RESEARCH

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The Impact of Derivative Trading on the Liquidity of Stocks

M S Narasimhan and Shalu Kalra

Executive Summary

Liquidity is an important factor for smooth trading for all assets including equities traded in the stock markets. Stock exchanges enable buyers and sellers to come together for transaction and in the process reduce the search cost and friction. Higher liquidity motivates more investors to participate in the stock market. Introduction of derivatives of the underlying stock increases the opportunity set available to investors and hence affect the liquidity of the underlying stock.

This study examines the impact of derivative trading on the liquidity of underlying stock using price impact measure of liquidity. The price impact measure of liquidity, which actually measures illiquidity, is given by the average daily ratio of absolute return of the stock to the daily volume over a period of time. The advantage of this measure is that it is based on the observed price changes associated with trades. Two time periods have been chosen to examine the short-term and long-term impact of derivative listing on liquidity of underlying stocks. The first time period is one month pre- and post-listing and the second time period is one year pre- and post-listing.

The results of this study show a shift in the volume from cash market to derivative market, decline in the number of trades, and lower volatility after the introduction of derivative trading. The illiquidity of the stocks also increased in the short run after the introduction of derivative trading and this is definitely not a desirable outcome of introduction of derivative trading. The sample has been divided into four quartiles on the basis of pre-liquidity levels to examine whether the change in liquidity is affected by the pre liquidity levels of the underlying stock. The results show that the impact of derivative trading on long-term liquidity of the market depends on the level of liquidity prior to the introduction of derivative trading. They also show an improvement in long-term liquidity after derivative trading when the liquidity of stocks prior to derivative trading was not high. In other words, derivative listing improved the liquidity of illiquid stocks significantly and served one of the basic objectives of risk management. On the other hand, long-term liquidity was marginally affected if the stocks were already liquid and it is not a matter of concern.

KEY WORDS

Derivative Trading

Illiquidity

Volatility

Price-Impact Measure

SEBI

Liquidity is the lifeblood of financial markets. In stock markets, it is possible to convert assets into cash and vice versa, only when there is liquidity in the market. Smooth flow of capital between asset classes is also critical for the economy. Its sudden erosion even in a single market segment or in an individual instrument can stimulate disruptions that are transmitted through increasingly interdependent and interconnected financial markets worldwide. Liquidity is a continuous characteristic. Assets can have different degrees of liquidity. According to Stange and Kaserer (2009), the degree of liquidity is determined by the type of the asset, the size of the position, and the liquidation horizon. A completely liquid asset can be traded without any cost and delay, no matter how much quantity is traded. The perfect example of completely liquid asset is cash. For practical purposes, liquidity adjustments to its value are not necessary. An asset can be called 'continuously tradable' when most positions can be traded albeit with a cost, a good example being limit order books of developed stock markets. The determination of the costs of trading is the main issue from a liquidity perspective. If liquidity deteriorates further, the asset becomes 'disruptively tradable', i.e. it can be traded from time to time. While market price provides an indicator for the fair value of the asset, a delay and its incorporation into liquidity measures is a major issue - in addition to trading costs. A good example is over-the-counter market of exotic bonds. Finally, an asset is 'illiquid' if no position size can be traded. Market prices are thus non-observable and value has to be determined by intrinsic methods. Rare art or currently collateralized debt obligations (CDOs) can be considered illiquid.

Liquidity is defined as the time and cost which are associated with the liquidation (or purchase) of a given quantity of financial securities. Liquidity risk arises from not being able to pull one's money out of an investment instantaneously at a "fair" price. Liquidity risk has been acknowledged for a long time as a source of risk and several economies have witnessed liquidity crisis at different points of time in different markets. The recent liquidity crisis in the European banking system is an example of how a liquidity crisis in one market or a region affects the other markets. However, liquidity risk is still not incorporated in the standard asset pricing models under the assumption that the liquidity risk can be diversified by holding a diversified portfolio of stocks.

While liquidity is important for all classes of assets for smooth trading, it is all the more important for stock markets. In fact, the basic purpose of having organized exchanges is to provide liquidity. Stock market enables buyers and sellers to get together for transaction and in the process reduces the search cost and friction. Higher liquidity ensures less friction. When the liquidity is high, more investors participate in the stock market and are ready to invest in assets of different risk classes. This is one reason why a number of IPOs are floated in the market when the liquidity is high.

Derivatives on underlying stocks increase the investment opportunities for the traders though derivatives are not new and can be synthetically replicated by a combination of stock positions already available in the market. Derivatives are found to be useful when there are certain restrictions like short-selling in the cash market. The introduction of derivatives makes an incomplete market more complete and thereby change the opportunity set available to investors. Derivatives also provide convenience when investors desire to hedge the risk or a component of risk like protecting only the downside risk. The availability of derivative products also encourages investors and traders to invest in market and thereby improves the liquidity of the market. Arbitrageurs who trade between cash market and derivative markets also provide additional liquidity for the markets. Though derivatives are expected to improve the liquidity, they are also criticized for increasing the volatility of the market and hence the valuation.

Derivatives were introduced in the Indian stock market in June 2000 with the launch of futures contracts in the BSE Sensex and S&P CNX Nifty Index on the Bombay Stock Exchange (BSE) and National Stock Exchange (NSE), respectively. Index options and individual stock options were introduced in June 2001 and July 2001 respectively. Single stock futures were introduced in November 2001. Since then the futures and options (F&O) segment has been growing continuously in terms of new products, contracts, traded volume, and value. The NSE is also planning to introduce trading on volatility index. The average daily turnover has increased from ₹101.07 billion in 2004-05 to ₹ 723.92 billion in 2009-10. Table 1 shows the growth of derivative markets during the last few years.

Though the impact of liquidity after the introduction of

derivative trading was examined earlier, these studies used volume of trading as a measure of liquidity. Among the available measure of liquidity, volume is not considered as an effective measure of liquidity. In this study, price-impact measure of liquidity is used to examine the impact of introduction of derivatives on the liquidity of the underlying stocks.

REVIEW OF LITERATURE

Derivatives are not independent financial instruments and hence any trading in the derivatives affects the underlying security in more than one ways, either beneficial or destabilizing, depending on numerous factors. Various studies have researched the impact of derivatives on the volatility, price, trading volume, and liquidity. Ross (1976) suggests that derivatives improve the efficiency of incomplete asset markets by expanding the opportunity set facing investors. Detemple and Selden (1991) show that when the market is incomplete, the derivatives market and the underlying securities market will, in general, interact and hence the valuation of the derivative and the underlying security is a simultaneous problem. They argue that when two classes of investors disagree on the downside potential of the stock, introduction of a derivative increases the equilibrium price of the stock and decreases the volatility of its rate of return. Investors with a high risk assessment sell the stock and buy the derivative and investors with a low risk assessment buy more of the stock and sell the derivative. The net effect is to increase the aggregate demand for the stocks and thus derivative complements the stock. Grossman (1988) argues that trading the derivatives market reveals important information about the future trading intentions of investors. Hence the volatility of stock prices can be lower when these informationally relevant real derivatives are traded. In this context, Detemple and Selden (1991) show that the positive price effect associated with derivative listing may result in a decline in returns volatility. Black (1975) notes that the financial leverage provided by stock derivatives can lower the transaction costs and thereby attract the otherwise unprofitable informed trades. Derivatives could also attract informed trades by enabling more efficient trading on negative information which is not possible in the stock market.

While some authors argue that derivatives increase volatility and destabilize the market (Cox, 1976; Stein, 1987; Ross, 1989), several others argue that derivatives produce positive results like higher liquidity and lower volatility in the market (Powers, 1970; Danthine, 1978; Antoniou et al., 1998; Chatrath et al., 1995; Kumar et. al., 1995). The impact of derivatives trading on volatility of the underlying stocks in Indian market has been examined by a few studies and the results of these studies show that volatility has decreased after the introduction of derivatives in India (Thenmozhi, 2002; Raju & Karande, 2003).

In addition to examining the impact of derivatives trading on volatility, researchers have also examined the impact of derivative trading on liquidity of the market. John et al. (1991) develop a model to show that the informed traders migrate to the derivatives markets on the listing of derivatives because they view derivatives as superior speculative instruments. This superiority of derivatives stems from their inherent leverage and their ability to avoid short sale restrictions on the stocks. The reduction in the proportion of informed traders in the underlying market lowers the adverse selection costs of the market maker, thereby lowering the spread and improving liquidity. Fedenia and Grammatikos (1992) find that the bid-ask spreads in the stock markets narrow after the derivative listings, thereby reducing the bid-ask bounce in stock prices and the variance of stock returns. The introduction of derivatives might allow market makers to hedge their risks more efficiently, allowing them to narrow the spreads they charge. Hayes and Tennenbaum (1979) and Damodaran and Lim (1991) find an increase in the volume of underlying shares traded in the cash market after the introduction of derivative trading. Kumar et al. (1998), in a comprehensive analysis, investigate the impact of derivative listings on the market quality of underlying stocks in terms of liquidity, information asymmetry, and pricing efficiency. Consistent with the findings of earlier studies, they find that derivative listings have beneficial impact on the market quality of underlying shares. More specifically, they observe a decrease in the spread and increase in quoted depth, trading volume, trading frequency, and transaction size after derivative listing.

LIQUIDITY MEASURES

Liquidity has different dimensions. Earlier work focused on the spread. Lee, Mucklow, and Ready (1993) stress the necessity of including the quantity dimension of depth into the price dimension of the spread. Kyle (1985) and Harris (1990) identify three aspects or dimensions of liquidity namely tightness, depth, and resiliency (Figure 1).

Tightness refers to the ability to buy and sell an asset at about the same price at the same time. Tightness shows in the clearest way, the cost associated with transacting or the cost of immediacy. Measures for tightness are the different versions of the spread. Tightness measures the cost of quickly buying and then selling a position. (i.e. cost of changing positions). ***Depth*** is the ability to buy or sell a certain amount of an asset without influence on the quoted price. A sign of illiquidity is an adverse market impact for the investor when trading. Market depth can be measured, aside from the depth itself, by the order ratio, the trading volume or the flow ratio. Depth is the number of units offered at the ask price plus the number of units bid at the bid price. Depth refers to the size of a transaction that is required to change prices that is trade size or thickness of the order book profile (order book refers to a panel which provides traders with bid-ask prices and volume offered per price) required for changing prices. ***Resiliency*** is the ability to buy or sell a certain amount of an asset with little influence on the quoted price. While the market depth regards only the volume at the best bid and ask prices, the resiliency dimension also takes the elasticity of supply and demand into account. This aspect of liquidity can be described by the intraday returns, the variance ratio, or the liquidity ratio. Resilience measures the speed at which prices recover to fundamentals after a non-informational trade, i.e. the time required to recover from price fluctuation caused by a sudden shock or to reach a new equilibrium. Using these three attributes, comparing liquidity of individual assets is problematic because one asset could be more liquid along one dimension of transaction costs while the other is more liquid in a different dimension. Different studies have used different measures of liquidity.

Literature provides myriad definitions and measures for liquidity to measure different dimensions to liquidity. The goal of liquidity measurement is to identify the cost structure which confronts investors, and hence influences their decisions on which assets to hold and when they should be traded. Because there are many dimensions of the relevant cost structure, there is no single method for measuring market liquidity. There are different proxies of liquidity measurement in literature, which are listed below:

Trading Volume: Trading volume generally indicates how much quantity the investors trade. Brennan and Subrahmanyam (1995) find that trading volume is an important determinant of measure of liquidity.

Turnover: Turnover is the ratio of share volume to the number of stocks outstanding. Turnover measures how much quantity investors trade and how fast investors change their positions averagely relative to the total shares outstanding. Datar et al. (1998) use turnover as a liquidity measure to investigate the cross-sectional relation between stock returns and liquidity.

Return Reversal Method: Pastor and Stambaugh (2003) suggest a reversal measure of liquidity. It is based on the finding of Campbell et al. (1993) that in a regression of a stock's daily return on its signed lagged dollar volume, the coefficient is more negative for less liquid stock.

Bid-ask spread: Bid-ask spread is the difference between ask price at which an investor is willing to sell a security and bid price at which the investor is willing to purchase a security. The bid-ask spread is an immediacy cost because it is paid when investors want to trade immediately. Many studies have used bid-ask spread measure (Stoll & Whalley, 1983; Amihud & Mendelson, 1986; Eleswarapu & Reinganum, 1993; Kadlec & McConnell, 1994). There are several types of bid-ask spread measures: quoted spread, effective spread, proportional spread, rolls spread.

Proportion of zero daily return: The proportion of zero daily return is used as a liquidity measure. Zero daily return is related to trading speed because the days with zero return mean the delay or difficulty in executing an order. It causes the interruption in the continuity of trading. Bekaert et al. (2003) use this measure to examine the impact of liquidity on expected returns in emerging equity markets. They find the proportion of zero daily return can predict future returns significantly.

Price-impact measure: Amihud (2002) introduces a new measure for liquidity known as price-impact measure of liquidity which can be constructed from daily data. The price impact measure of liquidity, which actually measures illiquidity, is given by the average daily ratio of absolute return to daily volume over the month. Equations 1 and 2 show the computation of price-impact method of liquidity.

$$Illiq_{i,d} = \frac{|R_{i,d}|}{V_{i,d}} \quad (1)$$

$$Illiq_i = \frac{1}{N}\sum_{i=1}^{N}\frac{|R_{i,d}|}{V_{i,d}} \quad (2)$$

where,

$R_{i,d}$ is the return for stock i on day d.

$V_{i,d}$ is the R volume (measured in ₹ crores) for stock i on day d

N is the number of trading days in a month or a period

If the price-impact liquidity measure for a stock on a day is 0.7 percent, it means the stock price will change by 0.7 percent for every ₹1 crore turnover. Table 2 compares the liquidity of two stocks (ACC and Ambuja Cements). ACC's liquidity on January 11, 2001 was 0.57 percent. It means that the price of ACC will change by 0.57 percent for every ₹1 crore turnover. On the other hand, Ambuja Cements, whose volume and turnover were also low, shows a liquidity value of 0.62 percent implying that the price of Ambuja Cements will move by 0.62 percent for every ₹1 crore volume. While the above computation shows that ACC is more liquid compared to Ambuja Cements, it is unreasonable to judge the liquidity of the stocks based on one day liquidity measure. Hence the liquidity values are to be averaged over a period of time. The liquidity values of ACC and Ambuja Cements for the year 2001 are 0.04 percent and 2.46 percent respectively. Though the market capitalization of both ACC and Ambuja Cements is around ₹2,000 crore, the liquidity measure differs considerably between the stocks. The volume turnover gives an indication of liquidity difference between the two stocks, whereas the price-impact liquidity measures the impact of liquidity difference in returns. Hasbrouck (2009) shows Amihud's (2002) price-impact measure to be the best available liquidity measure constructed from daily data. He also shows that price-impact measure is highly correlated with other measures like effective spread and other measures of spread. The advantage of this measure is that it is based on the observed price changes associated with trades. Lesmond (2005) checks the four liquidity proxies for 31 emerging markets and finds that the price impact measure is very highly and positively correlated with spread irrespective of the country.

SAMPLE

The Securities and Exchange Board of India (SEBI) introduced stock options and single stock futures in July and November, 2001 respectively. SEBI initially allowed derivative trading for 29 stocks and subsequently added more stocks for derivative trading over a period of time. Stocks for which futures and options were allowed during the period 2001 to 2003 are considered for the analysis. In all, single stock future and options were allowed for 65 stocks during the period. For five securities, derivatives were listed along with IPO listing and hence were not considered for the analysis due to the absence of pre-listing data. The final sample consists of 60 stocks (Appendix 1). NSE subsequently allowed single stock futures and options for a large number of securities. The analysis was restricted only to the first bunch of stocks on which derivatives were allowed because they were introduced within a short interval. Daily price and volume data for these stocks were collected for one year prior to derivative listing and one year after derivative listing. Data were collected using PROWESS Database provided by the Centre for Monitoring Indian Economy (CMIE). The illiquidity of sample stocks during pre-listing and post-listing periods is given in Appendix 1. Table 3 shows summary statistics of price-impact liquidity measure. The liquidity level of the sample stocks is significantly different. The lowest and the highest values of long-run illiquidity are 0.01 percent and 294.15 percent respectively during the pre-listing period. While Infosys, Reliance Industries, and Satyam shares the lowest illiquidity spot, United Phosphorus and KPIT Cummins share the top spot. Though there is no major change at the lower end of illiquidity (minimum value) during the post-listing period, there is a considerable reduction in the illiquidity values at the higher end (maximum value) during the post-listing period. The maximum illiquidity value declined from 294.15 percent to 90.70 percent for United Phosphorus during the post-listing period. The volume turnover for the United Phosphorus improved from ₹2.96 crore to ₹ 28.07 crore during the same period. The lowest value of liquidity showed some increase during the post-listing period. The standard deviation is also high. While the mean values show a decline in illiquidity during the post-listing period, there is an increase in the median value of illiquidity. This inconsistent result indicates a sharp decline in illiquidity at the higher end and an increase in illiquidity at the lower end. In view of this inconsistent statistics, it is difficult to comment on the overall impact of introduction of derivatives on liquidity position of the stocks in which derivative instruments were introduced

ANALYSIS OF LIQUIDITY

Liquidity of the markets and different segments of the stocks in the market differ. Figure 2 compares the liquidity of all stocks traded in the Bombay Stock Exchange (BSE) and also BSE-500 stocks from 2001 to 2003. The illiquidity of BSE all-stocks measured through price-impact measure is much higher than a segment of BSE (BSE-500 stocks) which consists of stock with large and medium capitalization. Figure 3 compares the illiquidity (price-impact) of all BSE listed stocks with the turnover of stocks in the BSE. Though the two measures are related, they are not similar always. The correlation between the BSE turnover and illiquidity is 0.06 whereas the correlation between the illiquidity of BSE and BSE-500 stocks is 0.65. Liquidity is about diversity and not size. The assumption that the bigger a market is, the more liquid it is, is so prevalent that turnover and liquidity are often seen as synonymous. In a market where a large number of participants try to sell or buy at the same point of time, the price would move away from the current level though the trading volume would be higher in such a market. Table 4 compares the relationship between illiquidity and other common measure of liquidity. Illiquidity is negatively related to the number of stocks traded, number of transactions, and daily turnover. While the correlation between other measures of liquidity (number of stocks traded, number of transactions, and daily turnover) is high, the correlation between illiquidity and other measures are relatively lower.

The price-impact measure of liquidity is used to study the effect of derivative listing on liquidity. Two window time periods are considered to examine whether there is any significant change in the liquidity of the stocks after derivative trading allowed on those stocks. Two time periods have been chosen to examine the short-term and long-term impact of derivative listing on liquidity of underlying stocks. The first time period is one month pre- and post-listing and the second time period is one year pre- and post-listing. For each stock, price-impact based liquidity measure was computed on a daily basis for the window period and then average value of the liquidity of the window period is considered for further analysis. Price impact measures the inverse of liquidity, which means if the value is high, the liquidity is low. Since the liquidity of the stock is also affected by the general changes in the market liquidity prevailing during the period, the liquidity values of each stock is also scaled by the market liquidity to allow comparison between pre- and post-listing liquidity of different stocks. Wilcoxon signed rank test is used to examine whether there is any significant change in the liquidity level after the introduction of derivative trading.

The impact of derivative listing on trading volume, stock price, and volatility was first examined. Table 5 shows the results of pre-listing and post-listing values of these variables for both short-term and long-term period. The results show a general decline in volume, number of trades, and volatility after derivative listing. The results are also statistically significant for the long-run values. The results are consistent with Skinner (1989) who suggests a decline in volume after derivative listing is possible on account of the diversion of trading away from the market for the stock to the market for its derivatives.

Having observed a similar decline in volume and number of trades, this paper examines the impact of introduction of derivative trading on liquidity using price-impact measure of liquidity. The summary statistics of illiquidity and standardized illiquidity (illiquidity scaled by market illiquidity) are provided in Table 6. In the short run (one month), the illiquidity and standardized illiquidity of the stocks in the cash market has increased during post-listing period. The mean value of illiquidity level has increased from 2.93 percent to 3.72 percent . Similarly, the standardized illiquidity has increased from 2.54 percent to 3.95 percent . Wilcoxson signed rank test also confirms the increase in illiquidity. Table 6 reports the changes in illiquidity and standardized illiquidity over one-year period. While the mean values show a sharp decline in the long-term illiquidity, the median values show an increase in illiquidity during post-listing period. The mean value of illiquidity has declined from 6.72 to 2.23. On the other hand, median value of illiquidity has increased from 0.39 to 0.50. The difference in long-term liquidity levels are however not statistically significant.

Since the mean and median illiquidity measures are giving different conclusion on the impact of derivative trading on liquidity, it requires further examination. One possible reason for the difference is illiquidity level prevailing prior to derivative listing. To examine whether pre-listing liquidity explains the difference, the sample firms are ranked on the basis of pre-listing illiquidity and the pre-listing and post-listing illiquidity measured for each quartile. The short-run and long-run impact of de-

rivative listing for each quartile is reported in Table 7. Table 8 shows similar results for standardized illiquidity.

Table 7 shows that the liquidity levels of the four groups are different. While the short-run illiquidity (non-standardized) increased across four quartiles, there was a mixed reaction in long-run illiquidity. The increase in short-term illiquidity is significant only in quartile 4 which consists of stocks with low pre-listing illiquidity. The mean value illiquidity in this group increased from 0.05 to 0.16 after listing. On the other hand, the results are completely different and surprising for the long-run illiquidity when illiquidity is examined at different quartiles. Earlier when all the stocks in the derivative segment were pooled, it was observed that the illiquidity changes were not statistically significant. When the stocks are grouped on the basis of pre-listing illiquidity, the long-run liquidity of the stocks with high pre-listing illiquidity improved. In other words, the introduction of derivative trading helped in improving the liquidity condition of the group. The mean illiquidity value of the group came down from 25.79 to 6.72 and the median value declined from 4.14 to 0.67, the values being statistically significant. On the other hand, illiquidity increased during post-listing period for other stocks whose illiquidity prior to derivative listing is low. The long-term illiquidity values increased from 0.80, 0.23, and 0.06 to 1.39, 0.55, and 0.28 respectively for the next three quartiles. Though the increase in illiquidity after the introduction of derivative transaction is statistically significant for these three quartiles, the absolute values of illiquidity are still small and considerably lower than the post-listing illiquidity value of the first quartile. Table 8 confirms that the results of short-run and long-run standardized illiquidity are similar to the one reported for illiquidity. In this group also, the standardized illiquidity declined significantly for stocks which were highly illiquid in the pre-listing period. The results show that the impact of derivative trading on liquidity is not uniform. This could be on account of the shift in cash market volume to derivative market particularly on stocks which are actively traded prior to derivative listing. Table 9 confirms the shift in volume from cash market to derivative market and such shift depends on the pre-listing liquidity. For stocks with low pre-listing illiquidity (Quartile 4), the mean volume of 60 has declined by 62.45 percent from ₹25,639.65 crore to ₹9,617.43 crore. Quartile 2 and 3 also witnessed a decline in volume after derivative listing in the order of -11.72 percent and -46.67 percent respectively. On the other hand, the mean trading volume of stocks with high illiquidity (Quartile 1) has increased from ₹1576.85 cr. to ₹2713.72 cr. The variance of the returns (volatility) of stocks in different pre-listing illiquidity has declined in general but without any specific trend.

The increase in illiquidity level of high volume stocks after derivative listing is not a real concern. The average illiquidity level of these stocks is 0.05 percent during the pre-listing period against the mean value of 2.93 percent for the entire sample. The illiquidity of this group increased from 0.05 percent to 0.16 percent post-listing which is far below the average illiquidity of the sample. It means that a ₹1 cr volume will cause a price change of 0.16 percent against 0.05 percent during pre-listing period. However, the 0.16 percent is far lower than 2.93 percent of the entire sample. In other words, though illiquidity of this group of stocks has increased after derivative trading, the liquidity of these stocks is still good compared with the liquidity of other stocks in the market. To summarize, the introduction of derivative trading improved the liquidity level of stocks whose pre-listing liquidity is low.

This paper examines whether the results are consistent with the other measures of liquidity. It was seen whether more actively traded stocks differed from the less actively traded stocks in their reaction to derivative listing. Regression was estimated with the ratio of trading volume after listing to trading volume before listing (standardized volume ratio) as dependent variable and ratio of trading volume of shares before listing to shares outstanding (Volume Turnover) as independent variables. One-month window period was used for these estimates. The estimated regression equation is:

$$\log(\text{Standardized Volume Ratio}) = \underset{(-7.31)}{-0.6494} + \underset{(-2.56)}{-0.1215} \log(\text{Volume Turnover})$$

The R^2 value is 0.11 and t-values are in parenthesis. The negative intercept points out a decline in trading volume post-listing. The results also show that the liquidity of stocks with higher trading volume (volume turnover ratio) is affected more after the introduction of derivative trading.

Many factors other than derivative listing may affect the liquidity levels. Earlier studies showed that the liquidity of stocks was also affected by changes in volume, volatility, and price levels (Kumar et al., 1998). The possibility of these cross-sectional effects on illiquidity were examined. Following Kumar et al. (1998), regressions with the ratio of illiquidity of a stock were estimated before listing and after listing as dependent variable and the ratio of post-listing to pre-listing trading volume, average price, and variance as independent variables. The regression equation is:

$$log\ \text{IlliquidityRatio}_i = \beta_o + \beta_1\ log\ \text{Volume Ratio}_i + \beta_2\ log\ \text{Variance Ratio}_i + \beta_3\ log\ \text{Price Ratio}_i + e_i$$

β_1 is expected to be negative since an increase in post-listing volume relative to pre-listing volume should reduce the illiquidity in post-listing period. β_2 is expected to be positive since an increase in variance (volatility) is expected to increase the illiquidity. There is no specific expectation as far as changes in price level β_3. If derivative listing has any effect on illiquidity, there should be a significant slope. A negative (positive) slope indicates that the introduction of derivative reduces (increases) the illiquidity level of the market. The regression results show that a change in illiquidity is negatively related to volume and price ratio and has no relationship with variance ratio (Table 10). The intercept is not statistically significant but the negative slope indicates an improvement in liquidity, following the introduction of derivative trading and after controlling for changes in volume, price, and variance.

CONCLUSION

The Securities and Exchange Board of India introduced derivatives in July, 2001. As derivatives were introduced in India long after its introduction in the US, the market was already familiar with the payoffs and the effects of derivatives trading. Shenbegraman (2004) quotes from a study of 25 countries done by Gulen and Mayhew (2000) that derivatives trading is associated with increased volatility in the US whereas the volatility was lower in many countries which introduced derivative subsequently. The impact of derivative trading on the market also depends on the regulatory structure, trading mechanism, contract design, and time when derivatives are introduced. A few studies conducted in the Indian context after derivative listing also point out a decline in volatility after derivative listing. Several studies carried out in the US context till date report an increase in liquidity after the derivative listing whereas Chamberlain et al. (1993) show that in Canada there is no effect on trading volume, return volatility, and liquidity of the underlying stock. This study extends the existing literature by examining the impact of derivative trading on liquidity in the Indian context. The short-term and long-term impact of derivative listing on liquidity is examined with the help of daily data for one-month and one-year period. While liquidity can be measured in several ways, this study uses price-impact based liquidity measure. The results of this study show a shift in the volume from cash market to derivative market, decline in the number of trades, and lower volatility after the introduction of derivative trading. The illiquidity of the stocks also increased in the short run after the introduction of derivative trading. The impact of derivative trading on long-term liquidity of the market depends on the level of liquidity prior to the introduction of derivative trading. The results show an improvement in long-term liquidity after derivative trading when the liquidity of stocks prior to derivative trading was not high. On the other hand, long-term liquidity was affected if the stocks were already liquid. A negative relationship was observed between the trading volume prior to derivative listing and post-listing trading volume. The results point out an important policy implication. The security market regulators like SEBI can consider derivatives among other tools to improve the liquidity of the stocks which are otherwise illiquid. The decline in liquidity and shift in trading volume from cash market to derivative market for stocks which are otherwise liquid need not be a concern in view of the marginal change in the liquidity of these stocks.

Table 1: Growth of Derivative Market in India

Year	Index Futures Turnover	Stock Futures Turnover	Index Options Notional Turnover	Stock Options Notional Turnover	Total No. of Contracts	Total Turnover	Average Daily Turnover
2000-01	24	–	–	–	90580	24	0.11
2001-02	215	515	38	252	4196873	1019	4.10
2002-03	440	2865	92	1001	16768909	4399	17.52
2003-04	5544	13059	528	2172	56886776	21306	83.88
2004-05	7721	14841	1219	1688	77017185	25470	101.07
2005-06	15138	27917	3385	1803	157619271	48242	192.20
2006-07	25396	38310	7919	1938	216883573	73562	295.43
2007-08	38207	75486	13621	3591	425013200	130905	521.53
2008-09	35701	34796	37315	2292	657390497	110105	453.11
2009-10	39344	51952	80280	5061	679293922	176637	723.92

Source: www.nse-india.com (Turnover values in ₹ billions)

Table 2: Liquidity of ACC and Ambuja Cements

	ACC Ltd.		Ambuja Cements	
Date	10-Jan-01	11-Jan-01	10-Jan-01	11-Jan-01
Open	122.00	133.30	20.37	20.80
High	123.00	140.20	20.37	20.92
Low	116.25	133.30	19.81	20.16
Close	117.30	139.10	19.99	20.23
Return		0.19		0.01
Volume (Quantity)	3035162	2368166	82842	125397
No. of Trades	22465	14507	566	1067
Volume (in ₹ cr.)	36.08	32.71	1.24	1.92
Market Capitalization	2006.42	2379.31	2205.48	2232.70
Liquidity (PI) on 11/1/ 2001		0.57%		0.62%
Average Liquidity in 2001		-0.04%		-2.46%

Table 3: Summary Statistics of Pre- and Post-Derivative Listing Liquidity

	Pre-listing Liquidity (%)		Post-listing Liquidity (%)	
	Absolute	Standardized	Absolute	Standardized
Minimum	0.01	0.01	0.02	0.02
Maximum	294.15	221.24	90.70	82.15
Mean	6.72	5.19	2.23	1.95
Median	0.39	0.27	0.50	0.37
Standard Deviation	38.07	28.64	11.64	10.54

Table 4: Correlation between Illiquidity and Other Common Measures of Liquidity (1995-2007)

Liquidity Measure	Transactions	Count	Turnover	Illiquidity
Transactions	1.0000			
Count	0.8590	1.0000		
Turnover	0.8049	0.6226	1.0000	
Illiquidity	-0.5517	-0.4458	-0.2907	1.0000

Note: Illiquidity is the daily illiquidity of the stock market measured as price impact. Count is the number of stocks traded during the day. Turnover is measured as volume on that particular day in ₹ (crore). Transaction is the number of transactions for all the listed stocks.

Table 5: Impact of Derivative Listing on Short-run and Long-run Volume, Trades and Volatility

	Standardized Volume		Standardized No. of Trades		Volatility	
	Before	After	Before	After	Before	After
Short-run (one-month)						
Mean	0.0016	0.0015	0.008	0.007	0.0082	0.0070
Median	0.0098	0.0059	0.0134	0.0129	0.0071	0.0067
Wilcoxon Test	0.0860		0.2218		0.0826	
Long-run (one-year)						
Mean	0.0015	0.0000	0.0141	0.0088	0.1388	0.1128
Median	0.0065	0.0000	0.0090	0.0065	0.1184	0.1037
Wilcoxon Test	0.0000		0.0120		0.0473	

Table 6: Impact of Derivative Listing on Short-run and Long-run Illiquidity

	Illiquidity		Standardized Illiquidity	
	Before	After	Before	After
Short-run (one-month)				
Mean	2.93	3.72	2.54	3.95
Median	0.19	0.39	0.15	0.04
Wilcoxon Test	0.028		0.001	
Long-run (one-year)				
Mean	6.72	2.23	5.19	1.95
Median	0.39	0.50	0.27	0.37
Wilcoxon Test	0.7488		0.4841	

Table 7: Impact of Derivative Listing on Short-run and Long-run Illiquidity when Sample Firms are Grouped on Pre-listing Illiquidity

	Quartile 1 (High Illiquidity)		Quartile 2		Quartile 3		Quartile 4 (Low Illiquidity)	
	Before	After	Before	After	Before	After	Before	After
Short-run (one-month)								
Mean	11.21	13.08	0.32	1.19	0.14	0.42	0.05	0.16
Median	0.75	2.11	0.31	0.70	0.13	0.34	0.05	0.11
Wilcoxon Test	0.2628		0.0680		0.0620		0.0181	
Long-run (one-year)								
Mean	25.79	6.72	0.80	1.39	0.23	0.55	0.06	0.28
Median	4.14	0.67	0.62	1.27	0.23	0.51	0.07	0.15
Wilcoxon Test	0.0001		0.0421		0.0079		0.0128	

Table 8: Impact of Derivative Listing on Short-run and Long-run Standardized Illiquidity when Sample Firms are Grouped on Pre-listing Illiquidity

	Quartile 1 (High Illiquidity)		Quartile 2		Quartile 3		Quartile 4 (Low Illiquidity)	
	Before	After	Before	After	Before	After	Before	After
Short-run (one-month)								
Mean	9.64	14.09	0.25	0.98	0.12	0.37	0.04	0.15
Median	0.64	1.62	0.23	0.54	0.12	0.28	0.04	0.12
Wilcoxon Test	0.062	0.009	0.0055	0.0225				
Long-run (one-year)								
Mean	19.94	6.09	0.61	1.03	0.17	0.45	0.05	0.23
Median	3.35	0.65	0.48	0.88	0.18	0.35	0.05	0. 12
Wilcoxon Test	0.0001	0.0310	0.0028	0.0090				

Table 9: Mean Values of Volume and Variance for different Quartiles of Illiquidity

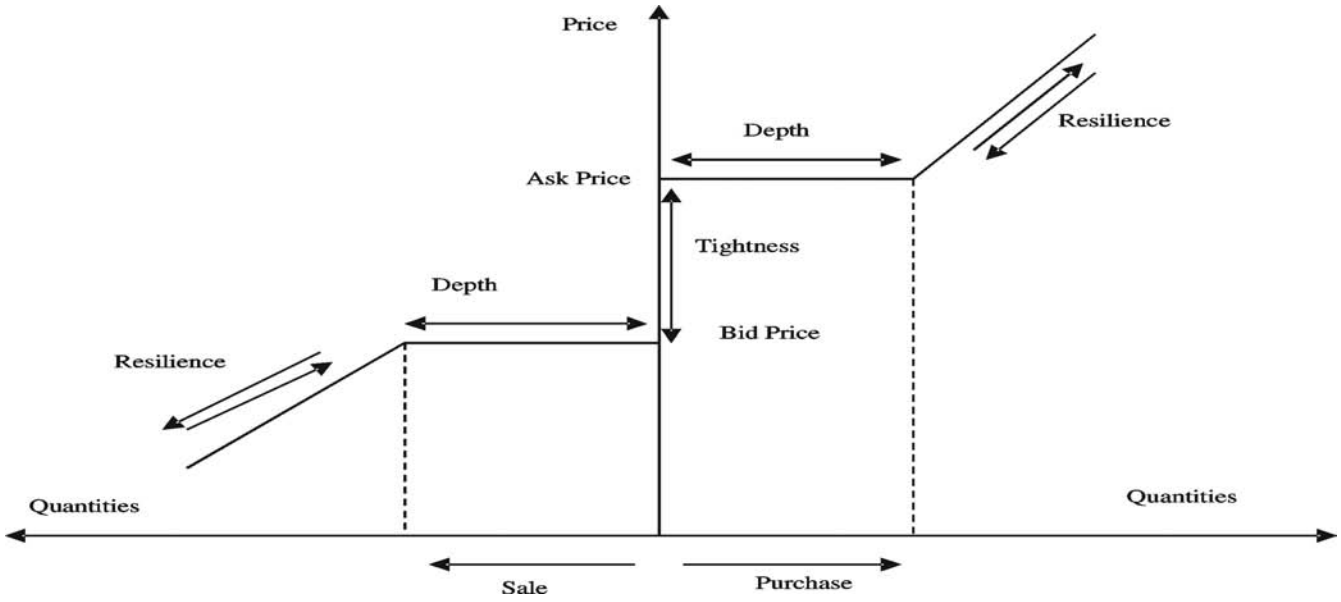
	Pre Listing			Post Listing		
	Liquidity	Volume	Variance	Liquidity	Volume	Variance
Q1 (High Illiquidity)	25.79%	1576.85	15.74	6.72%	2713.74	14.24
Q2	0.80%	1670.61	10.56	1.39%	1474.87	8.13
Q3	0.23%	5108.99	13.30	0.55%	2724.42	11.01
Q4 (Low Illiquidity)	0.06%	25639.65	15.46	0.28%	9617.43	11.78

Table 10: Relationship between Illiquidity, Volume, Variance, and Price

Independent Variables	Dependent Variable: log (Illiquidity Ratio)
Intercept	-0.0499(-0.3376)
log Trading Volume Ratio	-0.6768***(-3.4679)
log Variance Ratio	0.0248(0.0866)
log Price Ratio	-1.1200***(-3.3319)
R^2	0.55

Note: The asterisks '***' indicates statistical significance at 1% level.

Figure 1: Different Aspects of Liquidity



Source: Bervas, 2006

Figure 2: Illiquidity of All BSE Listed Stocks and BSE-500 Index (2001-03)

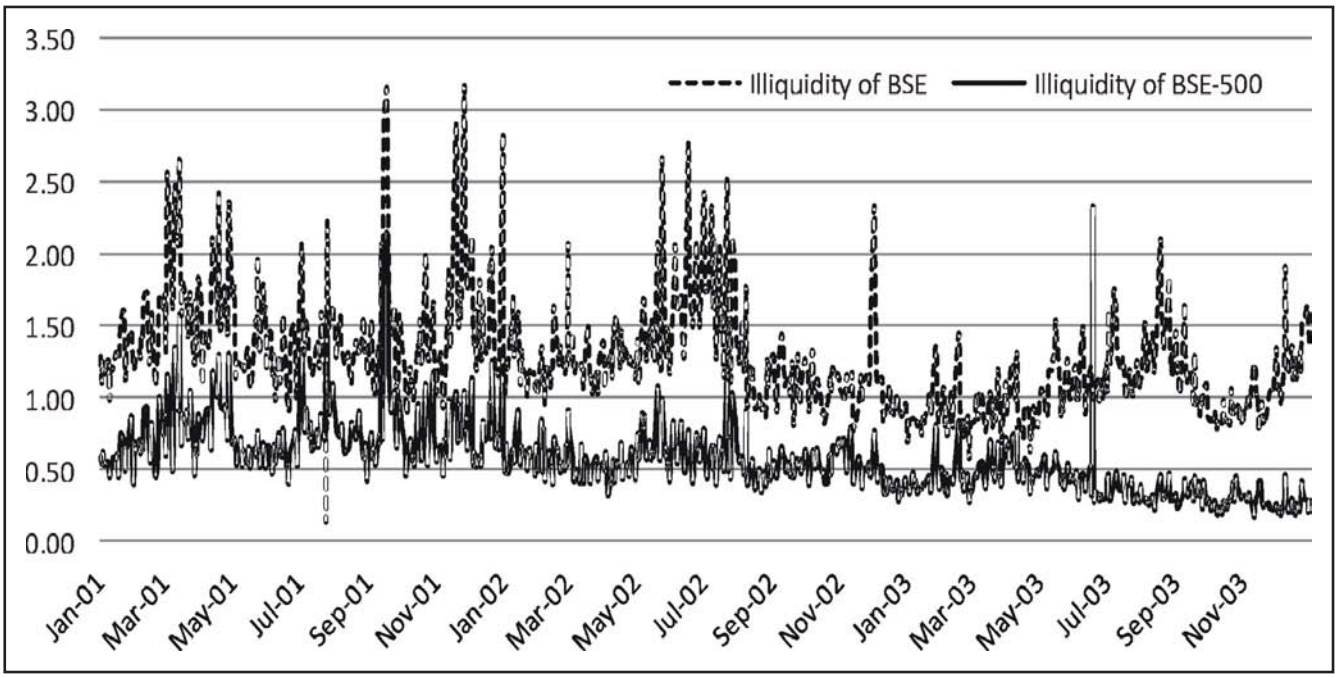
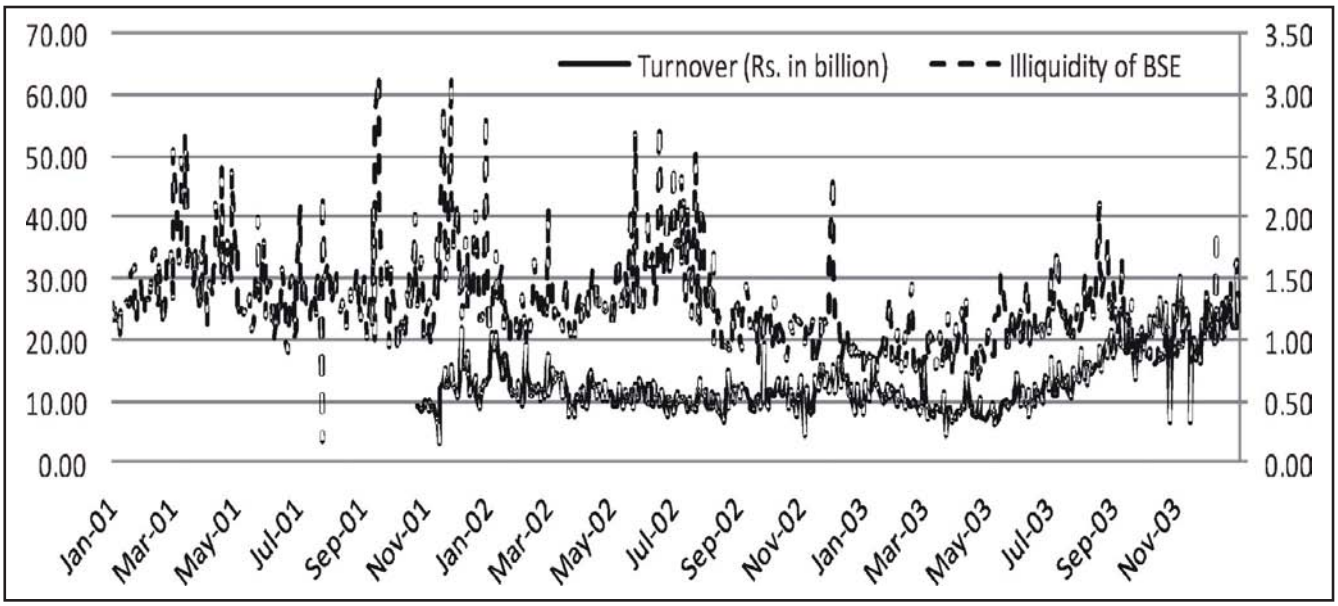


Figure 3: Turnover and Illiquidity of BSE Listed Stocks (2001-03)



Appendix 1: Illiquidity of Sample Stocks during Pre-listing and Post-listing Period

Stock Name	Listing Date	Pre-listing Liquidity (%)		Post-listing Liquidity (%)	
		Absolute	Standardized	Absolute	Standardized
A C C	2-Jul-01	0.10	0.07	0.21	0.15
Aftek	10-Jan-03	0.10	0.08	2.05	1.86
Ambuja Cements	2-Jul-01	0.40	0.27	1.27	0.88
Andhra Bank	29-Aug-03	4.73	4.50	1.49	1.44
Arvind	26-Sep-03	3.58	3.35	0.67	0.65
Bank of Baroda	29-Aug-03	4.31	4.10	0.25	0.24
Bank of India	29-Aug-03	4.93	4.69	0.74	0.71
BEL	31-Jan-03	1.41	1.09	1.28	1.19
BHEL	2-Jul-01	0.35	0.24	0.53	0.37
BPCL	2-Jul-01	1.24	0.85	1.54	1.07
Canara Bank	29-Aug-03	0.23	0.21	0.22	0.22
Cipla	2-Jul-01	0.22	0.15	0.27	0.19
Dr. Reddy'S Lab	2-Jul-01	0.17	0.12	0.13	0.09
Flextronics Software	10-Jan-03	0.55	0.41	0.45	0.41
G A I L (India)	26-Sep-03	2.33	2.18	0.10	0.10
G T L	10-Jan-03	0.14	0.10	1.06	0.96
Geometric	10-Jan-03	0.29	0.22	0.62	0.56
Grasim Industries	2-Jul-01	0.38	0.26	0.62	0.43
H C L Technologies	31-Jan-03	0.24	0.18	0.33	0.30
Hero Honda Motors	31-Jan-03	0.62	0.48	0.32	0.30
Digital Globalsoft	2-Jul-01	0.07	0.05	0.05	0.03
Himachal Futuristic	10-Jan-03	0.25	0.19	0.98	0.89
Hindalco Industries	2-Jul-01	0.44	0.30	1.68	1.17
Hinduja Ventures	10-Jan-03	2.20	1.65	0.42	0.38
HPCL	2-Jul-01	0.69	0.48	0.93	0.65
Hindustan Unilever	2-Jul-01	0.07	0.05	0.12	0.08
HDFC	2-Jul-01	0.48	0.33	0.87	0.61
I C I C I Bank	2-Jul-01	1.47	1.01	3.58	2.49
I T C	2-Jul-01	0.04	0.03	0.10	0.07
Indian Oil Corpn.	26-Sep-03	2.46	2.30	0.22	0.21
IPCL	31-Jan-03	0.67	0.51	0.50	0.46
Infosys Technologies	2-Jul-01	0.01	0.01	0.02	0.02
K P I T Cummins	10-Jan-03	36.12	27.17	2.36	2.14
L&T	2-Jul-01	0.06	0.04	0.17	0.12
MTNL	2-Jul-01	0.10	0.07	0.50	0.35
Mahindra & Mahindra	2-Jul-01	0.45	0.31	1.82	1.26
Mastek	31-Jan-03	0.08	0.07	0.16	0.15
N I I T	31-Jan-03	0.13	0.10	0.28	0.26
National Aluminium	31-Jan-03	4.14	3.20	1.16	1.08
ONGC	31-Jan-03	3.28	2.53	0.27	0.25
Oracle Financial Services	30-May-03	1.18	1.07	0.82	0.73
Oriental Bank	29-Aug-03	14.71	13.99	0.26	0.25
Polaris Software Lab	31-Jan-03	0.06	0.05	0.23	0.21
Punjab National Bank	29-Aug-03	4.70	4.48	0.17	0.17
Ranbaxy Laboratories	2-Jul-01	0.12	0.08	0.10	0.07

Stock Name	Listing Date	Pre-listing Liquidity (%)		Post-listing Liquidity (%)	
		Absolute	Standardized	Absolute	Standardized
Reliance Industries	2-Jul-01	0.01	0.01	0.04	0.03
Reliance Infrastructure	2-Jul-01	0.51	0.35	2.93	2.04
Rolta India	10-Jan-03	0.33	0.25	1.36	1.23
Satyam Computer Service	2-Jul-01	0.01	0.01	0.03	0.02
Shipping Corpn. of India	31-Jan-03	2.38	1.84	0.95	0.89
State Bank of India	2-Jul-01	0.12	0.09	0.41	0.29
Tata Motors	2-Jul-01	0.34	0.24	0.80	0.56
Tata Power Co.	2-Jul-01	2.77	1.91	1.04	0.72
Tata Steel	2-Jul-01	0.14	0.10	0.51	0.35
Tata Tea	2-Jul-01	0.42	0.29	2.06	1.43
Union Bank of India	29-Aug-03	1.43	1.36	0.75	0.73
United Phosphorus	10-Jan-03	294.15	221.24	90.70	82.15
Visualsoft Technologies	10-Jan-03	0.10	0.08	0.25	0.22
Wipro	31-Jan-03	0.05	0.04	0.08	0.08
Zee Entertainment	10-Jan-03	0.07	0.05	0.15	0.13

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M S Narasimhan is currently Professor in the Finance and Control Area of Indian Institute of Management Bangalore. His areas of interest include financial and management accounting and control systems, corporate finance, capital markets and risk management. He holds a Ph.D from University of Madras and is also a member of the Institute of Cost and Works Accountant of India. In addition to teaching for postgraduate and doctoral programmes, he is also actively involved in designing and conducting senior management executive education programmes at IIMB.

e-mail: msn@iimb.ernet.in

Shalu Kalra is Assistant Professor at School of Management and Entrepreneurship, Shiv Nadar University. She started her career in securities' market and has also taught at various management schools before joining Shiv Nadar University. She has done her Fellow Programme in Management from Indian Institute of Management Bangalore and Masters in Management from Indian Institute of Technology, Roorkee. Her research interest includes asset pricing and valuation, systematic market liquidity, and capital markets.

e-mail: shalu.kalra@gmail.com