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A Systematic Review of Empirical Literature with Reference to Financial Derivatives

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Abstract
The introduction of financial derivatives in capital markets took off so as to control the volatility, thereby, providing a more controlled environment to the investors which can result more investment in capital markets. Thus, financial derivatives, most notably forwards, futures and options came into spot-light in the post-1970s period by reason of growing instability in the financial markets which was the reflection of high volatility in exchange rates and interest rates. Through the use of derivatives, it has been possible to partially or fully transfer the risk by locking-in the asset prices. During the mid-eighties, financial derivatives became the most active derivative instruments, generating volumes many more than the commodity futures. Since their emergence, these products have become so popular that by 1990s, they accounted for two-thirds of the total transactions in derivatives products. In the recent years, the market for financial derivatives has grown tremendously in terms of the variety of instruments available, their complexity and also turnover. In the class of equity derivatives, the world over, futures and options on stock indices have gained significant popularity than on individual stocks, especially among institutional investors, who are major players of index-linked derivatives, even small investors find these useful due to high correlation of the popular indices with various portfolio.

Keywords: Systematic Review, Empirical Literature, Financial Derivatives

The level of efficiency of a market determines its level of liquidity and volatility. In an efficient market, all information relevant for determining the value of a product is reflected in the current market price. A liquid market reflects truer price values and gives investors confidence in the market place. In this regard derivatives products represent some of the basic tools necessary in the mechanics of efficient capital markets. The economic functions of these derivatives contracts is to allow risks that formerly had been combined to be unbounded and transferred to those most willing to assume and manage each risk component. Thus, by virtue of derivatives application, risks are reduced and profits are increased.

The derivatives products also play a significant role in the price discovery that brings about effective dissemination of price information. In the absence of price information, investors, consumers and producers cannot make informed decisions. Thus, the wider the use of derivatives, the wider the dissemination of the price information.

Therefore, one must underscore that futures exchanges are particularly adept at price discovery and dissemination of price information. This growing importance of derivatives in the present capital markets has made various researchers around the world to undertake the studies so as to determine its real impact on the various aspects of the capital market. It is against this backdrop that the researchers have undertaken a comprehensive review of various major studies so as to make a critical analysis of these studies. Thus, this study is a humble attempt to add some more resorces to the existing literature.

Lee Sang Bin and Ohk Ki Yod (1992) investigate in their study the relationship between stock index futures listing and structural changes in time-varying volatility. They undertake five significant international index futures markets in their study, such as. All Ordinaries Share Index (Sydney), Hang Seng (Hong Kong), NIKKEI (Tokyo), FTSE- 100 (London) and VLCI (New York). The findings they come up with, demonstrate that there is an increase in the spot market volatility following the introduction of NIKKEI, FTSE- 100 and VLCI Futures Contracts. But, in case of AOI and Hang Sang there is no evidence that can indicate that index futures induce volatility in the spot market, instead, Index Futures decrease the persistence of volatility shocks in the spot market.

M. Thenmozhi (2002) in her study on futures trading, information and spot price volatility of NIFTY-50 investigate the impact of futures trading on the volatility of spot index returns. The main data for the study is the returns of the S&P CNX NIFTY index futures and spot NIFTY index. The study, undertaken, reveals that there is a decline in volatility since the inception of futures trading which may be attributed to increased trading in cash market, due to faster dissemination of information, making cash market more liquid and less volatile. The study validates the statement by providing, statistically, significant difference between the volatility before and after the introduction of futures. Khurshid Ali Ganai (2020), made a study to establish whether the introduction of stock futures trading influences the volatility of the underlying stock or not? The findings put forth by the study confirms increased volatility during the post-derivatives period compared to pre-derivatives period.

Bechetti, S. and Robert, D. J. (1999) in their study regarding index futures and spot market volatility come up with the findings that suggest that there exists a high correlation between Index futures and cash market volatility as the former (Index Futures) has had a significant impact on the latter (spot market) in controlling the level of volatility during the post-derivatives period as compared to the pre-derivatives period during which the level of volatility in the spot market used to remain at higher levels. Khurshid Ali Ganai (2019), Carried out an analysis on the dynamic relationship between Index Futures and Spot Index Volatility to ascertain the extent of influence that Index Futures hold over underlying (spot index). The findings put forth by the comparison affirms that there exists a significant correlation between index futures and underlying volatility (Spot Index) as the level of the volatility throughout the post-derivatives period has had a considerable decline.

Antonios Antonion and Phil Holmes (1995) undertake the study to examine the impact of trading in FTSE-100 stock index futures on the volatility of the underlying (spot market). They took daily closing prices of FTSE-100 Index, FTSE-500 Index and FT-30 Index for the period of November 1980 to October 1991, the results presented in the paper, suggest that there has been an impact of futures trading on the spot price volatility. In particular, the variance of price change pre-futures was integrated, suggesting shocks have a permanent effect on price change, whereas, post-futures sample is stationary which indicates that futures trading improves the quality and speed of information to spot markets as confirmed by the increase in the news coefficient. Hence, the evidence suggests that there has been an increase in spot price volatility on a daily basis, but that is due to increased information in the market and not due to speculative waves.

Narasimhan Jegadeesh and Avanidhar Subrahmanyam (1993) make the study so as to determine the liquidity effects of index futures contracts on the underlying. In this regard they made an observation of bid-ask spread in the stock markets around the introduction of Standard and Poor's (S&P) 500 Index futures contracts. The researchers take the sample of S&P 500 stocks which consists of all stocks that were included in the S&P 500 index throughout the sample period, traded on the NYSE. The controlled sample of non-S&P 500 stocks were selected randomly choosing an equal number of stocks that did not appear on the index in the sample period. They documented that there is evidence that the average proper time spread in the stock market increased subsequently on the introduction of the futures contracts. It was witnessed that the spread increased significantly in the S&P 500

sample and marginally in the non-S&P 500 sample. The researchers repeat the test by controlling the factors like price, return variance and trading volume. The results still suggested that the spread has remained at higher levels throughout the post-derivatives period. Thus, the overall results indicate that the onset of index futures did not reduce spreads in the spot market, besides, there also exists weak evidence that spread might have increased in the post-futures period.

Nicolas, P. Bollen (1998) in his study regarding the impact of options on the return volatility seeks to determine whether the introduction of options affects the return variance of underlying stocks. The final data sample taken includes 745 stocks from New York Stock Exchange (NYSE-AMEX) and 265 NASDAQ stocks, all with no missing observation of returns. A control group is constructed by matching each stock in the sample group one-for-one with another stock within the same trading location. The evidence that emerges out from the results indicates that the average impact of options introduction on variance is insignificant, since the control group exhibits change in variance that match the change in options stocks. Thus, this evidence supports the hypothesis that options listing has no significant effect on stock return variance. Khurshid Ali Ganai (2021), *Carry out an investigation to determining the impact of Stock options trading on the volatility of underlying stocks. The study affirmed an increase in the level of volatility in the post-derivatives period. Thus, the study concluded, on the basis of the comparative analysis of statistical scores that the introduction of stock options trading has a definite impact on the volatility of the underlying stocks as the volatility levels registered upward trajectory throughout the post-derivatives period as compared to pre-derivatives period.*

Benilde Maria Do Nascimento Oliveira and Manual Jose Da Rocha Armada (2001) investigate the impact of futures market on the volatility of spot market. The main data are in relation to Portuguese stock index-20 for the period under analysis is collected from the Oporto Derivatives Exchange. The results in relation to the analysis of the variance suggest an increase of the mean level of the volatility for the Portuguese stock market after the introduction of the Portuguese stock index-20 index futures market and it seemed that the Portuguese stock market became less efficient as the volatility shocks became more persistent after the inception of Portuguese stock index -20 index futures transactions.

Cao, H. Henry (1999) examines the effect of derivatives assets on information acquisition and price behavior in the rational expectation equilibrium. The results demonstrate that introduction of options contracts performs market completion function. However, additional options trading will have less effect on the price of underlying asset. It is also concluded that introduction of derivatives reduces price volatility as price becomes a less biased estimate of the asset payoff due to more information collection, regarding liquidity. He cautions that the effect on trading volume (liquidity) of underlying asset would depend upon the kind of derivatives asset introduced in the market. He expects the liquidity of the underlying asset to increase after the commencement of options trading.
Maberly, Edwin D; Davis, S. Gilberth and Roy, F. (1989) undertake the study to examine the influence of stock futures on cash market volatility. They use several different time sub-periods to emphasize the fact that the results are highly sensible to the selected time period. The selected post-futures sub-period is between the years 1987-1988 in which they witness a significant volatility for the year of 1987-1988 that simply reflects more accurate information diffusion process.

Bacha, O. and Villa, A. F. (1994) in their study put forth that the futures markets have had an influence over the volatility of the cash market. However, they argue, that the changes in the volatility may be ascribed erroneously to futures trading if changes in the economic factors induce concurrent changes in the volatility. Similarly, counter movements in these factors may obscure futures- related changes in volatility. Khurshid Ali Ganai and Ahmad Hayek (2020), made a study to determine if the onset of stock futures trading affects the liquidity level of the underlying assets. The analysis of the level of liquidity of both the reference periods is made separately, followed by a comparative analysis of both the periods that leads the study to the conclusion, affirming that the onset of stock futures has brought about a significant impact on the liquidity of the underlying stocks. Hence, the findings of the study have further strengthened the argument that the onset of futures trading has caused diversion of speculative interest towards the futures market. Thus, causing a decline in the level of liquidity in the spot market.

Kumar Raman, Atulya Sarin and Kuldeep Shastri (1998) undertake the study to find the impact of options trading on the market quality of the underlying security. After a comprehensive analysis in terms of liquidity, information asymmetry and price efficiency. The findings that they put forth are Consistent with the findings of earlier studies. They come to the conclusion that options listing do have a beneficial impact on the market quality of the underlying share, more specifically, they observe a decrease in the spread and an increase in quoted depth, trading volume, trading frequency and transaction size after options listing which simply indicates higher liquidity, lower information asymmetry and greater price efficiency.

Hodgson Allan and Nicholls Des (1991) undertake the study to estimate the impact of index futures markets on Australian share market volatility. After making a thorough analysis of the data, collected from the Australian Associated Stock Exchange AOI (All Ordinaries share index), the findings suggest that the introduction of index futures market in Australia has not brought up any increase in the stock market volatility that also strengthens the argument put forth by the United States of America studies.

Damodaran, Aswath and Joseph Lim (1991) in their study wherein, an attempt is made to investigate the effects of options listing on the underlying stocks return process. The potential explanation put forward for the observed variance decline after the listing of options contracts is that the option listing does not lead to shift in intrinsic variance rather it expedites the price adjustment process. It is also evident from the study that option listing leads to decline in the noise term that can be attributed to decline in either bid-ask spread or in noise in the information process as institutional activity increase in the optioned stocks. However, they were unable to find the relation of trading volume with the event of option listing. Khurshid et.al. (2020), Undertook a study to make an empirical investigation of volatility effects of index options trading on the underlying spot index. After the thorough analysis, the findings put forth by the study confirm that the introduction of index options contracts on the sample index has resulted into increased volatility throughout post-derivatives period compared to pre- derivatives period.

Skinner, Douglas J. (1989) undertakes the study to examine the relationship between options markets and stock return volatility. After the analysis of the data, he concludes that options listing is associated with a decline in stock return variances and an increase in trading activity in the underlying stock. But, he does not find any impact on non-diversiable risk of the stock. However, he is unable to find the evidence whether the decline in the variance of observed returns is attributable to the changes in trading noise. Khurshid et.al. (2020), made a detailed study about the growth of derivatives in India and the findings of the study put forth that the derivatives has grown quite well over the years, despite, many economic turbulences.

Brenner, M; Subrahmanyam, M. and Uno Jo (1989) investigate in their study the behaviour of price of Nikkei spot market and futures market. They put forth that futures trading increases spot portfolio volatility but the volatility impact does not spill-over to stocks against which futures are not traded. Thus, it is concluded in the study that the absence of volatility spill-overs from Nikkei to non-Nikkei stocks suggest that the volatility impact is not spuriously caused by extraneous economic disturbances.

Hayes, Samuel L. and Michael, E. Tannenbaun (1979) investigate the impact of option listing on the volume of underlying shares traded in the cash market. They conclude that the listing does not result in increase in the volume of trading in the underlying shares. According to them, this effect is caused by the variety in option trading strategies and linking between cash market and option market as it results in continued feedback to each of these markets.

Whiteside, Mary M; William, P. Dukes and Patrick, M. Donne (1983) undertake the study to examine the short-term impact of option trading on underlying securities. The study do not find any clear evidence regarding the impact of options trading on the volatility of underlying security or average daily volumes. However, when results are evaluated by the year of trading, post-derivatives period witnesses a trend towards decreased variability in the number of shares traded daily.

Eric, C. Chang; Joseph, W. Chang and J. Michael Pinegar (1999) undertake the study to investigate whether futures trading increases stock market volatility or not. The data for the study is obtained from the PACAP DATABASE

prepared by the University of Rhode Island. Daily close-to-close returns are used to compute return variances and cross-sectional dispersions. The total sample consists of 122 firms listed on the first section of the Tokyo Stock Exchange. Ninety-five of these firms are in the Nikkei 225 stock index. After undergoing a thorough analysis, the tests decompose spot portfolio volatility into the expected cross-sectional dispersion and the average volatility of return on the portfolio's constituent securities.

The prediction of the model is tested with two groups of stocks traded on the Tokyo Stock Exchange. As for as Nikkei stocks are concerned, spot volatility increases and cross-sectional dispersion decreases relative to average volatility after NIKKEI futures began trading on the Osaka Security Exchange (OSE). The study witnesses no shift when the Nikkei future commences trading on the Singapore International Monetary Exchange (SIMEX), as for as non-Nikkei stocks are concerned, no shift occurs when futures began trading on either exchange. These findings held with both daily and monthly data. The evidence put forth by the findings is consistent with the hypothesis that, absent the trading restrictions, futures trading increases spot portfolio volatility but the volatility impact does not spillover to stock against which futures are not traded. The absence of volatility spillover from Nikkei to non-Nikkei stocks also suggests that the volatility impact of futures trading on Nikkei stocks is not spuriously caused by extraneous economic disturbances. However, most of the variation in spot asset volatility is attributed to disturbances in broad market factors, and the increase in volatility induced by futures can only be detected when tests properly control for disturbances in these other factors.

Kamara, A; Miller Junior, T. W. and Segel, A. F. (1992) investigate the effects of futures trading on the stability of the S&P 500 returns. They witness the change in the volatility of the S&P 500 index due to the introduction of futures trading for the period 1976 to 1987; the changes in the volatility are examined using parametric and non-parametric tests. The results show that the daily returns volatility is higher in the post futures period while the monthly returns remain unchanged. It is concluded that increase in volatility of daily return in the post-futures period is necessarily not related to the inception of futures trading.

Hang Chai and Subrahmanyan, A. (I994) undertake the study to investigate whether futures trading has any impact on the volatility and liquidity of spot market by measuring bid-ask spread. The main data are collected from S&P 500 and the major market index for the period of one year. After the analysis of the data, the findings that emerge out indicate that the average intraday bid-ask spread in post-major market index futures has increased while there is no significant change in the volatility. The trading volume has registered a rise in both S&P 500 and the major market index.

Bauldof Brad and Santoni, G. J. (1991) in their study regarding stock price volatility. After making a thorough analysis of the data, the results decompose that the index futures transactions have had a destabilizing impact on the underlying volatility of the spot market prices. Thus, the spot market has witnessed more volatility during the post-derivatives period as compared to the pre-derivatives period.

Gorton, G. and Pennacchi, G. (1991) in their study regarding, security baskets and index linked securities, come up with the findings that imply a reduction in trading volume in the individual stocks on the introduction of index futures because uninformed portfolio trades migrates to the futures market. Since there is a large degree of substitutability between diversified portfolios and uninformed traders with portfolios that do not correspond to the underlying index may also switch to the futures market. The migration of uninformed traders to the futures market may, therefore, occur both from S&P 500 stocks and many widely held non-S&P 500 stocks. Moreover, uninformed speculative trades from stocks in general may also shift to the futures market. Thus, Ceteris Paribus, one predicts a reduction in the trading volume of the underlying stocks not on the index, following the introduction of futures market.

Mark Fedenia and Theoharry Grammatikos (1992) undertake the study with the purpose of investigating the impact of options listing on the bid-ask spread of the underlying stock. The main data were collected from five options exchange. Chicago Board of Option Exchange (CBOE), American Stock Exchange (AMEX), Pacific Stock Exchange (PSF), Philadelphia Exchange (PHLX) and New York Stock Exchange (NYSL). The sample for the study contains 340 NYSE stocks and 98 OTC stocks that traded call options for various periods of time on at least

one of the five option exchanges. The findings of the study witness that options listing do significantly affect the spread of the underlying stock. The empirical findings show an average decline in spreads of NYSE traded stocks associated with the options trading. The firms selected for options listing exhibit changing volatility that may actually cause the option exchange to list the stock. The findings show that, although volatility changes affect spreads around options listing. There appears to be a distinct effect on stock spreads due to the options listing. The listing effect apparently co-exists with volatility changes surrounding options listing. Average volatility in the stock appears to be enhanced by options listing.

Mekenzie Michael, D; Brailsford, T. J. and Robert, W. Faff (2001) in their study examine the impact of the introduction of stock index futures trading on the daily returns seasonality of the underlying index for seven national stock market indices. Specifically, the markets analysed are Australia, Spain, Germany, Japan, Switzerland, The United Kingdom and The United States. Daily stock market index data are collected from the DataStream data base from the earliest available data to the end of January 1999. The findings that the study comes up with generally, suggest that the introduction of futures trading has been associated with reduced seasonality of mean return.

Harris, L. M. (1989) undertakes the study to investigate the impact of index futures on the volatility of spot market. It is observed that there emerges increased volatility after the introduction of index futures by comparing daily return volatility during the pre-futures (1975-1982) and post-futures (1982-1987) between S&P 500 and non S&P 500 group of stocks controlling for differences in firms attributes. It is noted that increase in volatility is a common phenomenon in different markets and index futures by themselves may not bear the sole responsibility. The researcher points out other related instruments and developments such as growth in index funds and increase in foreign ownership or equity are possible explanation for higher volatility in stock markets.

Grossman, S. and Miller, M. (1998) undertake the study on the liquidity of the underlying security and the results exhibit that options play a real information role that cannot be fulfilled by dynamic trading strategies in the underlying security. Specifically, in imperfect markets, options increase investors' ability to engage in speculation and hedging activities by reducing uncertainty in the cost of obtaining the desired payoff patterns. Besides, the price of the traded option conveys demand for the security. This information cannot be easily established from observed prices when the security must be dynamically synthesized. Both of these effects may attract new traders who find the options market to be cost efficient relative to synthetic option strategies. Therefore, traded options result in a less uncertain and more liquid market for the underlying security.

James, T. W. (1993) undertakes the study to study the impact of price discovery by futures market on the cash market volatility. Thorough analysis of the data is undertaken to determine the price discovery function of the futures market. The findings that emerge out affirm that futures market is beneficial with respect to cash market as it brings about better efficiency, higher liquidity and also lowers the long term volatility of the spot market.

Brorsen, B. Wade (1991) undertakes the study on futures trading, transaction costs and stock market volatility. The findings of the study exhibit that short-term volatility increases (variances of daily price changes) while long-term volatility (variances of week and month price changes) does not exhibit any significant change.

Irag, G. Kawaller; Paul, D. Koch and Timothy, W. Koch (1990) examine the relationship between volatility in S&P 500 futures price and volatility in the S&P 500 index. The data are collected from Chicago Mercantile Exchange (CME) which consists transactions data on all values of nearby S&P 500 futures contracts and all values of the S&P 500 index for every business day in the forth quarter of 1984-1986. This data are used to construct time series reflecting volatility movements in futures and index prices over the life of a nearby futures contract. The paper looks into whether intraday S& P 500 index futures and S&P 500 index price volatility has changed notably in recent years and whether intraday volatility in futures prices has systematically led to intraday volatility in the index. The results exhibit that average intraday volatility for both S&P 500 futures and index prices increased from 1984 to 1986. However, it is revalidated by granger tests that there exists no systematic pattern of futures volatility leading index volatility, or index volatility leading futures volatility.

Detemple, Jerome and Philippe Jorion, (1990) undertake the study to investigate the relationship between options listing and stock returns. The findings of the study exhibit that the introduction of the option market increases the speed at which information is released to the market because investors with private information prefer to take position in options market as against the stock market, therefore, the introduction of options has price effects, volatility effects, cross effects, announcement effects and persistence effects on the market for underlying shares. Antonios Antoniou, Gioia Pescetto and Antonis Violaris, (2003) In their study investigates the stock index and stock index futures market interdependence that is lead-lag relationship and volatility interactions between the stock and futures markets of three main European countries, namely France, Germany and the United Kingdom. In addition, the paper explicitly accounts for potential asymmetries that may exist in the volatility transmission mechanism between these markets. The findings of the study put-forth that the volatility levels transfer from futures market to spot market.

Golaka, C. Nath (2006) study the behavior of volatility in cash market after the introduction of derivatives in order to arrive at a dependable conclusion, comparison is undertaken, regarding performance of the stocks for whom derivatives are available with those for whom the same is not available and it is seen, generally, that the static volatility has come down for almost all the stocks while for a few the same has increased. Only one stock from the sample under study which witnesses higher levels of static volatility during last one year period compared to pre-derivatives period. The statistical scores in the study suggest that the volatility of the market as measured by benchmark indices like S&P CNX NIFTY and S&P CNX NIFTY JUNIOR have fallen in the post-derivatives period.

Elfakhani Said and Mohammad Chudhury (1995) undertake the study to find the volatility effect of options listing and the underlying security. In the study, it is established on the basis of the results that options listing has a stabilizing effect and the underlying security in total risk as well as non-diversifiable risk sense during 1970s. In 1987, Said and Chaudary come up with another study in which it is concluded that listing of put options have stabilizing effect as the systematic risk of the underlying stocks has declined in post-options listing in Canada. Besides, an analysis of the cross-sectional variations in the volatility effect of put options listing has been undertaken and the results exhibit that options listing enhances liquidity and thus has a stabilizing influence on the stock variance.

Chatrath Arjun, Ramchander Sanjay and Sang Frank (1998) undertake the study to examine the impact of speculative activity and stock market volatility. The findings of the study report a total lack of empirical evidence to support the argument that the number dimensions of speculative positions in S&P 500 index futures market produce higher level of spot volatility.

Hogan Kedreth, C. J; Kroner Kenneth F. and Sultan Jahangir, (1987) make a study to find out the relationship among program trading, Non-program trading and market volatility. It is concluded in the study that futures transactions can. In fact, produce greater spot volatility. However, these authors emphasize the idea that such volatility does not necessarily mean less efficient prices.

Jangkoo Kang, Chang Joo Lee and Soonhee Lee (2006) make an empirical study to investigate intraday price change relations in the KOSPI-200 (Korea Composite Stock Price Index) spot market, the KOSPI- 200 futures markets, and the KOSPI- 200 options market and provided some explanation for the observed lead-lag relations. First all the relationships among the stock market, its futures market and its options market. Besides, the study extends to examine the lead-lag relations of volatilities as well as, thereof, returns among the markets.

The study come up with the findings that the KOSPI- 200 futures and options returns lead the KOSPI- 200 stock index returns by up to 10 minutes. This relation still holds in market after the bid-ask spread affect and the trading effect. There is also no evidence that the change in the released volatility of the KOSPI 200 implied forwards lead or lag changes in the released volatilities of the KOSPI 200 futures returns. It is also witnessed that the KOSPI 200 futures and options volatilities lead the KOSPI 200 stock index volatilities by around five minutes.

Premalata Shenbagaraman (2004) assesses in the study the impact of the index futures and options contracts and the volatility of the underlying stock index in India. The data used in the study are taken from the S&P CNX NIFTY (INDIA) which is related to stock index futures and options contracts. The analysis of the study put forth that derivatives introduction does not have any significant impact on the spot market volatility. However, futures introduction seems to have changed sensitivity of NIFTY returns to the S&P 500 returns. The study also puts forth that the introduction of derivatives contracts improves liquidity and reduces informational asymmetries in the market. The study is concluded with the evidence that there exists no linkage between trading activity variables in the futures market and spot market volatility.

John Board, Gleb Sandmann and Charles Sutcliffe (2001) undertake the study to investigate the effect of futures market volume on spot market volatility. After the analysis, it is found that there exists no evidence that can affirm that futures trading instantly destabilizes the spot market. There is also no evidence that can suggest that an increase in volume in one market, relative to other market, instantly, destabilizes the spot market. Overall, the results demonstrate that contrary to some regulatory claims, contemporaneous futures trading, after expelling for the effects of information arrival and time trends, does not destabilize the spot market.

Ma, C. K. and R. P. Rao (1986) make a study to observe option trading and volatility of the underlying stock, in the study, there is a distinction, that is made between the stock experiencing increased volatility from those with decreased return volatility using multiple discriminate analysis and it is concluded that stocks with low return high risk, lower volume traded and lower growth potential, are more likely to be stabilized by the introduction of options.

One more study is made by the same team of researchers in 1988 in which it is concluded that there is a differential market impact of options on underlying stocks with volatile stocks becoming more stable after the listing because hedging behavior by uninformed traders and stable stocks becomes more volatile after listing because of increased speculation in the options markets by informed traders and provide support to this hypothesis by relating the post-listing change in variance to the pre-listing variance level for 245 stocks with options listed on them.

Amihud Yakov and Haim Mendelsol (1987) undertake a study to break down the observed return variance in the pre-listing and post-listing periods into three components an intrinsic variance portion that can be attributed to the volatility or the underlying business a price adjustment component that captures the effect of an imperfect price adjustment process and noise turns that is the result or information risk and the bid-ask spread. It is observed in the study that prices adjust more quickly to new information after option listing and the noise becomes smaller after the listing.

An attempt in the study is also made to explain speedier price adjustment in the post-listing period by looking at shifts in the information structures. In particular, it is found evident that more information is collected and disseminated to investors after the listing options. This reduction in the noise after the listing of options is attributed to a lower bid-ask spread, partially, because of increased complexion from market makers on the option markets and partially, because of increased interest from institutional investors.

Herbst Anthony; John McCormick and E. West (1997) undertake a study to investigate the lead-lag relationship between spot indices and their futures contracts. The results of the study indicate that the movements in the level of S&P 500 futures prices systematically lead movements in the S&P 500 index. It is against these results that lead to the expectation that their may exist the same relationship between the volatility of the index futures prices and volatility in the index where leading role is played by index futures prices.

Nabar, P. and Park, S. (1988) in their study regarding options trading and stock price volatility. The study comes up with the results that indicate towards the conclusion that there exists an impact of options trading on the volatility of stock prices. In the main conclusion the study affirms that stock return variance declines post-listing period in comparison with the pre-listing period.

Takato Hiraki, Edwin Marherly and Nohaya Takezawa, (1995) in their study investigate relationship between OSAKA NIKKEI Index futures and overnight spot returns for the period September 1988 through June 1991. The data for the study are provided by Osaka stock exchange that consists of Osaka Nikkei futures transaction prices for the September 1988-June 1991 period. The futures prices used in the study are for the contract to the nearest to the maturity except in the contract month when the price data is for the next nearest contract. After the employment of the statistical tools, the study puts forth the results that affirm the fact that there exist statistically a significant positive relationship between the unexpected component of futures return and overnight spot returns. In addition, the unexpected component of futures returns is positively related to trading period of spot returns over the next two days.

Harry, C. and R. Wholey (1992) undertake a study to assess the dynamic behaviour of spot market volatility by forecasting the volatility implied in the transaction prices of S&P 100 index options. Although volatility changes appear to be predictable yet it is noted that the results are not inconsistent with the market efficiency. In general, it is supported by various studies that derivatives market is more efficient than the underlying spot market which in turn caused reduction in the volatility once the stock is listed in derivatives market.

Bansal, V. K., Pruitt, S. W. and Wei, K. C. J. (1989) In their study regarding the impact of CBOE options initiation on the volatility and trading volume of the underlying equities. The findings of the study put forth that the initiation of the options makes a significant impact on the level of volatility and liquidity of the underlying.

Merrick John (l987) makes a study regarding volume determination in stock and stock index futures markets. The findings that emerge out from the study affirm that trading volume and price volatility are directly related. The logic suggests that if inter-market activity increases the volume of futures and stock transactions significantly that may directly increase volatility.

Kalak Chan et.al. (1991) undertake a study to assess the intraday relationship between returns and returns volatility in the stock index and stock index futures. The study covers both S&P 500 and major market index futures. The intraday patterns of volatility are estimated using auto-correlation and cross correlation patterns of the intraday returns. The findings of the study witness a strong inter market dependence in the volatility of the cash and futures market. It is also evident from the results that the intraday volatility patterns that originate either in the stock or futures market demonstrate predictability in the other market.

Min, J. H. and Najand, M. (1999) undertakes a study to examine the possible lead-lag relationship in returns and volatility between cash and futures markets, the results of the study suggest that unlike the lead lag relationship in the returns of futures and spot markets there is significant time dependent bidirectional causality between the markets, as for as the volatility interaction among the markets is concerned.

Chin Kalok; Chan, K. C. and Karolyi, G. A. (1991) undertakes a study to examine the intraday relationship among price changes and volatility of price changes in the stock index and under futures markets unlike the fact that the index futures markets turned as the primary market for price discovery as found in the previous studies, A stronger interdependence in both the directions in the volatility of price changes between the cash and the futures market then that observed in case of price changes only, The evidence provided by the results supports that the price innovation originates in one market can predict the futures volatility in another market.

Butterworth, D. (1998) undertakes a study to investigate the effect of futures trading in the FTSE mid 250 index and the underlying spot market using symmetric and asymmetric GARCH methods the results reported for the mid 250 index indicate that while the existence of futures trading have made little impact and the underlying level of volatility as measured by the standard deviation, it has significantly altered casually the structure of the spot market volatility.

Darret et. al. (1994) examine if futures trading activity has caused stock price volatility. The study is conducted on S&P 500 index futures for the period of 1982-91. The study also examines the macro economic variables such

as inflation, term structure rates and the volatility of the S&P 500 stock returns. The results affirm that the futures trading have not caused any jump volatility.

Anthony, J. (1988) undertakes a study to study the interrelation of stock and options market trading-volume data. The findings of the study affirms that trading volume on options leads trading on stocks within one day lag, suggesting that informed investors are more likely to trade on the options than on the spot market. In order to evaluate the effects of option listing on information structure, cross sectional averages for two proxies are taken into consideration. The pre-listing and post-listing periods. The post-listing increase in both proxies is larger for firms which have option listing on them, for the holdout sample of firms which do not have options listed on them, but the differences between the groups are not dramatic enough to explain the variance effects.

Sahlstorm, Petri (2001) undertake a study to analyse the impact of options listing on risk and return characteristics in Finland. The study documents that impact of stock option listing on underlying stocks volatility, bid-ask spread and autocorrelation structure of return series. the findings of the study provides an evidence which affirm that options listing causes decrease in the volatility and bid-ask spread of the underlying stock market.

Hamill Philip; A. Kwaku; K. Opong and Pat McGregor, (2002) make a study on the options listing in the United Kingdom to ascertain its impact on the underlying equity market. The study comes up with the findings that put forth that the impact of options listing event has diminished over time and this support the market completion hypothesis.

Aggarwal, R. M. (1988) makes a study regarding stock index futures and cash market volatility. The findings of the study confirm that the volatility of the post-futures period is more than the pre-futures period. However, it is added that stock index futures may not be the primary cause of this increase in volatility.

Edwards, F. R. (1988) undertake a study to investigate the futures trading and its impact on the market volatility. The study examines stock market volatility before and after the introduction of futures, and finds that futures trading bring about decrease in the volatility of the stock market.

Bessembiber, H. and Segian, P. J. (1992) undertake a study to investigate whether greater futures trading activity (volume and open interest) is associated with higher equity volatility. The results put forth by the study are consistent with the theories predicting volatility post derivate introduction.

Kawaller Ira; Paol Koch and Temiothy Koch (1987) undertake a study to investigate the price relationship between S&P 500 spot index and S&P 500 futures index. After making a thorough analysis of the data, the results indicate that movements in the level of S&P 500 futures prices systematically lead movements in the S&P 500 spot index. It is, therefore, reasonablly expected that the same relationship may exist between the volatility of the futures index prices and the spot index prices where the futures price volatility brings about the same levels of price volatility to the spot prices.

Canord, J. (1989) makes a study to find out the impact of options introduction on the price of the underlying. The data of the study is divided into two groups namely, pre-options period and post-options period. After using the statistical tools the study puts forth findings that decompose that the stock return variance has witnessed a decline during the post-options periods.

Cox, C. (1996) makes a study to find out the correlates of futures trading and market information. The findings of the study further strengthen the argument that futures trading can alter the available information and thus, spot market volatility for two reasons. That is, attracting additional traders because futures market is cost efficient than spot market. Thus, causing the diversion of speculative interest from spot market to futures market that increases the level of volatility of the spot market.

Conclusion

Hence, from the above comprehensive review of literature, it comes to fore that these studies have put forth diverse findings which has given rise to diverse school of thoughts about the impact of derivatives products on the liquidity and volatility of underlying assets. One school of thought affirms that the presence of derivatives in the capital markets enhances the dissemination of information that brings about efficiency in the flow of information that in turn can take the market towards the better levels of efficiency. Kedar Nath Mukherjee and R. K. Mishra (2006). The impact cost in the spot market is also influenced by the introduction of derivatives as these products increase the trading volume and liquidity in the cash market James T.W. (1993). The inception of futures trading has increased the liquidity of the spot market. Sandeep Srivatava (2000). These products help in the management of various risks through its diversified product range and they enable the market to absorb risk, otherwise, the cost of risk to the economy would be worse off. They serve as the agents of price discovery that gives direction to the cash market. Finnetry and Park (1987). In this way they act as catalysts to the growth of capital markets.

The other school of thought holds a different opinion regarding the impact of derivatives on the volatility and liquidity of spot markets. They hold that derivatives do not reduce risk; even they expose the users as well as the whole system to new types of risks, the management of which may be more intractable. The existence of derivatives facilitates the speculative waves of buying and selling in the spot market which can cause increase in the volatility of the spot market. Lee and Oak (1992). The availability of derivatives may also cause diversion of speculative traders from the cash market to the derivatives market, thus, causing a decline in the trading volume/liquidity in the cash market. Nathan Associates (1969). Besides, the results of the study undertaken by Agarwal R.M. (1998) come up with the findings, affirming that the level of volatility has shown an increase during the post-derivatives period. Therefore, it is concluded that the argument put forth in favour of derivatives is one-sided, unconvincing and overplayed.

Thus, the two schools of thought are putting forth conflicting opinions about the introduction of derivatives, therefore, it serves as a source of motivation for the researchers to undertake further research in the area of derivatives which will facilitate the existing literature and will develop better understanding about the impact of Derivatives products on Stock Market, Currency Market and Commodity Market.

References

Aggarwal, R. M. (1988): “Stock Index Volatility and Cash Market Volatility.” Review of Futures Market, 7:290-299.

Amihud, Yakov and Haim Mendelsol (1987): “Trading Mechanisms and Stock Returns: An Empirical Investigation.” Journal of Finance, 42:533-553.

Anthony, J. (1988): “The Interrelatrion of Stocks and Futures Market Trading-Volume Data.” Journal of Finance, 43:949-964.

Antonios Antonion and Phil Holmes (1995): “Futures Trading Information and Spot Price Volatility: Evidence for the FTSE-100 Stock Index Futures Contracts using GARCH Model.” Journal of Banking and Finance, 19:117-129.

Khurshid Ali Ganai (2019), “Correlates of Index Futures and Spot Index Volatility: A Study of Indian Stock Market. Archives of Business Research. Vol. 7, Issue 2, PP. 245-252.

Antonios Antoniou, Gioia Pescetto and Antonis Violaris (2003): “Modelling International Price Relationship and Inter dependencies Between the Stock Index and Stock Index Futures Markets of three European Union Countries: A Multivariate Analysis.” Journal of Business Finance & Accounting, 30:645-668.

Khurshid Ali Ganai (2020), “An Analysis of Relationship between Stock Futures and Underlying Stock Volatility.” Archives of Business Research. Vol. 8, Issue 2, PP. 51-64.

Bacha, O. and Villa, A. F. (1994): “Futures Market, Regulations and Volatility: The Case of the NIKKEI Stock Index and Futures Market.” Futures Market Journal, 2:201-225.

Bansal, V. K; Pruitt S. W. and Wei, K. C. J. (1989): “An Empirical Re-Examination of the Impact of CBOE Options Introduction on the Volatility and Trading Volume of the Underlying Equities.” Financial Review, 24:19-29.

Bauldof Brad and Santoni, G. J. (1991): "Spot Price Volatility: Some Evidence from an ARCH Model." Journal of Futures Markets, 11(2):191-200.

Khurshid Ali Ganai (2021), "Spillover Effects of Stock Options Trading on the Volatility of Underlying Stocks." Archives of Business Research. Vol. 9, Issue 5, PP. 47 – 58.

Bechetti S. and Robert D.J. (1999): "Will Increased Regulations of Stock Index Futures Reduced Stock Market Volatility?" Federal Reserve Bank of Kansas City Economics Review, pp. 33-46.

Benilde Maria Do Nascimento Oliveira and Manual Jose Da Rocha Armada (2001): "The Impact of Futures Markets's Introduction of the Conditional Volatility of the Portugeese Stock Market." Finance India, 4:1251-1278.

Bessembiber, H. and Segian, P. J. (1992); "Futures Trading Activity and Spot Price Volatility." Journal of Finance, 47:2015-2034.

Brenner M., Subrahmanyam M. and Uno Jo (1989): "The Behaviour of Prices in the Nikkei Spot and Futures Market." *Journal of Financial Economics*, 23:363-383.

Brorsen, B. Wade (1991): "Futures Trading Transaction Costs and Stock Market Volatility." *Journal of Futures Market*, 11(2):153-163.

Butterworth, D. (1998): "The Impact of Futures Trading on the Underlying Stock Index Volatility." The Case of the FTSE Mid 250 Contracts, Department of Economics, University of Philephedopia.

Canord, J. (1989): "The Effect of Options Introduction." Journal of Finance, 44(2):487-498.

Cao, H. Henry (1999): "The Effects of Derivatives Assets on Information Accquisition and Price Behaviour in a Rational Expectation Equilibrium." Review of Financial Studies. 12:1341-1363.

Chatrath Arjun; Ramchander Sanjay and Sang Frank (1998): "The Role of Futures Trading Activity in Exchange Volatility." Journal of Futures Market, 05:561-584.

Chin Kalok, Chan, K. C. and Karolyi, G. A. (1991): "Intraday Volatility in the Stock Market and Stock Index Futures Market." Review of Financial Studies, 4(4):637-684.

Cox, C. (1996): "Futures Trading and Market Information." Journal of Political Economy, 48:1215-1237.

Damodaran, Aswath and Joseph Lim (1991): "The Effects of Options Listing on the Underlying Stock Returns Process." Journal of Banking and Finance, 05:647-664.

Darret et. al. (1994): "Has Futures Trading Activity Caused Stock Price Volatility? Journal of Futures Market, 5:537-557.

Khurshid Ali Ganai and Ahmad Hayek (2020), "Impact of Stock Futures Trading on the Liquidity of Underlying Assets." International Journal of Scientific and Teaching Research. Vol. 9, Issue 4, PP. 3383-3388.

Detemple, Jerome and Philippe Jorion, (1990); "Options Listing and Stock Returns-An Empirical Analysis." Journal of Banking and Finance, 14:781-807.

Edwards, F. R. (1988): "Does Futures Trading Increase Stock Market Volatility." Financial Analysis Journal, 44:63-69.

Elfakhani Said and Mohammad Chudhury (1995) "The Volatility Effects of Options Listing." Some Canadian Evidence, Quarterly Review of Economics and Finance, **35**:97-116.

Eric, C. Chang; Joseph, W. Chang and J. Michael Pinegar (1999): "Does Futures Trading Increase Stock Market Volatility?" The Case of NIKKEI Stock Index Futures Market, Journal of Banking & Finance, 23:727-753.

Fleming, J., Ostdiek, B. and Whaley (1996): "Trading Costs and Relative Rates of Price Discovery in Stock, Futures and Options Markets". Journal of Futures Markets, 353-387.

Golaka, C. Nath (2006): Behaviour of Stock Market Volatility after Derivatives. (www.nseindia.com)

Gorton, G., and Pennacchi, G. (1991): "Security Basket and Index Linked Securities." Working Parper, Philladelphia: University of Pennsylvania, Whortan School.

Grossman, S. and Miller, M. (1998): "Liquidity and Market Structure." Journal of Finance, 43(3):617-633.

Khurshid Ali Ganai, Irshad Ahmad Malik and Khalid Ashraf Chisti (2020), "Volatility Effects of Index Options Trading on the Underlying Spot Index." Vol. 9, Issue 3, PP. 174-178.

Hamill Philip A. Kwaku, K. Opong and Pat McGregor, (2002): "Equity Options Listing in The United Kingdoms: A Comparison of Market-based Research Methodologies." Journal of Empirical Finance, 9:91-108.

Hang Chai and Subrahmanyan, A. (I994): "The Effects of Index Futures on the Underlying Stock Market." The Journal of Futures Market, 14:293-322.

Khursheed Ali, Khalid Ashraf Chisti and Mohi-ud-din Sangmi (2013), "Derivatives Trading in Emerging Economies with Special Reference to India." Vol. 3, Issue 1, PP. 5-20.

Harris, L. M., (1989): "S&P 500 Cash Stocks Price Volatility." Journal of Finance, 44:1155-1175.

Harry, C. and R. Wholey (1992): "Market Volatility Prediction and the Efficiency of the S&P 100 Index Options Market." Journal of Financial Economics, 31:43-74.

Hayes Samuel, L. and Michael, E. Tannenbaun (1979): "The Impact of Listing Options on Underlying Shares." The Journal of Financial Management, (Winter), pp. 72-78.

Hemler, M.L. and F.A. Longstaff (1991): General Equilibrium Stock Index Futures Price. Theory and Empirical Evidence. Journal of Financial and Quantitative Analysis, 26:287-308.

Herbst Anthony; John McCormick and E. West, (1997): "Investigation of Lead-Lag Relationship Between the Spot Indices and Their Futures Contracts." Journal of Futures Markets, 7:373-382.

Hodgson Allan and Nicholls Des (1991): "The Impact of Index Futures on Australian Share-Market Volatility." Journal of Business Finance and Accounting, 18(2):267-280.

Hogan Kedreth; C. J. Kroner; Kenneth F. and Sultan Jahangir, (1987): "Program Trading, Non-program Trading and Market Volatility." Journal of Futures Markets, 17(07):733-756.

Irag, G. Kawaller; Paul, D. Koch and Timothy, W. Koch (1990): "Intraday Relationship between Volatility in S&P 500 Futures Prices and Volatility in the S&P 500 Index." Journal of Banking and Finance, 14:373-397.

James, T. W. (1993): "How Price Discovery by Futures Impact the Cash Market." The Journal of Futures Market, pp. 469-496.

Jangkoo Kang, Chang Joo Lee and Soonhee Lee (2006): "An Empirical Investigation of the Lead-Lag Relationship of Returns and Volatilities among the KOSPI-200 Spot, Futures and Options Markets and their Explanations. Journal of Emerging Market Finance.Vol.5(3).

John Board; Gleb Sandmann and Charles Sutcliffe (2001): "The Effects of Futures Markets Volume on the Spot Market Volatility." Journal of Business Finance and Accounting, 28(7&8): Sep/Oct.

Kalak Chan et. al. (1991): "Intraday Volatility in Stock Index and Stock Index Futures Markets." Review of Financial Studies, 4(4):657-684.

Kamara, A., Miller Junior, T.W. and Segel, A.F. (1992): "Effects of Futures Trading on the Stability of Index S&P 500 Returns." Journal of Futures Market, 12:645-658.

Kawaller Ira, Paol Koch and Temiothy Koch (1987): "The Temporal Price Relationship between S&P 500 Futures and S&P 500 Spot Index." Journal of Finance, 42:1309-1329.

Kumar Raman; Atulya Sarin and Kuldeep Shastri (1998): "The Impact of Options Trading on the Market Quality of the Underlying Security: An Empirical Analysis." Journal of Finance, 53:717-732.

Lee Sang Bin and Ohk Ki Yod (1992): "Relationship between Stock Index Futures Listing and Structural Changes in Time-Varying." Journal of Futures Market, 12 (05):493-509.

M, Thenmozhi (2002): Futures Trading, Information and Spot Price Volatility of NSE-50 Index Futures Contracts. www.nseindia.com.

Ma, C. K. and R. P. Rao (1986): "Information asymmetry and Options Trading." The Financial Review, 23:39-51.

Maberly Edwin, D; Davis, S. Gilberth and Roy, F. (1989): "Stock Index Futures and Cash Market Volatility." Financial Analysts Journal, 45(6):75-85.

Mark Fedenia and Theoharry Grammatikos (1992): "Options Trading and Bid-Ask Spread of the Underlying Stocks." Journal of Business, 65(30).

Mekenzie Michael D., Brailsford, T.J. and Robert, W. Faff (2001): "New Insights into the Impact of the Introduction of Futures Trading on Stock Price Volatility." Journal of Futures Market, 21(3):237-255.

Merrick John (l987): "Volume Determination in Stock and Stock Index Futures Markets: An Analysis of Arbitrage and Volatility Effects" Working Paper No. 87-92 Jan. Federal Reserve Bank Philadelphia, pp. 1-29.

Min, J.H. and Najand, M. (1999): "A Further Investigation of the Lead-Lag Relationship between the Spot Market and Stock Index Futures: Early Evidence from Korea." Journal of Futures Markets, 19(2):217-232.

Modest David and Mahadevan Sundaresan (1993): "The Relationship between Spot and Futures Prices in Stock Index Futures Market: Some Preliminary Evidence. The Journal of Futures Market, 3:15-41.

Nabar, P. and Park, S. (1988): "Options Trading and Stock Price Volatility: Working Paper." New York: New York University.

Narasimhan Jegadeesh and Avanidhar Subrahanyam (1993): "Liquidity Effects of the Introduction of S&P 500 Index Futures Contracts on the Underlying Stocks." Journal of Business, 66: pp.171-187.

Nicolas, P. Bollen (1998): "A Note on the Impact of Options on Stock Return Volatility." Journal of Banking and Finance. 22:1181-1191.

Premalata Shenbagaraman (2004): Does Futures and Options Trading Increase Stock Market Volatility? (www.nseindia.com)

Sahlstorm, Petri, (2001): "Impact of Options Listing on the Risk and Returns Characteristics in Finland, International Review of Financial Analysis, 10: 19-36.

Simpson, W.G. and T.C. Ireland (1992): "The Effect of Futures Trading on the Price Volatility of GNMA Securities". Journal of Futures Market, **2**:357-366.

Skinner Douglas, J. (1989): "Options Markets and Stock Return Volatility" Journal of Financial Economics, 23:61-87.

Stephan, Jens A. and Robert, E. Whaley (1990): "Intraday Price Changes and Trading Volume Relationship in the Stock and Stock Options Markets". Journal of Finance, 45:191-220.

Stoll, Hans and Robert Whaley (1988): Expiration Day Effects of Index Options and Futures, Working Paper, Vanderbilt University.

Takato Hiraki; Edwin Marherly and Nohaya Takezawa, (1995): "Relationship Between NIKKEI Index Futures and Overnight Spot Returns." Journal of Futures Market, 4:212-234.

Whiteside Mary, M; William, P. Dukes and Patrick, M. Donne (1983): “Short Term Impact of Options Trading on the Underlying Securities.” Journal of Financial Research, 4-6:313-321.