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Significance of Stock Derivatives on Volatility and Liquidity of Market: A Comprehensive Review of Literature

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***Abstract*: This paper presents an overview of Significance of Stock Derivatives on Volatility and Liquidity of Market: A Comprehensive Review of Literature.**

***Keywords*: Volatility, liquidity, literature, derivatives.**

1. Introduction

1) Some Empirical Research Works

This paper presents a brief review of some of the empirical studies concerning the subject of stock market volatility and liquidity in the light of derivatives trading. Though, there have been a few studies on the stock price behaviors in the Indian stock market, yet much attention has not been paid to the problem of volatility. Most of the studies on volatility have been carried out abroad. These studies cover a wide range of issues ranging from the extent of volatility and its relationship with a variety of factors such as the arrival of information, traded volume, trading mechanism, dividend payout, debt to equity ratio and day of the week effect, etc. to the effect of regulatory interventions such as price limits, margin requirements, etc. Some of the important studies are discussed as below:

Amihud and Mendelson (1987) compared the behavior of open-to-open and close-to-close returns of NYSE stocks, given the differences in execution methods applied in the opening and closing transactions. The effect of two prevalent trading mechanisms – the periodic clearing house and continuous dealership market – on the behavior of stock returns has been examined. The empirical investigation employed price data from the opening and closing transactions in active NYSE stocks, utilizing the fact that each of these transaction series was generated by a different trading mechanism. Their results showed that the trading mechanism had a significant effect on a number of characteristics of stock returns. First, the distribution of open-to-open returns disclosed greater variance than that of close-to-close returns. Second, the serial correlation pattern was quite different in the two-return series. Further, employing an ARIMA (1, 1) model, they found that opening returns exhibited higher residual noise and stronger dependence on past returns reflecting stronger deviations from the random walk form of market efficiency hypothesis. Taken as a whole, the evidence suggested that trading at the opening exposes trader to a greater variance (volatility) than at the close, reflecting the differences between the trading mechanisms. King (1987) reviewed the situation when derivatives instruments were introduced at New York Stock Exchange. At the inception stage, stock index futures and options were perceived as disruptive to ordinary stock trading, particularly on days when futures contracts expired. The trading mechanisms in fixed income securities, however, showed signs of improvement. The new instruments helped the government bond dealers to survive in the volatile interest rate environment.

In competitive stock exchange, futures contracts enhanced liquidity. If cash and future prices were more closely aligned, then the future markets could have provided a clear net benefit to the efficiency of stock market trading. Edwards (1988) tried to gather evidence to verify the fact that stock index futures trading destabilized the spot market in the long run. Using variance ratio F-test from June 1973 to May 1987, he concluded that the introduction of futures trading had not induced any change in the volatility in the long run. There was some evidence of futures-induced short run volatility, particularly on futures contract expiration days, but this volatility did not appear to carry over to longer periods of time.

Harris (1989) observed increase in volatility after the introduction of index futures by comparing daily returns volatilities during pre-futures (1975-82) and post–futures (1982-1987) between S&P 500 and a non-S&P 500 group of stocks. He pointed out that index-related instruments and developments such as growth in index funds as well as increase in foreign ownership of equity were possible explanations of higher volatility in stock markets. Jones and Wilson (1989) assessed whether the stock price volatility in the US market had increased in comparison to historical levels. They measured volatility using two methods: (i) the percentage spread between high and low daily prices in each month, and (ii) the standard deviation of the daily prices in each month. The results over the 1985-89 period suggested that, while daily volatility had increased slightly since 1980, it was little different from the volatility that existed for more than 100 years. In fact, relative

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to the 1930-40 period, volatility for the study period was quite mild. This was held true whether one considered daily movements within a decade, monthly movements within a decade or daily movements over the whole period. By any measure, the volatility of the 1930s was unparalleled. If the 1930s was chosen as the benchmark, the 1980s was a wimp in terms of volatility.

Ross (1989) demonstrated that under conditions of no arbitrage, variance of price change must be equal to the variance of information flow. This implied that the volatility of the asset price would increase as the rate of information flow increase. It followed, if futures increased the flow of information, then in absence of arbitrage opportunities the volatility of the spot price must change.

Schwert (1989) characterized the changes in stock market volatility through time. First, stock market volatility was related to the time-varying volatility of a variety of economic variables. The relation of stock volatility was analysed vis-à-vis real and nominal macroeconomic volatility, economic activity, financial leverage and stock trading activity. Relative to the 1857-1987 period, volatility was unusually high from 1929 to 1939 (Great Depression) for many economic series including inflation, money growth, industrial production and other measures of economic activity. Second, stock market volatility was related to the level of economic activity. Stock market volatility was higher during recessions since most of the estimates were positive. Third, there was real evidence that macro-economic volatility as measured by growth rate of industrial production helped to predict stock and bond return volatility. Fourth, financial leverage affected stock volatility. When stock prices fell relative to bond prices or when firms issued new debt securities in larger proportion to new equity than their prior capital structure, stock volatility increased.

Herbst (1990) documented that expiration day volatility of the stock index futures had an impact on overall volatility. Volatility was measured by the standard deviation of returns. It was seen that there was a fall in the volatility within hour of due to change in settlement procedure from the third Friday to preceding Thursday.

Schwert (1990) measured volatility by the standard deviation of rates of return to a broad stock and market index such as the Standard and Poor's 500. The various estimates of standard deviation showed that volatility as measured using the standard deviation of rates of return has been stable since the mid-19th century in the United States. The major exception was the great depression period from 1929 to 1939. It was also observed that high levels of volatility following the Black Monday (October 19, 1987) was short-lived; the burst of volatility on Friday the 13th (October 13, 1989) was even more temporary. Moreover, the growth in stock index futures and options trading was not associated with an upward trend in stock volatility. The evidence indicated that future returns were more volatile than stock index returns when there were big price movements. There was also little evidence that computerized trading per se increased volatility except perhaps within the trading halts or circuit breakers.

Chaudhuri (1991) investigated the behaviour of ex-post returns on industrial share price indices and the volatility of returns and inter-temporal stability. The analysis of short-run share price movement was based on the time-series of weekend prices indices published by the Reserve Bank of India (RBI). The study spared over a period of five years (1986-90) and covered thirteen industry groups. The results indicated that the said period was characterized by sharp variations in the average realized returns – aluminium industry realizing the highest rate of return and man-made fibres showing losses. The return differentials across the industries varied from year to year. None of the industry groups except tea plantations, experienced positive returns consistently over the study period. The results of volatility patterns indicated that aluminium, electricity generation and supply as well as shipping industries were consistently volatile. The inter-temporal stability of volatility has been tested by applying multiple rank correlation technique and by computing Kendall's coefficient of concordance and its significance was assessed by Chi-square test.

Amihud and Mendelson (1991) presented evidence on the effects of the trading mechanism coupled with the timing of transactions on stock price behaviour. The comparison used data from the Tokyo Stock Exchange (TSE). The data consisted of opening and closing prices for both the first (morning) and second (afternoon) trading sessions. Their results showed that: (i) the mid-day clearing transaction was characterized by low price volatility and efficient value discovery, and (ii) a sequence of recent transaction prices facilitated value discovery and eased trades' influence on the current value of the security as well as on the market as a whole.

Bessembinder and Seguin (1992) examined whether greater futures-trading activity (volume and open interest) was associated with greater volatility. The authors also documented the heterogeneous effects on volatility of expected and unexpected components of each trading activity series. They used the S & P 500 index prices from Jan. 1978 to Sept. 1989 breaking them into expected and unexpected components using on ARIMA (0, 1, 1) model. They documented a positive relationship of spot volatility with unexpected futures trading volume and a negative relationship with open interest.

Chen (1993) examined the effects of changing daily price limits on stock price volatility in the Taiwan Stock Exchange. The stock volatility over three different price limit regimes was compared and bivariate regressions performed. The results showed that price limits did not provide a cooling-off effect on stock volatility except for the case of the tightening in October 1987. On the contrary, it was observed that price limits tend to slightly exacerbate price volatility. Further, it was noted that serial correlation of stock returns was inversely related to the range of price limits, implying a delaying effect of price limits. Engle and Nag (1993) measured and tested the impact of different news viz., dividend announcements, mergers and trends in global crude oil markets on volatility of stock market operations. They concluded that there was no set pattern of impact of different news on volatility.

Corhay and Taurani (1994) investigated whether the authoregressive conditional heteroskedastic models (ARCH) introduced by Engle and its generalized versions (GARCH) by

Bollerslev could adequately describe stock price behaviour in European capital markets which were generally much smaller and thinner than the American ones. Thus, the objective was to model non-linear dependencies in stock returns. The five countries selected for this were France, Germany, Italy, Netherlands and United Kingdom. The indices of these five European stock markets were collected from DATA STRAM for the period 1 January, 1980 to 30 September, 1990. The statistical findings confirmed the fact that daily stock returns were not normally distributed and were leptokurtic and skewed. The results clearly indicated that conditional heteroskedasticity was a prime feature of daily returns behaviour of five European equity indices. They exhibited non-linear dependence that could not be captured by the random walk model.

Broca (1995) developed a Control Chart approach for dynamically monitoring changes in the volatility of aggregate share prices on the Bombay Stock Exchange (BSE) as measured by the BSE Sensitive Index. The sequence of F-ratios so obtained was compared against critical upper and lower control limits at one per cent significance level. Application of this Control Chart approach on daily Sensex returns over 1990-92 revealed several volatility changes, some of which either signaled the onset/decline of speculative manias witnessed over the past years or coincided with the release of budget news.

Goyal (1995) examined the nature and trend of the stock return volatility in the Indian stock market and assessed the role of carry forward system in causing variations in the volatility levels. The analysis has been carried through vector autoregressive (VAR) model revealed significant influence of industrial output on volatility of stock returns. The volatility have been estimated on daily basis from May 1993 to December 1994 and on monthly basis for a period of 8 years from 1986 to 1994. Stock volatility levels were found to be sensitive to the day of the settlement period. Presentation of the Union Budget and declarations of book closures by firms produced seasonality patterns in monthly volatility estimates of stock returns. The erstwhile carry forward system contributed to volatility in the market. A comparison of pre- and post-ban periods clearly brought out this fact. The volatility in stock returns could be explained by macro-economic activity. The volatility in industrial production and money supply have significant effects on the movements in stock returns. Industrial production has been found to be more significant than money supply. VAR analysis also provided the evidence that industrial output was influenced by the changes in stock returns, thus, underscoring the importance of the vibrant capital market for the industrial sector. The hypothesis that changes in stock returns affected changes in money supply was rejected.

Nicholls and Tonuri (1995) presented an overview of the GARCH family of variance models and examined the behaviour of Australian aggregate stock market volatility over the period 1988-91 using the GARCH framework. The study considered daily returns on the Australian Fifty Leaders statex. Actuaries Accumulation Index from 4 January 1988 to 31 December, 1991 included a series of 1023 observations in total. Three asymmetric GARCH models, which have been considered in the study were: exponential GARCH model i.e., EGARCH, the absolute value GARCH model i.e., AGARCH and the GJR-GARCH model. When applied to Australian daily stock return data, the asymmetric EGARCH (1,1) model has been found to provide a suitable description of the variance of the data.

Roy and Karmakar (1995) focused on the measurement of the average level of volatility in the Indian stock market and whether it has increased in the current period. Volatility has been measured by the standard deviation of rates of return. Their sample data consisted two sets of index numbers. The first set comprised of the 'Capital' stock. It was published by the Capital magazine on a monthly basis for the period January 1935 to December 1960. The second set was composed of 'The Economic Times Index Number of Ordinary Share Prices' compiled and published by the Economic Times on a daily basis for the period 1961 to 1992. The study concluded that stock market volatility has increased in the current period. To prevent recurrence of such episodes in the future it was suggested that the government must initiate suitable steps to reform stock market activities.

Bernardo and Cornell (1997) tried to answer two related questions. First was on the shareholders' heterogeneity and the elasticity of demand for financial assets. Second was the perspective on fixed income valuation models. The results reported in this article added further support to the growing body of research that investors could not be viewed as homogeneous. It was observed that investors could be heterogeneous along several dimensions; it could be induced by (i) tax rules, (ii) transaction costs, (iii) difference in the investor's assessment of the value of security, (iv) non-tradeable risks, and (v) psychological reasons. The results also pointed to the potential value added and profitability of market making.

Reddy (1998) analyzed the effects of market microstructure on the stock market volatility. The influence of establishment of NSE and the introduction of BSE On Line Trading (BOLT) on the volatility of securities traded on the BSE has been analysed. Stock market daily trading data relating to about 3000 securities traded on the BSE for the period October 1994 to November 1995 formed the database. The data has been accessed from on-line corporate databases like Metastock, Capitaline Ole' and CMIE. The results of influence of the establishment of the NSE on the volatility in the BSE were mixed. Volatility as measured by standard deviation of returns showed no increase, while the standard deviation of closing prices and the extreme value estimator of volatility showed an increase. Thus, it was stated that the establishment of the NSE, though fragmented the stock market structure in India, has not really affected the working of the BSE, as his analysis could not find sufficient evidence for an increase in the volatility of the securities traded on the BSE. Sorescu (1998) examined the price effects on introduction of options. Throughout the paper the benchmark measure for the price effects of options was the cross sectional average of the cumulative abnormal returns (CARs). The researcher divided the study in two periods, viz. 1973-80 and 1981-95. Then tested two hypothesis (i) H1 – The price effects of options is negative throughout 1973 to 1995, (ii)

H2 – A switch in the mean CAR occurs around 1981, causing positive effect from 1973-80 and negative from 1981-95. And resultantly H1 was accepted at significant level of significance with t-statistic. The possible causes for the switch in the price effect of options were (i) age and size of underlying stocks, (ii) introduction of stock index options on April 21, 1982, and (iii) SEC imposed moratorium of new option listings during the period 1977 to 1979. The study recommended substantial changes in the operating procedures of option exchanges.

Chang et al. (1999) analyzed the effect of index futures listing on the underlying stocks by decomposing portfolio volatility into the average volatility of component stocks and the cross sectional dispersion of returns. They found that when Nikkei 225 futures were listed in Japan, the cross sectional dispersion of returns across stocks in the index decreased, and index volatility increased proportionally more than the average volatility of the individual stocks. Neither such results were found for stocks outside the index, nor was any effect found at the time of off share listing of Nikkei 225 futures in Singapore.

Hyonahn and Boudoukh (1999) provided a formal analysis of optimal risk control using option in a simplified framework in which an institution wanted to minimize its VaR (Value at risk). The analysis performed in a Black & Scholes setting was better suited to the problem of hedging exposures to exchange rates, equities or distributed assets. Hedging with options affected the VaR in two ways : (i) The cost of hedge reduced the future cash flows, and (ii) the payoffs of the options increased the cash flow when they finish in the money. The institution minimized its VaR using long position input options, subject to a cost constraint on hedging and a constraint that the exposure be underhedged. Using forwards or future to minimize the VaR of institution's asset was straightforward and less interesting. The GAAP hedge accounting guidelines might lead to forward not being an accounting alterative. The authors concluded that the optimal strike price of an option was independent of the level of cost, therefore, the Cost/VaR frontier was linear.

Kaski and Pontiff (1999) analyzed the use of derivatives by the equity mutual funds, by comparing the return characteristics of funds that use and do not use derivatives. The authors focused on three alternate ways, the derivatives might affect a mutual fund's returns: (i) First, depending on whether derivatives were used to speculate or to hedge; (ii) Second, the managers who used derivatives might improve net portfolio performance; and (iii) Third, they examined how derivatives affect the intertemporal relation between fund performance and risk. The findings of the study showed that most equity mutual funds were not using derivatives. From a sample of 679 domestic equity MFs only 21 per cent used derivatives. Funds that used derivatives have similar standard deviation, exposure to market risk, market timing, skewness and Kurtosis as compared to funds that did not use derivatives. The use of derivatives was also unrelated to net return performance. The most notable result was that there was no significant difference between the two groups for most of the investment objectives and variables considered. In certain cases the differences existed, but there was no systematic pattern in these results.

Varma (1999) studied the statistical process underlying changes in the rupee–dollar exchange rate. In the case of India and many other markets, forex markets showed a different trend due to important role played by the central bank. So, due to higher fluctuations in forex rates, the researcher developed Kurtosis prediction models that could be used for pricing rupee-dollar options and for value at risk calculations an open rupee-dollar positions. The empirical results showed that a jump-diffusion (abnormal mixture) model provided a better description of the exchange rate process. This model performed far better than GARCH Model that did not allow jumps. This suggested that the valuation of options on the rupee-dollar exchange rate must be based on the jump-diffusion model of Mertun.

Grinblatt and Longstoft (2000) conducted this study with an objective to understand the role played by financial innovations. They examined how investor used the successful Separate Trading of Registered Interest and Principal of Securities (STRIPs) programme of the U.S. Treasury. The data was obtained directly from the monthly statement of the public debt issued by the U.S. Treasury. The sample period of 54 months started from July 1990 to December 1994. The authors took four explanatory variables, viz. revolution differences, market completion, tax and accounting motivations, and liquidity. With the help of these variables they examined to which extent stripping and reconstitution activity could be explained. The findings of the study suggested that investors used the option to create treasury derivative strips primarily to make market more complete. Liquidity related factors helped in explaining differences of prices and treasury, bonds and STRIPs. The authors concluded that there was little evidence that the option to strip and reconstitute securities was used for speculative purposes.

Huseyin and Stewart (2000) examined stock market volatility before and after the introduction of index futures in 25 countries. Then they tested whether spot volatility after the introduction was related to futures market volume and open interest. The study was conducted over a general time period between 1973 and 1997 using the excess returns over the world market index. They used a variety of models like GJR-GARCH, Non-linear GARCH and Exponential GARCH. To estimate the impact of futures introduction they incorporated a multiplicative dummy in the variance equation. They found that futures trading is related to an increase in conditional volatility in Japan and US, but in the rest of the countries, they found no significant effect. They found that except for Japan and US, volatility was high in periods when futures volume was high, it was driven by unexpected components of volume.

Stewart (2000) summarised the theoretical and empirical research on how the introduction of derivative securities affected the underlying market. A wide array of theoretical approvals applied to the question of how speculative trading and the introduction of futures/options affected the stability, liquidity and price informativeness of assets markets have been reviewed. In most of the cases, the researcher found that speculative trading and derivative markets stabilized the underlying and tend to make spot markets more liquid and more

efficient informationally.

Thomas and Karmide (2000) focused on price discovery mechanism in castorseed market in India. India is the world's largest exporter of castorseed. The researchers used Barbade and Sibler framework to study price discovery across futures and spot markets. In this model, they treated the future and spot prices as a bivariate random walk. Data related to study was obtained from the Forward Market Commission. The findings indicated that in Bombay futures market prices had dominated spot market prices in all contracts but one. In Ahmedabad, neither the futures nor the spot market dominated in price discovery. Further, for the contract maturing at harvest, futures market prices were dominated by the spot market. It was more difficult to explain why Bombay futures prices dominated Ahmedabad futures prices in price discovery. One explanation was that Bombay market has informed traders, highly observed selection, wide bid-offer spreads and high market efficiency.

Balasubramanian and Bharadwaj (2001) attempted to find the evidence of a multifactor model in the Indian context. The authors used Principal Component Factor Analysis to estimate the factors and the loadings on the factors. For the purpose of study the researchers used the securities constituting the BSE 100 index. The price data has been adjusted for capitalization changes such as stock splits and bonus issues. A five-factor principal component analysis was performed on the three year weekly returns of BSE 100 index. These five factors were Pharma factor, Technology factor, Old Economy factor, FMCG factor and unknown factors. Almost all the stocks which have a high loading on factor three were the typical 'old Economy' stock belonging to heavy industries. Although it was not possible to provide a conclusive explanation for these five factor loadings. Yet the examination of the factor loading matrix suggested that the first four factors explained the returns generating process for the Indian stock market.

Shekhra (2001) concluded that the efficient fund allocation depended on the stock market efficiency in pricing the different securities traded in it. There were many systematic factors which influenced pricing of securities. The present study was an enquiry into such systematic factors through different methodologies. In this paper, the researcher studied the CAPM Model, APT Model and Factor Analysis model. He included twenty-eight major economic variables. The main categories of variables considered were those representing the product, money and capital markets as well as external trade. The study considered the five year period starting from January 1995 to March 2000. The results clearly showed that the Multifactor and APT Model showed better explanation than CAPM. Of the three models the CAPM overestimated the actual returns and the Mean Factor Model and APT Model underestimated the actual returns. So, the relatively higher forecasting efficiency could be seen in Factors Model. Shah (2001) focused on the question of market efficiency to the extent of mispricing on the equity derivatives market. By using intra-day data for one week in Sept. 2002, the researcher measured the returns available to three strategies. These three strategies related to interest were (i) Cash and Carry arbitrage for future, (ii) Put Call parity arbitrage, and (iii) Early exercise of American options. Pervasive violations of market efficiency were found that means the existence of arbitrage opportunities which could earn extremely supernormal rate of return.

Aggarwal (2002) discussed that the global market in Weather Risk derivatives was valued at US $ 3b-8b and was mainly in the USA. The main use of Weather Derivatives so far has been by energy related companies and utilities. The author provided a possible solution and a Weather derivative instrument with the underlying value as water table for agriculturalists to hedge their risks against rainfalls, droughts and floods. Weather risk was the uncertainty in cash flow and earnings caused by weather volatility. Water tables were influenced by climatic changes. Some key advantages of using water table as an underlying value were (i) reliable index (ii) more reliable long-term trends, (iii) usage for trading in stock exchanges, and (iv) as underlying value for droughts, floods and rainfall situations. The author discussed the possibility of Black & Scholes Model and Burn Analysis for pricing of the instrument. And a possible model was developed with some specific steps. One aspect of these instruments was just as a product being affected in the market to provide a cover against perceived future risks as an option. These could be structured as swap, call and put contracts based on weather indices.

Ammann (2002) conducted this study with the aim to devise and implement a statistical arbitrage strategy for testing market efficiency, namely, the efficiency of markets in pricing relative risk in highly correlated markets. To test this aspect the researcher used significantly related U.S. Equity indexes. The time period of the study was Jan. 1995 to Feb. 2000. Statistical arbitrage methodology consisted; (i) Calculation of correlations of the various index pairs, (ii) Regression of returns by using ordinary least squares, (iii) Conditional forecast of future variance between indexes returns, and (iv) based on implied volatility, a simple arbitrage trading strategy was implemented. The experience of the study signified that magnitude of volatility deviations tended to increase when the underlying stock indexes were volatile. Their simulated arbitrage strategy might not be fully replicating real market conditions because the options prices calculated from the implied-volatility data were not exact.

Daren (2002) studied the impact of futures trading on underlying stock index volatility. The author picked the data related to FTSE MID 250 contract. By using GARCH (1,1) the study concluded that the introduction of futures trading has stabilized the underlying market.

Gupta (2002) studied two research issues related to introduction of index futures on two stock exchanges of India. First issue was related to impact of introduction of index futures on the underlying stock market volatility. Second was the comparison of future market volatility to spot market volatility. The study utilized daily price data (high, low, open and close) for BSE Sensex and S&P CNX Nifty from June 1998 to June 2002. The researcher used four measures of volatility (a) The first was based upon close to close price; (b) The second was based upon open to open prices; (c) The third was Parkinson's Extreme value estimator; and (d) The fourth was Garman – Klass volatility measure (GKV) volatility. In terms of all the

measures, results indicated that the overall volatility of stock market has declined after the introduction of the index futures for both the Indices.

Sahadeven (2002) investigated the derivatives markets in agricultural commodities in India. The study surveyed the recognized exchanges and their organizational trading, and the regulatory set up for futures trading in commodities. A statistical analysis has been carried out to evaluate the efficiency of a sample set of markets in price discovery and to understand the inter-relationship between price and volume of transactions. The study revealed that many of the commodity exchanges failed to provide an efficient hedge against the risk emerging from volatile prices of many farm products. The results obtained from a statistical analysis of the data on price discovery in a sample of the six commodities traded in four exchanges showed that the future market in those commodities were not efficient. That means prices fixed by future market were not an unbiased predictor of rates.

Shah (2002) focused on question of market efficiency to the extent of mispricing on the equity derivatives market. By using intra-day data for one week in Sept. 2002, the researcher measured the returns available to three strategies. These three strategies related to interest were (i) cash and carry arbitrage for future, (ii) Put call parity arbitrage, and (iii) Early exercise of American options. The data used in simulations with Chanakya (Software programme) was arranged from Indian Quotations systems. Pervasive violations of market efficiency showed the existence of arbitrage opportunities which could earn extremely super normal rate of return. A survey was conducted to assess the relative significance of regulatory hurdles, implementation hurdles and internal difficulties for the poor market efficiency of the equity derivatives market.

Shenbagaraman (2002) examined the impact of introducing financial derivatives on cash market volatility in an emerging market like India. The researcher also investigated the effects of introducing both stock index futures as well as stock index options trading on underlying cash market volatility. Daily closing prices for the period 5th Oct., 1995 to 31st Dec. 2002 for CNX Nifty and Nifty Junior were used to apply statistical tools. The study improved upon the methodology used in prior studies by using a framework of Generalised Auto – regressive conditional Hetero skedasticity (GARCH) in univariate mode. The results suggested that the introduction of futures and options had no effect on spot market volatility as it was statistically in significant.

Singh (2002) examined the hypothesis that Indian agricultural futures markets were weak form of efficiency. The concept of weak form efficiency in futures markets was outlined and hypothesis was tested with respect to Indian castor seed, pepper, gur, hessian, potato and turmeric futures markets, using co-integration technique. The efficiency of futures market was explained through distributed log specification of futures price. Test for co-integration, estimated the long run relationship between spot price and the futures price on the first trading day of contract maturing in a specified period. Evidence for market efficiency was mixed and varied across the commodities. The results indicated evidence of efficiency and unbiasedness in relation to gur and potato. For other commodities, efficiency and unbiasedness have been varied according to maturity and months left to maturity.

Thenmozhi (2002) investigated the relationship between the NSE 50 futures and the NSE 50 index. The main objectives of the study were (i) To examine the volatility of spot market before and after introduction of stock index futures; (ii) To examine the lead-lag relationship between stock index futures and spot index returns. The data for the study has been collected from NSE website. The main data for the study was based on the returns of the S&P CNX Nifty index futures and spot index. Volatility has been measured by using standard deviation. The volatility in the post-futures (1.5191) period was less than before futures introduction (2.0113). It has been seen that information coefficient was more in post-future period. Futures market tended to lead spot market and index futures served as a primary market of price discovery. It also showed that the cash index returns did not lead the futures market.

Varma (2003) studied the pricing and volatility of the Indian Index options market using closing Nifty futures and options prices from June 2001 to February 2002. By employing the Black formula to calculate implied volatility for each option on each day, and then fitted a volatility smile to their implied volatility. As per research findings one could say that the Indian market lied almost halfway between the naive world where volatility was ignored and a more sophisticated world where volatility was reasonably priced. The author found little evidence that the market has been moving in the direction of greater sophistication in the pricing of efficiency.

Aggarwal and Aggarwal (2003) gave a brief history of derivative segment in Indian market. They discussed the saving mechanism in the derivative instruments. Later on, the socio-economic and marketing benefits of instruments were also discussed. The Securities Exchange Board of India revoked the banning of forwards trading under section 16 of SCRA (1956) in March 2000. Generally, there are three types of risk, viz. price risk, volume risk and quality risk. Derivatives instruments (like insurance products) helped in transferring such risks. The researchers proposed two options for the saving mechanism to be introduced in the derivatives instruments. The first was Money Back option which was basically seen as a multiple option bought monthly (yearly) for short (long) periods. The premiums paid would be the option prices. The second was repurchase option. In this option the insurance could, in turn, ask for part payments of amounts returned as cash and the other part as insurance instruments. So, this saving concept enabled the availability of derivatives instruments to the common man.

Gupta and Garg (2003) studied whether any causality existed between trading volume and returns in the stock market index. Widely used linear Granger non-causality test was used to investigate the linear relationship. While the non-linear Granger causality was investigated by using Beak and Brock test. The data used in this study was based on time series of daily stock returns as well as trading volume obtained from the NSE. To account the effect of shift from account settlement to rolling settlement, the researchers classified the period into three sub-periods. Linear causality test showed bi-directional change, i.e.,

from returns to volume change and volume to return change during the period when rolling settlement was either not introduced or introduced in a limited manner. The causality in either direction was not observed for the period when rolling settlement was introduced. However, the non-linear Granger causality was absent in either direction for all the time periods, suggesting that non-linear effects were not significant in the NSE and linear effects could be sufficient for predicting causality.

Madapati (2003) presented a brief scene of Indian derivatives markets. Under the background note the author wrote about appointment of L.C. Gupta Committee-I in November 1996 to develop the appropriate regulatory framework for derivatives trading. Derivatives trading in India finally got under way in 2000. But there was lack of depth of derivatives trading in India due to (i) problems regarding infrastructure, (ii) no clarity on the taxation and accounting aspect, (iii) bearish trends in market, and (iv) faulty regulatory framework. Like our stock markets the Indian derivatives markets were also becoming heavily dependent on a few instruments, for instance, futures in some blue chip companies. Trading in future contracts in pepper, turmeric, gur, jute, potato, coffee, cotton and soyabean and its derivatives were traded in eighteen commodity exchanges located in various parts of the country. While concluding the author suggested proper infrastructure for clearing and settlement.

Shenbagaraman (2003) studied the role of some non-price variables such as open interest, trading volume and other factors, in the stock option market for determining the price of underlying shares in cash market. Sample consisted of options on fifteen individual stocks that were most liquid based on trading volume. The study covered stock option contracts for four months from November 2002 to February 2003 consisting seventy-seven trading days. Based on two open interest based predictors and two volume based predictors, the researcher formed regression model to study relative significance of each of these predictors. The researcher concluded that net open interest of stock option was one of the significant variables in determining future spot price of underlying share. The results clearly indicated that open interest based predictors were statistically more significant than volume based predictors in the Indian context.

Singh and Sharma (2003) started with an observation that return on stock prices and trading volume were two prime indicators of trading activity in a stock market. This study investigated whether any causality existed between trading volume and returns in the stock market index. The researchers used linear Granger causality test and modified Beak and Brock test for testing non-linear causal relationship. The data used in this study was based on time series of daily stock returns as well as trading volume obtained from the NSE. To account the effect of shift from account settlement to rolling settlement they classified the period of study into three sub-periods: January 1996 to December 1999 as pre-rolling settlement (RS); January 2000 to July 2001 refer to the period when RS was partially introduced; and July 2001 to July 2002 when RS was compulsorily introduced. The causality in either direction was not observed for the period when RS was introduced. However, the non-linear Granger causality was absent in either direction suggesting that non-linear effects were not significant in the NSE and linear effects could be sufficient for predicting causality. The linear causality test also suggested that efficiency of the NSE was improving with introduction of rolling settlement in majority of stocks.

Singh (2003) attempted to understand the price risks of agricultural and derived commodities, with a view to justify the use of futures markets for individual commodities. The data comprised daily cash and futures price of six agricultural commodities for the period 1988-99. The minimum-risk hedge ratio was estimated by running ordinary least squares regression with spot price changes (price level) as dependent variable and future price changes (price level) as independent variable. The study concluded that among all the commodities on the future markets, castor seed and pepper were efficient and unbiased. Gur and turmeric markets were inefficient and unbiased. The author suggested that exchanges should regulate trade manipulations and multiple exchanges should be merged so as to save on administrative expenses.

Abhilash and Ramanathan (2004) studied whether there existed a tendency of co-movements between the US Indexes (NASDAQ, DJIA) and the Indian stock market indexes (NSE Nifty and BSE Sensex). To analyze the long run relationship the residual based approach proposed by Engle and Granger was used for carrying out co-integration analysis. To know the directions of causation amongst the co-integrated variables, three tests, i.e., Granger Test, Sims Test and Hasiao Test were applied. It was observed that more than half the variation in both Indian indexes (Nifty and Sensex) was explained by NASDAQ index, whereas Dow Jones Industrial Average Index explained only 36.5 per cent variations in Nifty and 24 per cent in Sensex.

Battalio and Jennings (2004) used trade and quote data from June 2000 and January 2002 to examine the extent to which equity option market had become a national market system. The authors examined two issues; first the overall execution quality and secondly compared market centres. By using twenty-one days of trade and quote data each month, a criteria was fixed that means a bad execution price was one that was more than $ 2.50 from execution time NBBO (National Best Bid Offer) midpoint. A crossed market was one in which the NBBO exceeding national best offer price. The results of the study suggested that the forces of competition, information technology and the threat of increased regulations might achieve regulatory objectives without imposing affiliation costs.

Chakravarty and Gulen (2004) investigated the level of price discovery in stock and option markets. This paper also contributed as to how informed trading in the option market was distributed across strike price. By applying Hasbrouck's method to the stock and at-the-money option, the authors found evidence of significant price discovery in the option markets. Their analysis was based on five years of transactions data for sixty stocks that were listed on NYSE and they have options trading on CBOE. The information share attributable to the option markets appeared to have decreased over sample period.

The coefficient on the option (stock) volume was positive (negative) and the coefficient on the option (stock) effective spread was negative (positive) indicating that more price discovery occurred in the option market when the option volume was higher and stock volume was lower and when option spread was narrower and stocks spreads were wider. In order to better assess the extent of informed trading in option markets, it might be interesting to implement this technique in periods immediately prior to announcements of important corporate events.

Karawaller (2004) explained that since the derivatives instruments were off-balance sheet items, therefore, their accounting treatment may differ from company to company. The author elaborated as to how and why FAS No. 133 resulted in such inconsistent accounting treatment. Depending on the nature of the risk being hedged, any one of the three hedge accounting methods could be considered, namely, Fair value hedge accounting, Accounting for cash flows from hedges, and Accounting for hedges of net investments in foreign operations resulting in diverse accounting treatment such a treatment can have led to inconsistent interpretation of financial statements.

Mayhew and Mihov (2004) identified stock characteristics that made them a likely candidate for option listing. The analysis was based on observed listing decisions from 1973-96. The data was divided into different sub-periods, as per regulatory changes in 1980, 1985 and 1991. The Securities Exchange Commission has played an important role in determining the eligibility requirements for underlying securities to be selected for option listing. The authors hypothesized that option trading volume should be higher on options listed earlier. Further, they found that the factors considered for earlier listing were: (i) trading volume, (ii) volatility for earlier period, (iii) Industry, and (iv) name recognition. A log model on a pooled data set based on volume, standard deviation, abnormal volume, abnormal standard deviation and size of the firm were estimated. It was found that the relative importance of factors influencing the listing decision has changed over time. Underlying trading volume and firm size were relatively less important vis-à-vis volatility that was identified as significant criteria particularly after the moratorium in the late 1970s.

Nagaraj and Kotha (2004) focused on investigating whether the change in the structure of spot volatility evolution process was due to the futures trading activity. The relation between the futures trading activity (measured through trading volume and open interest) and spot index volatility was documented. They following Bersembinder and Seguin (1992) partitioned trading activity into expected and shock components by an appropriate ARIMA model. The series were then appended in the variance equation through an appropriate ARMA-GARCH model. Further, the study examined the effect of September 11, 2001 terrorist attack on the Nifty spot futures relation. It was found that post September 11 attack has strengthened the relation between futures trading activity and spot volatility. It implied that the market had become more efficient in assimilating the information into its prices.

Nupur and Deb (2004) addressed three issues: firstly, whether the introduction of index future reduced the spot market volatility; secondly, if there was reduction in volatility in post-futures period; and thirdly, if the future markets effect was confirmed. The data used in the study consisted of daily prices of the S&P CNX Nifty Index, NSE 500 and Nifty Junior for the period June 9, 1999 to August 1, 2003. The Generalized Auto regressive Conditional Heteroskedasticity (GARCH) (1,1) model was used for studying the first objective. To test the second objective the MSCI Standard Index for US, NSE 50 and Nifty Junior Indices were introduced in mean equation of the model. The researchers concluded that the introduction of Nifty index future had a positive but delayed impact on the spot market index, making the markets more efficient and decreasing the volatility of returns.

Shenbagaraman (2004) reviewed the role of some non-price variables such as open-interests, trading volume and other factors, in the stock option market for determining the price of underlying shares in the cash market. The study covered stock option contracts for four months from November 2002 to February 2003, consisting seventy-seven trading days. The study concluded that net open interest of stock option was one of the significant variables in determining future spot price of underlying shares. The results clearly indicated that open-interest based predictors were statistically more significant than volume based predictors in the Indian context.

Subramanian (2004) developed an arbitrage free complete model in continuous time to price options on stock of firms involved in merger and acquisition processes. The results indicated that the market's perception of the outcome of a pending deal was reflected in stock and option prices even in the early period of the deal. The data set used, consisted of daily stock and option price data for each company involved in a stock-for-stock merger deal announced in the year 2001. The prices predicted by proposed model were significantly closer to the observed prices.

Thenmozhi and Kumar (2004) examined whether the introduction of index futures increased or decreased volatility of the spot index. The impact of index futures on the spot market has been analyzed by comparing volatility in the pre- and post-future period. The Nifty, daily closing price, returns of NSE-50 Index were considered in order to estimate the impact of futures trading was volatility for the period June 19, 1999 to September 10, 2001. Volatility measured using, standard deviation. F-test was performed on the sample returns to examine equality of variance. The data was then analysed using ordinary least squares multiple regression model. As per the findings, volatility in the post-futures period was less than volatility in the pre-futures period.

Thenmozhi and Thomas (2005) made an attempt to find out the impact of derivative trading and cash market volatility in the Indian context. GARCH model was used to measure volatility by examining the day-of-the-week effect, domestic market factors and world market movements. The change in volatility and information efficiency were examined for pre-and post-derivative period. The analysis showed that the introduction of index futures and options reduced spot market volatility. Persistence of volatility was reduced in post-derivatives period

and day-of-the-week effect was found to be insignificant after the introduction of derivatives. The results provide evidence of increased market efficiency in the Indian stock market after the introduction of derivatives. The study showed that both S & P CNX futures and option contracts have a stabilising effect on the underlying stock market and supports the "market completion" hypothesis and rejects the "destabilizing forces hypothesis".

Afsal and Mallikarjunapp (2007) made an attempt to study the volatility implications of the introduction of futures for the stock market in India. The data set covers stock market returns of nine individual stocks which have been available for trade in futures segment. The study found out persistence and clustering of volatility in general and little or no impact of the futures trading on the market volatility in majority of the cases. To account for the non-constant error variance in the return series,

Table 1
Table title

S. No.	Author (Year)	Market	Tool Used	Results on Volatility
1.	Santoni (1987)	S & P 500	F-test	No Effect
2.	Edwards (1988a, 1988b)	S & P 500, Value line	ARCH	Lower, No Effect
3.	Aggarwal (1988)	S & P 500	GARCH	No Effect
4.	Malbery, Allen & Gilbert (1989)	S & P 500	F-test	Higher
5.	Harris (1989)	S & P 500	Black & Scholes	Higher
6.	Fortune (1989)	S & P 500	Percentage	No Effect
7.	Becketti and Roberts (1990)	S & P 500	Black & Scholes	No Effect
8.	Lockwood and Linn (1990)	DJIA	Hasbrouck's Method	Higher
9.	Borosen (1991)	S & P 500	ARCH	Higher
10.	Chan and Karolyi (1991)	Nikkei 225	ARCH	No Effect
11.	Laatsch (1991)	MMI	F-test	No Effect
12.	Gerety and Muchain (1991)	S & P 500	F-test	No Effect
13.	Hodgson and Nicholls (1991)	Australian AOI	Beak & Brock	No Effect
14.	Baldauf and Santoni (1991)	S & P 500	GARCH	Lower
15.	Bessembinder and Seguin (1992)	S & P 500	Percentage	Lower
16.	Board and Sutcliffe (1992)	FT-SE 100	Garman – Klass measure	No Effect
17.	Lee and Ohk (1992)	Australian AOI Hang Seng US, UK & Japan	Black & Scholes	No Effect Mixed Higher
18.	Koch and Koch (1993)	S & P 500/MMI	Granger Non-Causality Test	No Effect
19.	Bacha & Vila (1994)	Nikkei 225	GARCH	No Effect
20.	Brenner, Subrahmanyan (1994)	Nikkei 225 / TOPIX	Percentage	Mixed
21.	Choi and Subrahmanyam (1994)	MMI	ARCH	No Effect
22.	Robinson (1994)	FTSE 100	F-test	Lower
23.	Antonion and Holmes (1995)	FTSE 100	GARCH	Higher
24.	Brown – Hurska & Kuserk (1995)	S & P 500	F-test	Lower
25.	Chen, Janet and Rhee (1995)	TOPIX	Cumulative Abnormal return	No Effect
26.	Darrat and Rahman (1995)	S & P 500	Vector Auto-Regressive Model	No Effect
27.	Kumar, Sarin and Shastri (1995)	Nikkei 225	ARCH	Lower
28.	Kan (1996)	Hang Seng	F-test	No Effect
29.	Rayes (1996)	CAC 40 KFX (Denmark)	ARIMA	Lower No Effect
30.	Galleway and Miller (1997)	Mid Cap 400	GKV Measure	No Effect
31.	Pericli and Koutmous (1997)	S & P 500	F-test	No Effect
32.	Reghunathan and Peker (1997)	Australian AOI	ARIMA	Mixed
33.	Antoniou, Holmes and Priestly (1998)	S & P 500, Nikkei 225 FTSE 100, IBEX35 DAX 100, SWISMI	Black & Scholes	No Effect Lower
34.	Chang, Chen and Pineage (1999)	Nikkei 225	Parkinson Extreme Value	Mixed
35.	Gulen & Mayhew (2000)	US & Japan	GJR-GARCH	Higher
36.	Thenmozhi (2002)	S & P CNX Nifty	GARCH	Lower
37.	Shenbagaraman (2003)	S & P CNX Nifty	F-test	No Effect

Source: The ICFAI Journal of Applied Finance (2004).

Varma (2006) studied the mispricing of volatility in the Indian index options market using closing Nifty futures and options prices from June 2001 to February 2004. He employed, the Black formula to calculate implied volatility for each option on each day, and then fit a volatility smile to these implied volatility. As per the findings, Indian market lies almost half-way between the naive worlds where volatility was reasonably priced.

GARCH model was applied for incorporating futures dummy variable in the conditional equation. Of the nine stocks seven were found affected by domestic market returns and two stocks by global market returns.

Bhaloh et al. (2007) investigated the liquidity and volatility of the SEM. Two samples of shares, viz. A- most liquid and B-least liquid have been use to study the effects of the new trading mechanism on liquidity and volatility. A group shares showed an increase in liquidity, whereas no significant changes were

found in volatility. However, the B shares did not experience any improvement with regards to change in liquidity but experienced a significant increase in volatility in the SEM.

2. Substantive Findings

The introduction of stock index futures has profoundly changed the nature of trading on stock exchanges. The concern over how trading in futures contracts affects the spot market for underlying assets has been an interesting subject for investors, market makers, academicians, stock exchanges and regulators alike. However, the findings are mixed, several studies like those by Edwards (1988), Harris (1989), Herbst and Maberly (1992), Jagadeesh and Subrahmanyam (1993) as well as Antoniou and Holmes (1995) have found that the introduction of stock index futures caused an increase in spot market volatility in the short run, while no significant change in volatility appeared in the long run. The apparent increase in volatility has been attributed to increased information flow in the market through the channel of futures trading. However, there are few studies (Schwert, 1999; Bessembinder and Seguin, 1992; Kamara et al., 1992 and Darrat and Rahman, 1995) showing the contrary, i.e., the introduction of futures trading have not resulted in an increase in spot market volatility. Since this study has been conducted during the introductory years of derivative trading in India so there is no substantial evidence regarding the impact on liquidity and regulatory framework for derivatives.

1) Some Methodological Observations

It can be derived from the review of literature that volatilities are measured in both the pre-and post-futures period and also tested for variations due to flow of market information. The impact of information content has been found to have strong correlation with the volatility of the underlying markets. A number of statistical models, namely, standard deviation of daily returns, bid-ask spreads, ARCH, F-test, Black and Scholes, Garman – Klass and GARCH models have been used as a measure of volatility. GARCH models have been favoured to measure volatility of micro derivatives products such as stock futures, stock options and swapoptions etc. In the event of analysis related to macro derivative instrument such as index futures, currency futures and index options, standard deviation of daily returns and F-ratio have been used as a measure of volatility.

2) Summing up

Table 1 gives a snapshot view of the choice of market index, method of investigation and result of studies on the volatility effects of stock index futures across the globe.

3. Conclusion

This paper presented an overview of Significance of Stock derivatives on volatility and liquidity of market: a comprehensive review of literature.

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