou and Holmes,1995 show that the volatility in the underlying spot market increases after the introduction of futures trading. The contrary evidence may be found in the works of Bessembinder and Seguin (1992). Then, there are some studies that show that the futures trading does not impact the spot market (Edwards, 1988; Darrat and Rahman, 1995; Hodgson and Nicholls, 1991). The inconclusiveness of the research also manifests itself in the findings that volatility is higher for bear markets than bull markets (Maberly 1989), and that bad news increases the volatility more than the good news. (Koutmous et.al., 1996). Studies in the Indian market find that volatility of the underlying market declined after introduction of derivatives trading (Thenmozhi, 2002; Gupta, 2002; Raju and Karnade, 2003; and Nath, 2003).

Theoretical studies on the effects of futures trading on the spot return volatility shows that the effect is ambiguous. Most of the empirical studies suggest that the introduction of a futures market has stabilized, or at least not destabilized, the underlying spot market. Kamara (1982) in his study finds

that a financial future trading reduces the cost of entry of small traders into the financial markets. Stein (1987) concluded that introducing new speculators into the markets improves risk sharing and increases liquidity, but can make cash prices more noisy and reduce net social welfare if these new speculators are less informed than traders already in the market. Futures trading can increase cash price volatility if increases liquidity causes cash prices to reflect new information more quickly. In this case, the increase in cash price volatility should increase net social welfare. Many, authors find no significant volatility effect associated with stock index future listing. Others, including Maberly, Allen and Gilbert (1989), Brorson (1991), Lee and Ohk (1992), Antoniou and Holmes (1995) and Gulen and Mayhew (2000) report a volatility increase in highly developed markets such as the United states, United Kingdom, and Japan. Those who argue that futures market increases stock market volatility, support this argument based on the observation that because of their high degree of leverage, futures markets are likely to attract uninformed traders. The lower level of information of futures traders with respect to cash market traders is likely to increase the asset volatility. Cox (1976), Figlewski (1981) and Stein (1987) found results supporting this in their studies. On the other hand Antoniou, Holmes and Priestly (1998) and Gulen and Mayhew (2000) find evidence that volatility decreased with future listings in many other countries. The opposite current of literature claims that futures markets play an important role of price discovery, and have a beneficial effect on the underlying cash markets.

Bessenbinder and Seguin(1992) and others, attempted to test whether the introduction of stock index futures affects the volume- volatility relationship in the spot market, and whether spot market volatility is contemporaneously related to trading volume or open interest in the futures market. These authors find that the unexpected component of future trading activity (measured by volume or open interest) is positively related to spot market volatility, suggesting that futures market volume responds to unexpected volatility events. The expected component of trading activity however, was found to be negatively related to spot market volatility, suggesting that futures markets help to stabilize cash markets. Hussein Gulen and Stewart Mayhew (2000) examined stock market volatility before and after the introduction of index futures in 25 countries. They then tested whether spot volatility after the introduction is released to futures market volumes and open interest. The study was conducted over a general time between 1973 and 1997 using the excess returns over the world market index. They used a variety of models like GJR-GARCH, non liner GARCH, (NGARCH) and exponential GARCH (EGARCH). To estimate the impact of futures introduction they incorporated a multiplicative dummy in the variance equation. To study the effect of trading activity, they broke the data series of open interest and volume into expected and expected components using an ARIMA model, restricting to five of less AR and MA terms. They found that futures trading are related to an increase in conditional volatility in US and Japan, but in the rest of the countries studied, they found no significant effect. They found that except for US and Japan, volatility tends to be lower in periods when open interest is high. During periods when volatility is high and in periods when future volume was high, it was driven by the unexpected component of volume.

In the Indian context, there are few significant studies in the last decade. Shenbagarman , P. (2003) examined the impact of introduction of NSE Nifty index futures on Nifty index using an event study over the period from October 1995 to December 2002. She concluded that futures trading has not lead to a change in the volatility of the underlying stock index but the structure of volatility seems to have in changed post-futures period. The study also finds that day-of-the-week effect seems to have dissipated after futures introduction. Saurabh Kumar , Gauri Mohan and Sriharsha Pappu (2004) analyzed the data of NSE NIFTY July 13, 1998 to July 11, 2002 to measure the impact of futures trading on National Stock Exchange (NSE) of India and concluded that introduction of future had increased the efficiency of market by quicker dissemination of information. But change in volatility of the underlying stock market could not be completely attributed to the introduction of futures trading.

M Thenmozhi and M Sony Thomas (2004) analyzed the relationship between stock index futures and corresponding stock market volatility of the NSE-Nifty using the GARCH technique. Taking the data from1995 to 2003, the study concluded the reduction of volatility in the underlying stock market and increased market efficiency. Nagaraj K S and Kotha Kiran Kumar (2004) studied the impact of Index futures trading on spot market volatility using the data from June 12,2000 to February 27, 2003 of S&P CNX NSE Nifty. Using ARMA-GARCH model, the study also examined the effect of the September 11, terrorist attack; the relation between futures trading activity; and spot volatility has strengthened, implying that the market has become more efficient and assimilating the information into its prices. Very recently, Singh and Bhatia (2006) analyzed the impact of futures trading on spot market volatility in India using NSE Nifty index. Using the (1, 1) variant of the Generalized Auto Regressive Coefficient of Heteroskedasticity (GARCH 1,1) , the study shows that daily spot market volatility in India has marginally declined sicne the introduction of futures trading in India. The study also shows a simultaneously significant improvement in the information coefficient and reduction in the persistence coefficient, implying growing market efficiency of the Indian stock market.

3. Objectives of the study

The specific objectives of this study are as follows:

a) To examine the effect of introduction of futures trading on the stability of BSE Sensex.

b) To measure the conditional volatilities of daily returns on BSE Sensex before and after futures trading.

c) To compare the conditional volatilities of monthly returns of BSE Sensex over pre-futures and post-futures periods, after adjusting macroeconomic factors.

d) To investigate whether futures trading have contributed to market crash in BSE Sensex (during May 2004 & May 2006) in the post-futures period.Appendix-1 provides the list of ten biggest falls in BSE Sensex.

4. Data and sources

The data employed in this study comprises of daily observations on the BSE SENSEX index. The daily and monthly closing prices (in spot market) were obtained from the official web page of Bombay Stock Exchange (www.bseindia.com). The period of study is from Jan 1996 to Dec 2007. BSE SEnsex is a well diversified 30 stocks index (based on market weighted capitalization method) representing about 62.49% of the total market capitalization at Bombay Stock Exchange (BSE) as on 31st December, 2007. The base year selected for BSE Sensex index is 1978-79.Index futures on BSE Sensex were introduced on 9 June 2000. Floor trading time for both the NSE Nifty and BSE Sensex is from 9.55 to 15.30 IST (Indian Standard Time). The price of a futures contract is measured in index points multiplied by the contract multiplier, which are 200 for the BSE SENSEX contract. Trading takes place in the 3 nearest delivery months, although volume in the far contract is very small. At any point in time there are only three contracts available for trading, with 1 month, 2 months and 3 months to expiry. These contracts expire on last Thursday of the expiry month and have a maximum of 3-month expiration cycle. The BSE provides a fully automated screen based trading system for futures and spot market transactions, on a nationwide basis and an online monitoring and surveillance mechanism. It supports an order driven market which provides complete transparency of trading operations and operates on strict price-time priority. The BSE SENSEX comprises 30 leading Indian companies listed at Bombay Stock Exchange (BSE). The study had used two most popular statistical/econometric packages for analysis, namely SPSS 11.5 version and Eviews 3.0.

5. Research methodology

This article investigates the effects of the BSE Sensex index futures market on the stability of the underlying cash index (BSE Sensex) from 1995 through 2007. Two methods are used to examine these effects. First the unconditional volatilities of returns on the cash index are compared before and after futures trading. Second, conditional volatilities, controlling for the effects of macroeconomic factors, are compared.

This study extends an earlier studies by Edwards (1988) and Harris (1989) in two ways. First, the changes in volatilities of daily and monthly returns are examined using parametric and nonparametric tests. The variance, ratio F tests used by Edwards (1988a, b) are sensitive to the underlying assumption of normally distributed stock returns. This study rejects the hypotheses that daily and monthly returns are examined using parametric and nonparametric tests are used and it is found that the dispersion of daily Nifty and Sensex returns are significantly higher in the post futures period (June 12, 2000 to December 31, 2007) than in the pre futures period (January 1, 1995 to June 9, 200). This study does not reject the hypothesis that the dispersion of monthly returns (for both indices) in the two periods are equal. Upon further investigation, statistically significant evidence is found that the distribution of daily returns could be frequently (and non event induced) changing. Consequently, one cannot conclude that the significant increases in the volatility of daily Nifty and Sensex returns after the inception of futures trading is necessarily futures induced.

Second while Harris (1989) examines individual stocks adjusting for the effects of firm attributes, this study examines the volatility of the monthly returns of the BSE Sensex index conditional on macroeconomic effects based on Chen, Roll and Ross (1986), henceforth CRR. Empirical studies of the effects of stock index futures trading on the stability of the cash market are " one shot" event studies examining characteristics of returns about the effects of futures trading, one must rule out all other possible explanations that could have had the same timing. While it is impossible to control for and refute all conceivable alternatives to the hypothesis that the inception of futures trading affects the volatility of stock returns, there is a need to account for the most likely alternative explanations. The two most likely alternative explanations for changes in the volatility of stock returns are microeconomic factors and macroeconomic. Harris (1989) investigates the former and this study investigates the latter. The stability of the residual volatility is tested after adjusting for the effects of macroeconomic factors as identified in CRR.

5.1 Univariate Stability Tests

The stability issue is examined further by using two statistical tests that do not depend on the assumption of normally distributed stock returns. The first assumption is of normally distributed stock returns. The first nonparametric test is the Kolmogorov Smirnov two-sample test that test whether two independent samples come from populations with the same distribution. The two tailed version of this test is sensitive to any difference in the sample distributions such as location (Central tendency), dispersion, skewness, or kurtosis. The procedure measures the largest absolute difference between the two cumulative distribution functions. If this difference is larger than a critical value, then the null hypothesis that the two distributions are identical is rejected. The second nonparametric test is the Wilcoxon Rank Sum test. This test is especially likely to reject the null hypothesis when the populations have unequal locations (central tendencies). The Wilcox on Rank sum test pools the observations from the two samples and then ranks these observations from the smallest to the largest. The test statistic depends on the totals of the ranks for both samples. If the probability distributions are identical, then these rank rums will be of similar size.

The BSE Sensex crash of May 14 2004 and May 18 2006 regulatory agencies like SEBI (Securities Exchange Board of India) to implement various measures designed to reduce volatility in the stock market. Because the popular press seems to equate volatility with "big" absolute price movements in the stock market, the hypothesis that there are more utilizes in the daily returns of the S & P 500 index since the inception of futures trading is tested. Assuming outliers were as likely before futures trading as after, a big return is defined as an outlier that is identified by using the interquartile range calculated from the entire sample. This procedure classifiers only three monthly returns as outliers out of the 156 months in the sample: March 1980(-10%), January 1987 (+13%), and October 1987 (-22%). For daily data, 114 of the 3286 observations are classified as outliers.

5.2 Multivariate Stability Tests

Apart from comparing the unconditional volatility of returns before and after futures inception, we also study the other factors that influences stock returns. The conditional volatilities of monthly returns in the pre and post futures periods are also examined after adjusting for macroeconomic effects. This is done by testing the stability of the residual volatility after the effects of the macroeconomic factors, based on CRR, are removed.

CRR suggest that the following factors affect stock returns:

a) Innovations in the rate of productive activity.

b) Unanticipated changes in the default risk Premium.

c) Unanticipated changes in the discount rate.

d) Unanticipated price level changes.

e) Changes in expected inflation.

The CRR calculations of the proxies for the factors are replicated a follows. The monthly growth in industrial production, MP_1, proxies innovations in the rate of productive activity. This factor is calculated as MP_t = Log [IP_{t+1} / IP_t], where IP is the Industrial Production Index (not seasonally adjusted) taken from the PRWORESS data base of CMIE (Center for Monitoring Indian Economoy). Following CRR, IP is led by one month to make industrial production and stock returns contemporaneous. The default risk factor, URP_t = BAA_t - LGB_1, is end of period monthly returns on BAA bonds minus the end of period monthly return on long term government bonds. The LGB (long government bonds) returns series is from RBI (Reserve Bank of India) bulletin. The BAA returns series are calculated from BAA yields obtained from Moody's Bond Record using the procedure described in Schwert (1989).The third factor, unanticipated changes in the discount rate, can be approximated with unanticipated return on long-term bonds (URL) using the formula UTS_t = LGB_t - TB_t. GB_t is the end of period monthly return on long term government bonds and TB_t is the end of period return on one month T (treasury) bills. Both series are from the PRWORESS data base of CMIE.The fourth factor called unanticipated price level changes is measured taking the value of unanticipated inflation factor (UI) given as the difference between actual inflation (I_t) minus expected inflation { $E(I_t \mid t\text{-}1)$}.

The fifth factor called changes in expected inflation is estimated by using Fama & Gibbons' (1984) methodology as did

CRR. Defining I_t -= log [CPI_t/CPI_{t-1}], let the change in the ex-post real rate of interest be : $U_t = (TB_{t-1} - I_t) - (TB_{t-2} - I_{t-1})$,

where TB_{t-1} is the return on one-month T-bills from t-1 to t. Estimating ø from the moving average process $U_t - øU_{t-1}$, the

estimated expected real rate of interest from t-1 to t at timet-1 is : $E(R_t) = TB_{t-2} - I_{t-1}$)- $øU_{t-1}$. From the Fischer equation, expected inflation is {E (It | t-1)} = TB_{t-1} – E (Rt | t-1), and the unanticipated inflation is $UI_t = I_t$ – E (It | t-1). Further, the following regression is estimated for the entire sample, the futures and the post futures sub samples where

SP_t is the monthly return (with out dividends) on the BSE Sensex Index.

$$SP_t = ü_0 + ü_1 (MP_t) + ü_2(URP_t) + ü_3(UTS_t) + ü_4 (UI_t) + ü_5(DEI_t) + H t \quad \ldots\ldots. (1)$$

6. Analysis and findings

Table 1report summary statistic for daily and monthly BSE Sensex returns from Jan 1996 to Dec.2007. The mean and standard deviation of both daily and monthly returns in the post futures period are higher than those in the pre futures period. Using an F test as in Edwards (1988a, b). Table 2 shows that one cannot reject the null hypothesis that the variance of monthly returns is the same for the pre and post futures periods, but this null hypothesis is rejected for daily returns. These variance ratio tests are, however, sensitive to the assumption of normally distributed stock returns. Table I also reports normally tests for daily and monthly returns. The null hypothesis that daily and monthly returns are normally distributed is rejected at a 0.0001 level for all but two subgroups: the monthly returns in the pre futures subgroup and the monthly returns in the post futures subgroup without the crash of May 2004 & May 2006. The relative size of the skewness and kurtosis measures suggest that the normality rejections stem primarily from leptokurtosis.

Table 2 report the results of the two nonparametric tests. For daily data, the Wilcoxon rank Sum test does not reject the null hypothesis that the pre futures and the post futures subgroups have the same distribution while the Kolmogrove Smirnov test does reject. The results of the two nonparametric tests are consistent with the hypothesis that the daily location (Mean) has not changed but the daily dispersion (Variance) has changed between the periods. For monthly data, neither the Wilcoxon Rank Sum nor the Kolmogorov-Smirnov test rejects the null hypothesis that the pre futures and post futures returns have the same distribution. These results are consistent with the hypothesis that neither the monthly location (mean) nor the monthly dispersion (variance) has changed between the subgroups. The nonparametric tests thus suggest that the daily volatility of the BSE Sensex returns is higher after futures trading commenced, but the volatility of returns is unchanged.

One possible alternative explanation of why a change in daily volatility is found, but not in monthly volatility, is simply that the monthly test has less statistical power than the daily test. Another possible alternative explanation for a change in daily volatility, but not in monthly volatility, is that the distribution of daily returns is frequently and randomly changing, whereas the distribution of monthly returns is not so. Although they do not test the significance of these annual changes, both Edwards (1988) and Harris (1989) report substantial changes in the variance of daily BSE Sensex returns from year to year. In a similar manner, this study attempts to examine this possibility for daily BSE Sensex returns from year to year. To investigative this possibility, the parametric and non-parametric test based on two alternative (nonevent induced) splitting of the data set: i) 1997 – 1999 versus 2000 – 2007 and (ii) 1997 – 2000 versus 2001 – 2007 are retested. The results are similar to those reported in Table 2.

Using the Kolmogorov Smirnov test, it is found that the hypothesis that the two samples come from populations with the same distribution is always rejected (at conventional levels, with and without the crash) for daily returns, but never for monthly returns. Consequently, it can be concluded from Tables 1 and 2 and futures trading has no significant effect on the volatility of monthly returns. But it cannot be concluded from tables I and II that the significant increases in the volatility of daily returns in the post futures subgroup is necessarily related to the inception of futures trading.

Table 3 presents the results of the outlier test of daily returns. Using the binomial distribution, this test calculates the probability of observing a number of outliers that is at least as extreme a were observed in the post-futures group if outliers were randomly distributed among all observations. That test confirms that there are significantly more daily return outliers (low, high, and total) in the post futures trading period than in the pre futures trading period. Excluding the months of May 2004 & May 2006, however, low daily outliers are statistically no more frequent in the post futures period than in the pre futures period. With or without May 2004 & May 2006, daily high outliers are significantly more prevalent in the post futures period. These last two facts counter popular press perceptions that futures period. These last two facts counter popular press perceptions that futures trading are associated with only “big” daily declines in the stock market.

The outlier test and the data in table 3 illustrate the effects of May 2004 & May 2006 crash on the distribution of daily stock returns. Twenty three of the 42 trading days in May 2004 & May 2006 are classified as outliers, with 8 of them classified as low outliers. In fact, the months of May 2004 & May 2006 accounts for 14 of the 127 daily outliers consisting 8 low outliers and 6 high outliers. Including the months of May 2004 & May 2006, one can reject, at the 5% level, the null hypothesis that there are no more low daily outliers in the post futures era than in the sample. Including the months of May 2004 & May 2006, this null hypothesis cannot be rejected at conventional levels.

Table 4 presents results of regression of results in which the moving average parameter for expected inflation (ø) is estimated using all data for three study periods, namely pre-futures, post-futures and entire study sample. For the pre-futures period, the model as a whole is significant, as the F-value shows, though the only significant regressor is the default risk factor. It is to be noted that the default risk factor, $URP_t = BAA_t - LGB_1$, is end of period monthly returns on BAA bonds minus the end of period monthly return on long term government bonds. An unexpected increase in the default risk over the monthly holding period reduces end-of-period BAA bond prices relative to end-of-period LGB bond prices; and thus, reduces the difference in the end-of-period monthly returns. Consequently the negative value of the coefficient of the default risk factor implies that the BSE Sensex returns increase with default risk. In the post-futures period, the model as a whole is also significant and two regressors are significantly positive: Unanticipated changes in the discount rate, and Unanticipated price level changes. The negative correlation of -0.67 between the ‘Unanticipated changes in the discount rate’ and default premium suggests that the finding that the default premium is significant in the pre-futures period while ‘Unanticipated changes in the discount rate’ factor is significant in the post-futures period may be as a result of multicollinearity and not an economic result.

Before testing whether the conditional variance between two periods is different, it is necessary to test the stability of the regression coefficients in eq. (1) between the periods. Table 5 presents the results of Weerahandi’s (1987) test of regression coefficient stability. This test allows for unequal variances across the subgroups. The Weerhandi test does not reject the hypothesis that the regression coefficients are stable between the pre- and post-futures periods.

To test the hypothesis that the conditional variances for the pre and post futures eras are equal, the Goldfeld Quandt test is used. This test examines the residuals from the same regression model fitted separately to the two subgroups. The null hypothesis is that the variance of the errors in another part of the sample. Dropping some observation out of the middle of the sample increases the power of this test. Table 6 presents the result this test. Including the crash, the Goldfield Quant test rejects the null hypothesis of equal conditional variances and the conditional volatility in the post futures period is lower (but not significantly lower) than that of the pre futures period.

While the causes of the crash of May 2004 and May 2006 are not yet known extant literature suggest that is was not caused by futures trading. The tests used in this study fail to reveal the evidence that stock index future trading has destabilized the stock market based on monthly returns.

7. Conclusion

This paper has explored the impact of the introduction of Futures trading on cash market volatility in an emerging capital market like India by taking a leading stock index in India namely, BSE Sensex on which futures trading is available. The impact of futures introduction on the conditional and unconditional volatilities of the underlying stock index (BSE Sensex) is examined. In a stock market marked with higher uncertainty due to global factors, the stability issue is examined further by using two statistical tests. It is responsibility of regulatory agencies like SEBI (Securities Exchange Board of India) to implement various measures designed to reduce volatility in the stock market.

In this study, the Parametric and nonparametric tests that the volatility of daily returns in the post futures period was higher than in the pre futures period but the volatility of monthly returns remained unchanged. Further investigation, however, reveals statistically significant evidence that the distribution of daily returns could that the significant increases in the volatility of daily returns after the inception of futures trading is necessarily futures induced. Controlling for the effects of macroeconomic variables this study finds no evidence, apart from the month of May 2004 and May 2006 that monthly BSE Sensex index volatility has increased after inception of the BSE Sensex Futures market. In fact, excluding May 2004 & May 2006, the conditional volatility of index returns is slightly lower in the post futures era. While the causes of the Sensex crash are not fully known, there is no evidence that stock index futures trading has an adverse effect on market stability. Finally as Working (1963) noted in judging the net social benefits of a futures market, it is not necessary to find that the futures market stabilizes the underlying cash market, but only that futures trading does not destabilize it. The hedging benefits of the futures market are then sufficient to conclude that the existence of the futures market increases net social welfare. No evidence is found here that the stock index futures market destabilizes the underlying cash market based on monthly returns. The findings and the wide use of stock index futures by hedgers suggest that returns. The findings and the wide use of stock index futures by hedgers suggest that the introduction of stock index futures may have increased net social welfare.

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Appendix 1.10 Biggest falls in the Indian stock market history (BSE Sensex)

May 18, 2006: The Sensex registered a fall of **826** points (6.76 per cent) to close at 11,391, it's biggest ever, following heavy selling by FIIs, retail investors and a weakness in global markets.

April 28, 1992: The Sensex registered a fall of **570** points (12.77 per cent) to close at 3,870, it's second-largest, following the coming to light of the Harshad Mehta securities scam.

May 17, 2004: Another Monday. Sensex dropped by **565** points, its third biggest fall ever, to close at 4,505. With the NDA out of power and the Left parties, part of the UPA coalition government, flexing their muscle, the Sensex witnessed its second-biggest intra-day fall of 842 points, twice attracting suspension of trading. At close, however, it regained some of its lostground.

May 15, 2006: The market fell by **463** points to 11,822 points.

May 22, 2006: Sensex slumped by **457** points to 10,482.

May 19, 2006: Sensex slumped by **453** points to 10,939.

April 4, 2000: Sensex slumped by **361** points to 4,691.

May 12, 1992: Indian stock markets plunged **334** points to fall to 3,086.

May 14, 2004: Sensex lost **330** points to fall to 5,070.

May 6, 1992: Losing **327** points, the Sensex fell to 3,561 points.

Table 1. Descriptive statistics for daily rates of return on BSE Sensex

	Entire Sample	Pre-Futures	Post-Futures	Post-Futures (No Crash)
Mean	0.00062	0.0049	0.0095	0.0102
Std.Deviation	0.00951	0.00743	0.01354	0.00854
Skewness	-6.31	1.03	-5.18	-0.086
Kurtosis	88.42	12.98	76.31	11.32
Normality Test	46528	565.5	68433	254.5
p-value	0.000	0.000	0.000	0.0001

[a] The standard measures of skewness and kurtosis are : $\ddot{u}_1 = \mu^2_3 / \imath^2$ and $\ddot{u}_2 = \mu_4 / \imath^4$, respectively. $\mu_{3=}$ E(x- μ)^3 and μ_4 = E(x- μ)^4, where μ is the sample mean and ı is the standard deviation.

[b] Null hypothesis H_0 : $\ddot{u}_1$ =0, $\ddot{u}_2$=0. H_A : H_0 Is not true and the distribution belongs to the Pearson family. The test statistic is n [(b_1 /6) + {(b_2-3)^2 /24}] , where b_1 and b_2 are the sample estimates of $\ddot{u}_1$ and $\ddot{u}_{2.}$

[c] Two-tailed p-values for the hypothesis that the returns are normally distributed.

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IRJA-Indian Research Journal, Volume: 1, Serious: 2. Issue: March,2014 **ISSN: 2347 – 7695**
Online Available at www.indianresearchjournal.com

Table 2. Descriptive Statistics for Monthly rates of return on BSE Sensex

	Entire Sample	Pre-Futures	Post-Futures	Post-Futures (No Crash)
Mean	0.00087	0.00056	0.00158	0.00178
Std. Deviation	0.0465	0.0449	0.0475	0.0413
Skewness	-0.0942	0.0465	-2.128	0.541
Kurtosis	9.441	5.685	12.354	6.54
Normality Test	120.85	9.64	75.36	12.35
p-value	0.000	0.000	0.000	0.1235

[a] The standard measures of skewness and kurtosis are : $\ddot{u}_1 = \mu^2_3 / \imath^2$ and $\ddot{u}_2 = \mu_4 / \imath^4$, respectively. $\mu_{3=}$ $E(x- \mu)^3$ and $\mu_4 = E(x- \mu)^4$, where μ is the sample mean and $\imath$ is the standard deviation.

[b] Null hypothesis H_0 : $\ddot{u}_1$ =0, $\ddot{u}_2$=0. H_A : H_0 Is not true and the distribution belongs to the Pearson family. The test statistic is $n\ [(b_1 /6) + \{(b_2-3)^2 /24\}]$, where b_1 and b_2 are the sample estimates of $\ddot{u}_1$ and $\ddot{u}_{2.}$

[c] Two-tailed p-values for the hypothesis that the returns are normally distributed.

Table 3. Test of Stability for rates of Return before and after Introduction of Futures Trading (2-tailed p-values in parenthesis)

Data Periods	Non-Parametric Tests		Parametric Test	
	Wilcozon Rank Sum (z- statistic)	Kolmogorov-Smirnov (chi-square)	Test for Equality of Means[a]	Test for Equality of Variances[b]
Daily data : Pre-vs. Post-futures	1.546 (0.3256)	9.652 (0.0238)	1.325 (0.2185)	2.576 (0.0023)
Daily data: Pre-vs. Post-futures (**without crash)**	1.796 (0.1254)	3.548 (0.2987)	1.452 (0.1543)	1.657 (0.0785)
Monthly data : Pre-vs. Post-futures	1.468 (0.3179)	9.784 (0.0345)	1.548 (0.1023)	1.783 (0.0056)
Monthly data: Pre-vs. Post-futures (**without crash)**	1.896 (0.1678)	3.254 (0.2796)	1.985 (0.0956)	1.129 (0.1354)

[a]H_0: $\mu_1 - \mu_2 = 0$. Test statistic: $Z = (x_1 - x_2) / \imath_{(x1 - x2)} = (\imath^2{}_1/n_1 + \imath^2{}_2/n_2)^{1/2}$. This test assumes: 1) both samples are approximately normally distributed; and 2) both samples are random and independent.

[b]H_0: $\imath^2{}_1 = \imath^2{}_2$. Test statistic : $F_{v1,v2} = s^2{}_1 / s^2{}_2$, where $s^2{}_1 > s^2{}_2$ and v_1 and v_2 are numerator and denominator degree of freedom. This test assumes: 1) both samples are approximately normally distributed; and 2) both samples are random and independent.

[c]Pre-futures period: Jan 1996 to June 9 2000 ; Post-futures period: 12 June 2000 to 31 Dec.2007

Table 4. Test of Daily Outliers using Binomial Probability Distributions for entire period

Description/Indices	**Entire Sample**	**Entire Sample without May 2004 & May 2006**
No. of Observation in Pre-Futures	1071	1071
No. of Observation in Post-Futures	1726	1674
No. of Low outliers in Post-futures	26	18
Total of **All Low outliers**	**49**	**41**
Prob. (Post-Futures Outliers)	0.0356	0.2679
No. of High outliers in Post-futures	52	46
Total of **All High outliers**	**81**	**75**
Prob. (Post-Futures Outliers)	0.0006	0.0054
No. of All outliers in Post-futures	78	72
Total of All Outliers	**130**	**113**
Prob. (Post-Futures Outliers)	0.0000	0.0003

The two-tailed p-value, PROB (post-futures outliers), is the probability of observing at least this extreme total number of outliers in the post-futures period if outliers are randomly distributed among all observations. An observation is classified as an outlier if it is less than Q_L -1.5 D_Q or if it exceeds Q_U + 1.5 D_Q where Q_U and Q_L denote the upper and lower quartiles and $D_Q = Q_U – Q_L$.

Table 5. Regression Results of Monthly BSE Sensex Returns on Macroeconomic Factors

Economic Factor/Statistic	BSE Sensex		
	Entire Sample	Pre-Futures	Post-Futures
Intercept	0.00845 (0.0561)	0.00328 (0.5139)	0.00914 (0.3146)
Growth in Industrial Production	0.2846 (0.1954)	0.9468 (0.1238)	0.2846 (0.5188)
Default risk factor	-0.2513 (0.3245)	-0.4981 (0.0236)	-0.0941 (0.6685)
Unanticipated Discount rate change	0.4235 (0.0105)	0.1238 (0.5216)	0.4238 (0.0059)
Unanticipated price change	1.2386 (0.1946)	-3.3125 (0.1537)	4.4216 (0.0349)
Expected Inflation	-0.4129 (0.6428)	-1.3548 (0.2157)	-0.6125 (0.6551)
Adj. R^2	0.2361	0.3415	0.2946
F-statistic	6.4812	4.2198	4.3611
p-value	0.0005	0.0012	0.0246
Durbin-Watson statistic	2.156	3.115	2.546

Note: The Moving average parameter for expected inflation ( )is estimated separately for each entire period and for sub-periods; The values in parenthesis are the t-values.