Chapter- 2

Review of Relevant Literature

2.1 Introduction

The effect of changes in market microstructure on stock market has been studied extensively across the world. Interest in market microstructure stems from rapid structural, technological and regulatory changes which has affected the security trading industry all over the world. Substantial increase in trading volume, competition between exchanges, regulatory changes, adoption of new technologies, internet, introduction of new financial instruments are some of the major events that took place in security trading industry. Stock market crash of 1987 and increased availability of high frequency data since 1990’s also increased the interest in this area. Earlier studies have examined the impact of structural changes on volatility, liquidity, market efficiency, relationship between spot and derivatives markets etc. Since reforms are expected to improve market quality, researchers engaged in exploring implications of such reforms on market quality through various dimensions. However, a general consensus does not exist on implications of reforms on market quality. As a background to the present study, an attempt is made to review relevant literature in this chapter. The review is organized into five sections. The first four sections cover security speed of adjustment, incorporation of private information, liquidity effects, and transaction cost measurement respectively. The last section gives the concluding remarks regarding the overall review of literature.
2.2 Market Microstructure and Security Speed of Adjustment

Based on the price adjustment model given by Amihud and Mendelson (1987), Damodaran (1993) developed an estimator for price adjustment coefficients based on the information contained in return processes. This measure was applied to listed firms on NYSE, AMEX, and over the counter markets. The speed with which stock prices adjust to information has been regarded as a measure of market efficiency. Empirical results confirmed a lagged adjustment to new information. The price adjustment coefficients were significantly less than one for return intervals up to five days. Delayed price adjustment led to positive autocorrelation in the return series. This finding was consistent with Roll (1984) findings, which showed positive autocorrelation at shorter differencing intervals and negative autocorrelation at longer differencing intervals. This study also found overreaction at longer differencing intervals since price adjustment coefficients were significantly greater than one.

A correction was proposed by Brisley and Theobald (1996) for an error in the estimator developed by Damodaran (1993). Empirical results had shown that, the magnitude of error difference was greater at shorter differencing intervals than at longer differencing intervals. Damodaran’s (1993) estimator resulted in overestimation of price adjustment coefficient by about 18.4 percent at two day differencing interval and declined to below one percent at longer differencing intervals. It was shown that, Damodaran (1993) estimator of price adjustment coefficient was biased towards one. But, this correction did not change the conclusion of Damodaran (1993) study. Price adjustment coefficients
were less than one at shorter differencing intervals and moves towards one at longer differencing intervals.

While investigating the intertemporal adjustments across stock index futures and cash market, Theobald and Yallup (1998) proposed an estimator of speed of adjustment. Partial adjustment factors were estimated from cross-covariance of returns in cash and futures markets. Estimators were adjusted for non-synchronicities. This study used a sample of UK stock index futures and underlying index data. Empirical results showed that, partial adjustments were fuller at futures markets than cash markets. After adjusting for non synchronicities this phenomenon was reduced. This result was also compared with Damodaran (1993) estimator. It was found that, Damodaran (1993) estimator’s performance was poor at shorter differencing intervals.

Fama (1998) examined market efficiency with reference to long term return anomalies and behavioral finance. This study argued that, return anomalies were chance results and overreaction of stock prices to information was as common as underreaction. Evidences of abnormal returns before an event and following the event was as common as reversal following the event. Long term return anomalies can be due to methodology used for the study and such evidence of abnormal returns tends to disappear with changes in methodology. This study finally concluded that, the evidence of long term return anomaly does not suggest abandoning the market efficiency concept.

Based on investor psychology, Daniel et al. (1998) attempted to propose a theory of security market underreaction and overreaction. The theory was based on investor over
confidence and biased self attribution. An over confident investor is defined as those who over estimate the precession of their private information signals above the information signals received by general public. This study found that, when over confident investor over weigh the private signal than the public signal leads to stock price overreaction. As public information arrives, price moves closer to full information value. So this study argues that stock prices overreact to private information signals and underreact to public information signals. As far as biased self attribution is concerned, when investors receive confirming public information, their confidence rises but disconfirming news may cause fall in the confidence to a lesser extent. It shows even the arrival of public information can lead to overreaction but such momentum will decline as more and more public information arrives and bring price to the equilibrium level. So, biased self attribution can lead to short run momentum and long term reversals in security prices. These findings are in sharp contrast to earlier studies which attributed positive return autocorrelation to underreaction to new information and negative autocorrelation to overreaction to new information.

A parsimonious model of investor sentiment was proposed by Barberis et al. (1998) to explain underreaction of stock prices to news like earnings announcements and overreaction to series of good or bad news. This evidence presents a challenge to market efficiency theory because a superior investor can take advantage of underreaction and overreaction without bearing any additional risk. This study claims that, people tend to pay too much attention to strength of evidence and too little attention to the statistical weight of the news. It assumes that, corporate announcements about earnings information
are of low strength but more statistical weight. This leads to underreaction of prices to earnings information and similar news. A series of good earnings announcements which is news of consistent pattern has more strength but less weight. It leads to overreaction of stock prices to consistent pattern of news. This study has claimed that, their assumptions regarding the strength of news and its statistical weight are reasonable and empirically measurable.

Unified behavioral model was proposed to explain underreaction and overreaction of prices in asset markets by Hong and Stein (1999). The model includes two types of agents; news watchers and momentum traders. Bounded rationality on the part of both agents is assumed, which means each agent is able to process only some subset of publicly available information. Based on privately observed price signals, news watchers forecast future prices but it is not based on the current or past prices. It means news watchers fail to extract other news watchers information revealed through price. Momentum traders make forecasts about future prices based on past price changes. But they do not observe news. If information disseminates gradually across traders, prices tends to underreact in the short run. When there is underreaction, it provides an opportunity to momentum traders to profit by following past trends. Since their strategy depends only on historic prices, it leads to overreaction in the long run. So gradual diffusion of news about fundamental value is primarily responsible for both underreaction and overreaction.

provided evidence for the profitability of momentum strategies using data from 1965 to 1989. Their study in 2001 has further shown evidence for profitability of momentum strategies in 1990’s as well, indicating that results were not data biased. Behavioral models argued that momentum strategies profits were entirely due to bias in the way in which investors interpret information. Delayed overreaction to information pushes the profits of winners above their long term values and that of losers below it. In subsequent periods, stock prices return to their fundamental values and returns of losers exceeds the returns of winners. But others argued that, momentum profits are more due to cross sectional variation in expected returns than any predictable time series pattern. The empirical findings of the entire sample period from 1965 to 1998 of the study published in 2001, showed significant positive returns for first 12 months following formation of a portfolio whereas cumulative returns from 13 to 60 months, returns were negative. This was consistent with the behavioral theories. But return reversals were strong for small firms whereas weak for large firms and return reversal was strong during 1965 to 1982, whereas weaker during 1982 to 1998. This study concluded that behavioral models provide only partial explanation to the profitability of momentum strategies.

The impact of stock market structure on the speed with which new information is incorporated into prices was examined in a study by Maulis and Shivakumar (2002). This study compared the speed of adjustment on NYSE, AMEX and NASDAQ for seasoned equity offering, and showed that, the speed of adjustment was quicker on NASDAQ than NYSE and AMEX for seasoned stock offering announcements. Price adjustment was nearly one hour faster on NASDAQ than NYSE and AMEX. After controlling for
sampling differences, it strengthened the speed advantage of NASDAQ. NYSE and AMEX stocks recorded lower spreads, higher equity capitalization, and greater trading activity. But in spite of all these advantages, NYSE and AMEX had a lesser speed of adjustment over NASDAQ. Based on these findings, this study concluded that differences in the market structure can significantly affect the security speed of adjustment to news.

Productive efficiency of stock exchanges in India was measured by Marisetty (2003) based on price adjustment coefficients. His study covered the individual stocks listed on Bombay Stock Exchange (BSE) and National Stock Exchange (NSE) and their respective indices also. His results confirmed overreaction on both exchanges and overreaction varied from firm to firm. Overreaction in prices gradually reduced with time and full adjustment occurred around 19th day of information arrival. But this study did not find difference in speed of adjustment based on the market capitalization of firms. With reference to indices, it fully adjusted to information on the day of arrival of information itself. It indicates that, firm specific information is being absorbed faster than the company specific information.

As a solution to the various limitations of earlier estimators, Theobald and Yallup (2004) developed two measures for determining security speed of adjustment coefficients. Framework for these measures was provided by Amihud and Mendelson (1987) partial adjustment model with noise. The measures of speed of adjustment coefficients developed in this study are functions of autocorrelations in stock returns, since underreactions and overreactions in prices induce autocorrelations in the return series.
Based on this insight, autocovariance ratio and ARMA estimators were proposed in this study. Empirical results confirmed significant underreactions at shorter differencing intervals since speed of adjustment coefficients were significantly less than one. But speed of adjustment was higher than the results found in Damodaran’s (1993) study. Theobald and Yallup (2004) results showed that speeds of adjustment increased with increase in differencing intervals and at longer differencing intervals significant overreactions were recorded in a few cases. Comparison of speed of adjustment coefficients between large and small capitalization stocks have shown that, the former had higher speed of adjustment than the latter. Even after adjusting for thin trading effects, large market capitalization stocks had higher speed of adjustment than low market capitalization stocks but speed of adjustment coefficients increased for small market capitalization stocks and speed of adjustment difference between large and small market capitalization stocks reduced.

With regard to Indian stock markets, Poshakwale and Theobald (2004) examined the lead- lag relationship between large and small market capitalization stocks by using data of four stock market indices, two each from Bombay Stock Exchange (BSE) and National Stock Exchange of India (NSE). Empirical results confirmed that lead- lag relationship in returns exists between large and small market capitalization stocks and it was derived from differences in the speed of adjustment. Indices of large market capitalization stocks found to have higher speeds of adjustment coefficients than small market capitalization stocks indices. Thin trading effects further led to the differences in the speed adjustment and lead- lag relation between large and small market capitalization stocks. Speed of
adjustment of security prices have shown underreaction in the beginning and overreaction in later time period and the result was more pronounced for small capitalization stocks indices. This study concluded that, while assessing the lead-lag relationship, it is important to consider both thin trading and differential speed of adjustment for large and small capitalization stocks.

The impact of stock ownership by foreign and domestic institutional investors on speed of adjustment was explored by Park and Chung (2007). Their empirical findings have shown that the speed of adjustment was higher for stocks with high foreign institutional investment than for stocks with low foreign institutional investment. Returns for stocks with high foreign institutional investment led the returns of stocks with low foreign institutional investment. At the same time, speed of adjustment was higher for stocks with high domestic institutional investment than for stocks with low domestic institutional investment, and the returns of the former led the latter. This confirmed foreign institutional investors advantage over domestic institutional investors and domestic institutional investors advantage over individual investors in accessing and processing new information.

From the foregoing review of select studies, it becomes clear that the stock price reaction to news is an important aspect which needs attention in the wake of rapid changes in the market microstructure.
2.3 Market Microstructure and Private Information

The relationship between liquidity and autocorrelations in individual stock returns has been examined by Avramov *et al.* (2006). They argued that predictability at higher frequencies poses a serious challenge to market efficiency hypothesis, and showed that liquidity plays an important role in understanding autocorrelation patterns in stock returns. High turnover stocks exhibited higher negative serial correlation and also low liquidity stocks had more negative serial correlations. These stocks gave highest chance for contrarian trading strategy profits.

Trading mechanisms can have a significant impact on stock returns. Such an empirical investigation was made by Amihud and Mendelson (1986). They compared the open to open and close to close returns on NYSE stocks for which there was a difference in the execution in opening and closing transactions. Opening returns had higher volatility than closing returns and opening returns had more negative and significant autocorrelations than closing returns. This study attributed such a difference in volatility and autocorrelation pattern to differences in trading mechanism for opening and closing transactions.

Stock return variances during trading and non trading hours were examined by French and Roll (1986). The study found that stock return variances were higher during exchange trading hours than non trading hours. Three factors have been identified as responsible for such a difference in volatility, i.e. arrival of public information which is frequent during a business day, arrival of private information through the trading of
informed traders during trading hours and pricing errors. The study concluded that, the arrival of private information is the major factor causing volatility difference in trading and non trading periods.

A study on stock market return volatility during overnight and intraday periods was made by Lockwood and Linn (1990). The study has showed that market volatility was higher during daytime over overnight period. Hourly intraday returns variance has shown an inverse J shaped curve i.e. highest at the open falling until early afternoon and rising as the market moves towards close. Except during the futures period, variance of open to open returns was higher than close to close returns.

The relationship between volatility and serial correlation in stock returns was examined by LeBaron (1992). The study has found that serial correlation changes overtime. The first order autocorrelations in returns were larger for periods of low volatility and smaller during higher volatility periods. This was found in both daily and weekly returns.

The effects of feedback trading on stock return autocorrelation was examined by Sentana and Wadhwani (1992) using a century daily data. The study found that when volatility was low, stock returns showed a positive autocorrelation whereas; when volatility was high stock returns followed negative autocorrelation. It also found that positive feedback trading was greater following price decline than following price rise. This study argued that when some traders follow feedback strategy, it contributed to the serial correlation in returns.
The relationship between trading volume and serial correlation in stock returns was investigated by Campbell et al. (1993). The study has found that the first order autocorrelations in daily stock returns was lower on high volume days than on low volume days in case of both stock indexes and individual stock returns.

Pattern of autocorrelation in stock returns around the non trading days was investigated by Bessembinder and Hertzel (1993). The study found that the correlation of returns between first and second day after the weekend or holiday was low and negative, which shows a reversal in prices. It also found high positive return autocorrelation on last day and after weekends and holidays.

Autocorrelation in short horizon returns was examined by Boudockh et al. (1994). This study reexamined the autocorrelation patterns in short horizon returns and observed that autocorrelations were overstated in the existing literature. It supported the market efficiency based explanation for the evidence of autocorrelation in returns. They argued that institutional factors are the likely source of the autocorrelations in stock returns.

An examination of the overnight and daytime stock returns dynamics after the market restructuring in 1986 and stock market crash of 1987 in London Stock Market was made by Maulis and Ng (1995). The study found significant changes in daytime and overnight return dynamics. The prior daytime return shocks impact on overnight volatility increased after market restructuring and declined after the crash. The impact of negative daytime return shocks on overnight return volatility declined after market restructuring and increased after market crash. The impact of positive overnight shocks declined and also
impact of positive daytime shock on daytime volatility declined after market restructuring. The impact of positive overnight shocks on daytime return volatility increased after crash.

Trading by institutional investors can be a factor contributing to serial correlation in daily returns. Such a hypothesis was proposed by Sias and Starks (1997). Their empirical results revealed that for NYSE portfolio and individual security daily returns, autocorrelations were an increasing function of the level of institutional ownership. This finding is consistent with an earlier finding that institutional investors have access to more information and such stocks having higher speeds of adjustment.

Volatility and serial correlation difference in opening and closing returns was examined by Steeley (2005) for the FT-30 components listed in London Stock Exchange. The evidences showed a higher volatility and negative serial correlation in opening returns whereas lesser volatility and positive autocorrelation in closing returns. This study argued that volatility differences in opening and closing returns cannot be attributed to difference in trading mechanism since stocks included in this study have been traded using same trading mechanism. Further, speed of adjustment of stock prices to new information were estimated for both opening and closing returns and found that opening returns had a tendency towards overreaction whereas closing returns had a tendency towards underreaction.

The implications of the presence of serial correlation in security prices for market efficiency and trading strategies have been examined by McKenzie and Kim (2007). The
study focused on the relationship between volatility and autocorrelation and also the
determinants of autocorrelation in general. Empirical evidences showed a negative
relationship between volatility and autocorrelation.

The behavior of open-close and close-open return variance ratio and return
autocorrelation were examined by Chordia et al. (2008). The study found higher open-
close variance than close-open return variance in all three tick size regimes. The first
order autocorrelation of daily returns has decreased over three tick size regimes. Based on
these findings, they argued that higher open-close variance is an indication of increased
incorporation private information in prices. Decrease in autocorrelation in returns was
seen as decrease in return predictability and miss pricing.

2.4 Market Microstructure and Market Liquidity

Liquidity effects of the introduction of index futures have been examined by Jegadeesh
and Subrahmanyam (1993) based on event study methodology. They estimated the bid-
ask spreads around the introduction of S&P 500 index futures contracts. After controlling
for determinants of spreads, empirical results have shown a significant increase in
average spreads i.e. deterioration in liquidity during the post futures period.

Differences in trading mechanisms and market organization can have an impact on
liquidity. One such study was undertaken by Graves et al. (1994), who examined the
impact of differences in market organization on bid-ask spreads. They compared the bid-
ask spreads for NYSE and AMEX with NASDAQ and National Market System (NMS)
stocks. Empirical results have shown that the order processing component of the spread was lower for NYSE and AMEX stocks than for NASDAQ and NMS stocks. The inventory cost component which is measured as a percentage of quoted spread was statistically significantly higher for NYSE and AMEX but the difference was insignificant when it was measured as a fraction of price. NASDAQ and NMS stocks had statistically significantly lower adverse selection component than NYSE and AMEX stocks.

Another study regarding liquidity difference in different market structures was done by Huang and Stoll (1996). They have attempted to explain differences in execution cost for dealer and auction markets by comparing NASDAQ and NYSE. Execution cost is defined as the cost to a trader of selling and buying of stocks. They found that, cost of execution was higher in NASDAQ than NYSE by every measure used in the analysis. Quoted spread, effective spread, realized spread, Roll (1984) implied spread and perfect foresight spread measures has been used in this analysis. Authors examined various possible explanations for such difference in two markets. They examined impact of factors like size of the listed stocks, frequency of trading, trading inside the spread, adverse information, market depths and inventory costs, changes in NASDAQ etc as a possible explanation for difference in execution cost. But none of these factors explain the higher execution costs on NADSAQ than on NYSE. Finally authors concluded that, spreads are too high on NASDAQ because there is little incentive to reduce them.

Bessembinder (1997) analyzed the relation between trade execution costs and price rounding practices for NYSE and NASDAQ listed firms. For both NASDAQ and NYSE
both quoted and effective bid-ask spreads were wider for stocks with more frequent rounding of prices and quotations. The relationships between bid-ask spreads and rounding frequencies was stronger for NASDAQ than NYSE. This study found a strong positive relation between execution costs and price rounding frequencies for NASDAQ issues but not for NYSE issues. These findings shows price rounding conventions led to higher execution costs in NASDAQ than NYSE.

An empirical examination of the benefits of multiple trading locations to investors was done by Bessembinder and Kaufman (1997). Stocks listed on NYSE are also traded in five domestic regional stock exchanges. Comparison of average trading costs by exchanges, quoted half spreads were substantially narrower on NYSE than regional exchanges, NSAD and Cincinnati exchange in all categories i.e. small, medium, large stocks and average of all stocks. In terms of effective spreads, lowest effective half spreads was recorded on Cincinnati exchange. When sample was divided in terms of trade size and firm size effective half spreads was almost similar between NYSE and Cincinnati exchange and NYSE had lower spreads in comparison with NSAD and regional exchanges. The price impact of all trades executed at NYSE was significantly higher than all other exchanges which implied that, on an average each NYSE trade moves the subsequent price more than any other exchanges considered in this study. Realized half spreads, which measures price reversals after trade, was significantly lower on NYSE in all firm size and trade size groups.

Entry and exit of market makers and its determinants was analyzed by Wahal (1997). This study on NASDAQ has found that number of market makers is closely related to the
level of trading activity (volume and number of trades), risk (volatility), and price charged for providing service (bid-ask spreads). Increase in trading volume attracts entry and number of shares traded was also positively related entry. Risk can decrease the number of dealers and spreads was positively related with entry. Entry was more likely in securities with larger spreads. End of the trading day quoted spreads decrease following entry. Spreads changes were larger for issues with few market makers and for securities with more market makers also recorded significant changes in spreads. There was no significant change in both volume and number of shares traded following independent entry. But significant decline in both volume and number of shares traded following exit of market makers. Independent entry was associated with decline in the sum of squared returns and exit is associated with increase in volatility.

There were a series of studies in the 1990’s regarding avoidance of odd eight quotes by NASDAQ dealers. Christie and Schultz (1994) found that for 70 out of 100 actively traded NASDAQ securities odd eight quotes were not existed. They raised the question whether NASDAQ dealers colluded to maintain wider spreads. This study was followed by various other studies and one such study was made by Barclay (1997). Bid-ask spreads were higher on NASDAQ when market makers avoided odd eight quotes and it declined when these securities moved to NYSE or AMEX. Large difference in effective bid-ask spreads for securities for which market makers avoided odd eight quotes and securities for which market makers used both odd and even eight quotes were almost eliminated when those securities are traded in NYSE or AMEX. When market makers started using both odd and even eight quotes, spreads were small and slightly declined
with listing in other exchanges. This study concluded that odd eight quotes were avoided as a device to increase the bid-ask spreads.

Intraday behavior of bid-ask spreads was analyzed by Abhyankar et al. (1997) on London stock exchange. They found that, average bid-ask spreads were highest at the market open, declines to a low level through the trading day and slightly widens again during the market close. Similar pattern in spreads was observed across stocks classified on liquidity basis. In other words, bid-ask spreads shows a U shaped pattern during the trading day. But trading volume is not U shaped. It showed a double humped pattern, one after the market open and another prior to the market close. Return volatility follows a U shape, highest at the open, falls rapidly to a constant and rises slightly during market close.

A series of reforms was introduced in NASDAQ after Christie and Schultz (1994) alleged the tacit collusion among NASDAQ dealers to inflate the bid-ask spreads by avoiding odd eight quotes. Barclay et al. (1999) investigated the impact of market reforms on bid-ask spreads. After reforms, quoted and effective bid-ask spreads declined and the reduction was more pronounced for stocks whose spreads were relatively wide before reforms. Similar evidence was found for small stocks also. Average trade size declined after reforms and there was sufficient depth and width in the posted quotes. On the whole reforms produced more competitive and efficient trading system.

Advancement in information and communications technology, automated trading and such other adoption of technology in trading can have an important bearing on liquidity
and trading costs. Domowitz and Steil (1999) have analyzed such an impact on trading costs based on bid-ask spreads. They used quoted and effective spreads for measuring implicit cost of trading and also considered explicit costs. Both costs were lower in electronic systems than the traditional broker system. Analysis of execution costs and commissions have shown that trading was easier in electronic trading system than traditional broker system.

Liquidity as well as trading costs can vary across exchanges. Jones and Lipson (1999) attempted to provide empirical evidences regarding debate over execution cost difference across major US stock exchanges. The execution costs for institutional trades changed a little when firms shifted exchanges and there was no significant change in total cost for any order size. An implementation cost which is measured by bid-ask spreads are relatively small for NYSE. But it will be misleading if it is concluded that transaction costs are less in NYSE because commissions are separately assessed for NYSE and AMEX trades whereas for NASDAQ it was often incorporated in spreads. So transaction cost measure should include both implementation cost as well as commissions.

The impact of market reforms which was implemented on January 1997 by Securities and Exchange Commission on the competitive structure of NASDAQ was investigated by Weston (2000). Based on the comparison of spreads components before and after market reforms found that, decline in spreads was due to either reduction in order processing costs or economic profits. It was observed that new competition arising from limit orders has reduced the NASDAQ market maker rents. It was also found that, market reforms created competitive forces which resulted in similar spreads on NASDAQ and NYSE,
though NYSE spreads were slightly smaller than on NASDAQ. These small differences may be explained by factors such as commissions which are mostly incorporated in NASDAQ spreads whereas paid explicitly on NYSE.

Most of the studies which have analyzed liquidity are around a particular event. There are very few studies which analyzed liquidity over fairly long period of time. One such analysis of liquidity for over the years was made by Chordia et al. (2001) who examined aggregate market spreads, depths, and trading activity for US stocks over 11 year period. The study has found a secular downtrend in spreads and an uptrend in depth and volume. They also found that liquidity and trading activity are highly volatile and negatively serially dependent.

Jones and Lipson (2001) analyzed the impact of reducing tick size from eights to sixteenths on execution costs by taking a sample of institutional trades on NYSE based on bid-ask spreads. Empirical findings have shown that quoted and effective spreads declined but realized execution costs for institutional trades increased after switching to sixteenths. Increases in institutional execution costs were more for those who demand liquidity more aggressively. Smaller spreads benefitted the small investors whereas institutional traders execution costs increased.

One major technical change that occurred in the security trading was shift from open outcry system to automated trading system. Venkataraman (2001) attempted to investigate the relative merits of automated and floor trading structures by comparing the trade execution costs of Paris Bourse and New York Stock Exchange (NYSE). This study
compared the execution costs of large and liquid firms across Paris Bourse and NYSE by using quoted, effective and realized bid-ask spreads. Effective spreads were significantly lower for NYSE stocks than Paris Bourse. Execution cost difference remains statistically significant even after controlling for difference in adverse selection, relative tick size etc. Author has pointed that automated trading systems may not be able to fully replicate the benefits of human intermediation on trading floors unless regulators formulate trading rules which are flexible enough to meet the requirements of different types of market participants.

Christie et al. (2002) investigated the effects of individual security trading halts and reopening procedures on prices, trading activity, and execution costs. The sample for this study includes 714 news related trading halts on NASDAQ between September 1997 and December 1998. Trading halts are classified as halts initiated prior to the open and trading halts during trading day or intraday periods. Intraday trading halts are further classified as halts reopened with 5 minute and 90 minute quotation period. For empirical exercise dollar inside spreads represents transaction costs, absolute price change and number of quote revisions for volatility, and number of trades and average trade size for volume. This study has found that, volatility and transaction costs after reopen was significantly higher for trading halts reopened with 5 minute quotation than for trading halts reopened with 90 minute quotation. Significant increase in volume and volatility was observed for trading halts reopened next morning with a 90 minute quotation period. But comparatively it was smaller than trading halts associated with 5 minute quotation period. For halts reopened with 5 minute quotation period, spreads increased from pre-
halt level after reopen and returned to pre-halt level within 10 to 15 minutes, whereas for halts with 90 minute quotation period, spreads returned to pre-halt level within 5 minutes. But the magnitude of spreads increase was more in case of halts with 5 minute quotation period than with 90 minute quotation period.

Tick size can have an important bearing on liquidity and cost of transaction in a stock market. Bessembinder (2003) compared the trade execution and market quality before and after change to decimal pricing system on NYSE and NASDAQ. Quoted, effective and realized spreads have been used to measure trade execution cost. Significant reduction was found in quoted bid-ask spreads on both NASDAQ and NYSE and largest reduction recorded for heavily traded stocks. Trades completed outside the spread found largest reduction in execution cost than trade completed within the spread. Largest reduction in spreads has been recorded for large capitalization stocks on NASDAQ. So comparison of market quality between NYSE and NASDAQ becomes more sensitive to sample selection, measure of trade execution costs, method of averaging the results etc. On NYSE more trades and more shares received price improvement, whereas on NASDAQ more trades and fewer shares received price improvement. This study found that volume weighted average effective bid–ask spread on NASDAQ after decimalization was not statistically significantly different from pre decimalization measure as well as post decimalization NYSE measure. Small and medium market capitalization stocks had smaller spreads on NYSE than NASDAQ after decimalization. But trade execution costs computed from volume weighted averages across the sample were almost similar for both exchanges.
Ulibarri and Schatzberg (2003) attempted to assess the relative merits of screen based and open outcry trading. They estimated the liquidity costs on Chicago Board of Trade (CBOT), since it initiated parallel trading from September 28, 1998. They found that liquidity costs on screen based trading vary in relation to time and level of open outcry trading. Liquidity costs were least before opening of floor trading sessions. Once both screen based and floor trading operate side by side, intraday spreads had an inverse J shaped curve i.e. spreads were highest following opening of floor trading, declines to a low level and again increases when trading nearing the close. They also found that, average daily bid- ask spreads on screen trading was little higher than floor trading spreads. During the study period, screen trading was not a full- fledged parallel trading; instead it was just a supportive exchange. So this study concluded that empirical results of this study should not be interpreted as inefficiency of screen based trading.

Chung and Chuwonganant (2004) examined impact of tick size and order handling rules on trading costs on NASDAQ. This study has shown that, the effect of tick size change on spreads on NASDAQ depends on changes in order handling rules which was enacted on NASDAQ since 1997. NASDAQ stocks were divided into two groups on the basis of whether tick size change preceded or followed order handling rules change. Empirical results have shown that, tick size change had no impact on spreads of stocks for which tick size change was prior to order handling rules change, whereas, tick size reduction had a significant effect on spreads of stocks which have been subjected to new order handling rule before tick size change.
Van Ness et al. (2005) examined trading pattern and trading costs on NASDAQ during the period 1993 to 2002, which witnessed market reforms and tick size changes. They found a steady decline in spreads during the period under study and argued that reduction in spreads was not exclusively caused by either rule changes or tick size reduction. Tick size reduction was introduced when spreads were gradually declining. Significant change in trading pattern was found. The frequency of trading has increased and average trade size reduced. Authors have attributed this change to greater retail participation in stock market trading. Based on the methodology used in Chordia et al. (2001), this study analyzed the liquidity and trading activity determinants. Day of the week effect was found; Fridays having higher spreads and lower volume and Tuesdays having lowest spreads and highest volume. Macroeconomic news had little impact on spreads, but key interest changes had direct influence on trading volume and after 2000, macroeconomic changes had an impact on spreads.

Chordia et al. (2008) have examined the short horizon return predictability from order flows. They found a secular reduction in average effective bid-ask spreads over the study period from 1993 to 2002. Reduction in spreads was associated with tick size reduction from eights to sixteenths and to decimal tick size regimes. Within each tick size regime trends in spreads did not change significantly in spite of erratic fluctuations in spreads.

From the foregoing review of select studies, it becomes clear that liquidity is not a permanent feature of a financial instrument. Liquidity can change overtime and it can change even within the trading day. So it becomes important to assess the liquidity effects of changes in market microstructure.
2.5 Market Microstructure and Transaction Cost

Various approaches have been used in the market microstructure literature to assess the quality of a stock market through transaction cost measurement. Broadly we can classify these approaches into three categories, quoted bid-ask spreads, effective bid-ask spreads and dynamic models which uses transaction price, trade size etc. Brief reviews of studies which have used the last category of models have been attempted here.

A new approach to transaction cost measurement as a tool to assess quality of a security market has been proposed by Hasbrouck (1993). This method divides the transaction price into random walk component and stationary component. Random walk component is identified as efficient price and residual stationary component as pricing error, which is the difference between transaction price and efficient price. By using vector autoregressive model, standard deviation of pricing error has been estimated. Standard deviation has been regarded as a proxy for market quality based on the assumption when trade barriers are reduced; actual transaction prices closely follow efficient prices.

Comparison of the execution costs on NASDAQ and NYSE for institutional investors was done by Chan and Lakonishok (1997). The execution cost includes market impact cost and commissions, which is measured by evaluating all trades in the trading package against a benchmark price. Empirical findings did not support superior liquidity on NYSE over NASDAQ. Based on a regression model after controlling for firm size, trade size, costs were lower on NASDAQ for trades in relatively small firms whereas costs for trading in large firms were lower on NYSE.
Transaction cost can be different with reference to different investment styles. Such an investigation was done by Keim and Madhavan (1997), transaction costs were found to vary with investment styles and order submission strategy. Both implicit and explicit costs were considered in transaction cost estimation. The implicit cost of a buyer initiated trade is given by the ratio of volume weighted average price of the component trades in the order to the decision price whereas for seller initiated trade it is the negative of the this return. Empirical results have shown that, transaction costs were significantly lower for exchange listed stocks than for NASDAQ. In terms of investment styles, value traders had lower transaction costs than index traders and index traders had lower transaction costs than technical traders. In terms of order types, technical traders relied more on market orders which shows their demand for immediacy whereas value traders relied more on limit orders. Even within a trading strategy, cost differences were found across institutions.

Least transaction cost trading strategies for small liquidity traders in call and continuous markets have been examined by Brooks and Su (1997). Intraday transaction data of NYSE and AMEX has been used in this study. Three trading strategies have been considered: market at open order, an intraday order, and a limit order. Cost savings, defined as purchase price minus opening price for a buy strategy and opening price minus sale price for a selling strategy has been used to assess the relative merits of three strategies. Based on empirical results they proved that a small liquidity trader can significantly reduce the transaction costs by trading at the market open. Market at open consistently performed better than market order or limit order trading during the intraday
trading period. It was mainly because the opening call market brings both informed and uninformed traders together and all will get a single consensus price. For rest of the trading day, it will be a continuous market and small traders will not know about the presence of informed traders. They concluded that even though a well worked out limit order strategy may better perform than market at open trading strategy, opening price proves to be a good benchmark price for any trading strategy analysis. Opening price easily available and it is same for both buyer and seller.

Based on a general equilibrium framework Vayanos (1998) analyzed the impact of transaction costs on asset prices. This study found that price of a stock may increase in its transaction costs. Frequently traded stocks have been found to be less adversely affected by transaction cost increase. Stock prices may decrease when transaction cost of a more liquid and correlated stock decrease. It was also found that stock turnover decreases with increase in transaction cost and turnover increases with increase in the transaction costs of other stocks. Transaction costs found to have small effects on stock prices and large effects on turnover and trading strategies.

As an alternative to the most commonly used bid-ask spreads estimates Lesmond et al. (1999) advocated a new method for measuring transaction costs. The proposed model uses daily returns to endogenously estimate the effective transaction costs. It is based on a limited dependent variable specification that endogenously estimates transaction costs through the incidence of zero returns. They found that, for smallest firms nearly 80% of the daily security returns were zero and for largest firms nearly 40% daily returns were zero. The transaction cost estimates varies from 10.3% for small firms and 1.2% for large
firms during 1963 to 1990 for all listed firms of NYSE and AMEX. They found 85% correlation between the proposed model’s empirical results and more commonly used spreads based estimates of transaction costs. Transaction cost estimates given by limited variable estimates were smaller than spreads based estimates.

An attempt to provide empirical evidences regarding debate over execution cost difference across major US stock exchanges was made by Jones and Lipson (1999). Volume weighted average execution price for institutional orders in firms that switch exchanges has been used in this study. The execution costs for institutional trades changed a little when firms shifted exchanges and there was no significant change in total cost for any order size. An implementation cost which is measured by bid- ask spreads are relatively small for NYSE. But it will be misleading if it is concluded that transaction costs are less in NYSE because commissions are separately assessed for NYSE and AMEX trades whereas for NASDAQ it was often incorporated in spreads. So transaction cost measure should include both implementation cost as well as commissions.

Schultz (2000) investigated the impact of regulatory and legal pressures on cost of trading on NASDAQ which resulted because of the allegations of tacit collusion among dealers for almost complete absence of odd- eight quotes in 70 out of 100 active stocks by Christie and Schultz (1994). Trading costs were measured by Roll (1984) spreads, declined for all sample stocks and all trade sizes. Decline in trading costs remained even after adjusting for changes in volume, volatility and stock prices. This study concluded that regulatory and legal pressures had a positive impact on trading costs and benefited the investors.
An examination by Domowitz et al. (2001) has shown the interaction between cost, liquidity and volatility. The study is based on the panel data for 42 countries. They considered both explicit cost (commission and fees) and implicit cost in total cost estimation. Implicit cost was measured by taking the deviation of transaction price from unperturbed price that would have prevailed if the trade had not occurred. Empirical results have shown wide variation in transaction cost across countries and emerging markets have shown significantly higher costs even after controlling for factors which affect the trading costs. They also found that higher volatility passing through trading costs reduces portfolio’s expected return and turnover had negative relation with trading costs.

Transaction cost estimates are sensitive to the methodology used. Bessembinder (2003) analyzed the certain methodological issues relating to measurement of trade execution costs. Trade execution costs were sensitive to the time adjustment made before comparing trades to quotes and method adopted to classify trades as buyer or seller initiated trades. Empirical findings have shown that effective spreads estimates vary with time lag with which trades are compared with quotes and variation was statistically significant. But inferences regarding within and cross market comparisons between NASDAQ and NYSE did not change. In contrast realized spread estimates were not sensitive to the adjustment for trade reporting lags. Trade execution cost estimates obtained using trade direction assigned by Lee and Ready (1991) and Ellis et al. (2000) algorithms. Effective spreads estimated using Ellis et al. (2000) algorithm was less than Lee and Ready (1991) algorithm. Once again inferences regarding cross market
comparisons between NYSE and NASDAQ were largely same. NYSE had smaller effective spreads than NASDAQ under both methods.

Peterson and Sirri (2003) evaluated the bias in the estimation of trade execution cost using trade and quote data. They found that, trade execution cost estimated by using effective spreads from trade and quote data overestimated the trading costs by 17%. Bias was highest for small trades and trades by large firms. It was attributed to the bias in assigning trade direction and benchmark quote. Accuracy of trade direction algorithms of Lee and Ready (1991) and Ellis et al. (2000) was tested. Empirical results confirmed that both algorithms are similar and accuracy improves when lags with which trades are compared with quotes decreased. It was found that, bias was less for relative effective spreads estimates than effective spread estimates.

An examination of the impact of tick size reduction from sixteenths to penny on institutional trading costs on NYSE was conducted by Chakravarty et al. (2005). Implementation shortfall approach has been used to measure price impact. Implementation shortfall is measured as weighted average execution price for each order from price at close on the day prior to the decision. They found that, overall trading costs declined after switchover from sixteenths to penny ticks. Trading costs slightly increased for orders executed within the trading day whereas trading costs declined for orders executed over the trading days. Trading costs declined for those had smallest pre-decimal spreads whereas costs increased for stocks with largest pre decimal spreads. They also found that trading costs declined for more patient institutional investors than those who demand immediacy.
A study by Gehrig and Fohlin (2006) attempted to investigate trading costs on Berlin Stock Exchange for period between 1880-1910. Using Roll’s (1984) implicit spreads measure and transaction cost estimator advocated by Lesmond et al. (1999), implicit effective spreads and transaction costs has been estimated. These transaction costs results are compared with transaction costs of German markets during 1990-2000. The overall trading costs fell from 1.16% in 1880 to 0.45% in 1910. Trading cost decline from decade to decade was statistically significant. While comparing the transaction cost values during 1880-1910 period with modern German markets, it was found that, with exception of estimates for 1880, rest of the transaction cost values fall in between transaction values of German DAX-30 and MDAX. Authors have argued that, advances in technology have done little for reducing transaction costs of security trading.

Jang et al. (2007) attempted to contradict some of the earlier works which concluded that transaction costs have only second order effect on liquidity premium even though these transaction cost affect investment strategies significantly. This study argued that such a conclusion depends on the assumption of constant investment opportunity set. Based on a stochastic regime switching model with transaction cost, they have shown that transaction costs can have a first order effect on liquidity premium and can be important for asset pricing in case of stochastic investment opportunity set.

2.6 Concluding Remarks

From the foregoing review of select studies, it becomes clear that changes in market microstructure can have a significant impact on market quality. There is also lack of
consensus regarding the outcome of similar events in different markets. Different criterions were used to examine market quality. Regarding Indian securities markets there are very few studies which assessed the impact of changes in the market microstructure on market quality. From the review of literature this study selected four criteria viz. speed of adjustment, private information, liquidity, and transaction cost to assess the impact of changes in market microstructure on market quality over the years.