CHAPTER II

MARKET MICROSTRUCTURE

A THEORITICAL FRAMEWORK

2.1 INTRODUCTION

In this chapter an attempt is made to provide information about market microstructure and the issues related microstructure at the National Stock Exchange of India. This chapter defines market microstructure, the concept, how market prices are formed and what factors influence market microstructure.

2.2 DEFINITION OF MARKET MICROSTRUCTURE

Market microstructure deals with the purest form of financial intermediation—the trading of financial assets. In a trading market (the stock exchange), assets are not transformed from one instrument to the other, as in the case of banks and financial institutions, where deposits are converted into loans. Instead, they are merely transferred from one investor to another investor. Market microstructure, the branch of finance studies how the actual markets behave and how the realities are different from the behavior of perfectly efficient markets. Investors are involved in three different markets—the market for information, the market for securities and the market for transaction services. Market microstructure deals with market for transaction services. This type deals with the transaction by investors—the price that is fixed for buying and the price fixed for selling. A trader acts in a transaction service by placing a market order to trade at the best available prices—the bid price if selling or the ask price if buying. These prices are called the bid price and the ask price. The market for security deals with the determination of security prices and the market for information deal with the supply and demand of information.

The basic function of a market is to bring the buyers and the sellers together. A market is characterized by heterogeneous traders with complex interactions and gives particular emphasis to microeconomic factors governing markets. This behavior of investors is the crucial issue of working of the stock markets and it affects the important variables like volume of trades, price, volatility, and degree of liquidity. A matching of demand and supply
of shares which include price and volume from relatively small investors reflect the short run behavior of the market. Thus market equilibrium is determined by investor’s trading strategies, which depend on individual’s information, desire for liquidity and perception about the trading environment. So market microstructure is a study on the trading arrangements, the rules governing the trading procedures, how they are affected by the organization and the structure of the market – what can be traded, who can trade, when and how the trading takes place, what types of orders are submitted, who can handle orders and how prices are set. Market microstructure is essentially the study of the short run behavior of the market. It is the discipline that studies how securities prices are determined under different market mechanism.

The metric of the primary focus of market microstructure is the bid ask spread for stocks. The magnitude of the spread is an important decision variable that an investor considers in trading venue as well as the stock to buy or sell. The bid ask spread depends on a number of factors including the volume of trading, proportion of information based trading, the pricing grid (tick size) and share prices. Market participants care about bid ask spread because it affects trading costs, return on securities, and information efficiency of asset price. Bid ask spread focuses on the market events. The complete record of order submission, cancellation and execution events refers to market events. Cancellation of events also matters as they carry information for predicting future market activity and liquidity supply. If it is anticipated that liquidity is large, liquidity traders trade intensively and the spread is light. If low liquidity is expected, uninformed trading is reduced, the proportion of informed trading is large and spread is wide.

2.3 DEVELOPMENT OF MARKET MICROSTRUCTURE

Stock exchange, the place where securities are traded, is an important intermediary in the capital market which provides an organized market place for transparent price discovery. At the National Stock Exchange, trading members use an electronic trading platform, to trade in securities either on their behalf or on behalf of others. In India, there are two major stock exchanges and 21 regional exchanges. The stock markets exhibit diversity and a few securities are traded on different markets settings and with different procedures. The stock exchanges are governed by the regulatory authorities, who constantly monitor the stock markets to
control negative influences. Market performances and the observed statistical regularities are conditional on specific institutional setup and individual characteristics.

The efficiency of stock exchanges lies in providing liquidity of securities. It depends on the trading strategies of investors. The need for liquidity, the trading environment of liquidity, market’s valuation of a security all forms the trading strategy. In a liquid market, economic agents are able to buy or sell an unlimited amount of the security with immediacy and at a price very close to the last traded price. Alternatively, an illiquid market is one where economic agents transact at a price different from the last traded price and transact large volumes only over an extended time period. Liquidity is the ability to accommodate large orders with minimum price impact and market stability. It also indicates the speed in absorbing external shock without much fluctuation in price. Various market liquidity indicators do not necessarily move in the same direction. Market liquidity exists when market participants evaluate the prices of products and manage their portfolios. Therefore the maintenance of sufficient liquidity under normal conditions will automatically improve market stability by expanding the market boundaries and improving the participants’ confidence on market sustainability. A decline in liquidity premium like the bid ask spread and market impact improve market efficiency resulting in efficient fund and risk allocation. Therefore the maintenance of sufficient liquidity under normal conditions will automatically improve market stability by expanding the market boundaries and improving the participants’ confidence on market sustainability.

Liquidity recognizes by how low uncertainties of the execution prices are. Market liquidity is an important factor which affects market efficiency. It is considered as one of the factors affecting price discovery function. It can be regarded as a factor which affects market pricing uncertainties - in the sense that market prices do not reveal all available information or the market price temporarily diverge from the market clearing equilibrium price – or price discovery function, and will as a result, affect market efficiency. Liquidity is measured in three dimensions. They are price, volume and time. It deals with the price that the security is bought and sold for a given quantity at a given time.

Kyle (1985)\(^1\) in one of his articles links market microstructure with liquidity. He explains liquidity in three dimensions namely, tightness, depth and resiliency. When market liquidity is discussed in market microstructure theory, more practical concepts are introduced,
such as ‘cost of changing position’ (tightness), trade size or thickness of the order book profit, (order book refers to a panel which provides trades with bid ask prices and volume offered per price) required for changing prices (market depth) and the required period of time to recover from price fluctuations caused by a sudden shock or to reach a new equilibrium (market resiliency). Along with these three dimensions, a fourth dimension is also introduced. So the four dimensions of liquidity are width, depth, immediacy and resiliency. Width refers to the bid ask spread and brokerage commission and other fees per share for a given number of shares. Depth refers to maximum number of shares which can be traded at a given bid and ask quotes. Since it is hard to measure liquidity, the bid ask spread is the most frequent proxy as it represents the average costs of a round trip transaction of a normally traded quantity. Traditional measure of liquidity only captured the volume of transactions: number of shares traded denoted by volume, number of transactions and turnover rate. These are measured at the level of an individual stock, or at the level of the market.

The next set of measures reflected the depth of the market, being the quantity of shares available to be sold or bought in the market. Most recently, the bid ask spread is used as a measure of liquidity. It is the difference between the best buying price and best selling price. The bid ask spread is determined by taking into account the premium against price uncertainties, changes in the bid ask price at the moment of trade executions (market impact) and the period of time required to reach a new equilibrium after trade executions (market resiliency).

The liquidity component of the bid ask spread is related to the liquidity function of the market makers. When the market makers are required to provide liquidity in the security they are assigned, they take position in the security that causes their portfolio to deviate from the optimal level. In this process, they set the bid ask spread such that the increased utility from earning this spread offsets the decreased utility of deviating from the optimal portfolio.


2.4 THE PROCESS OF PRICE FORMATION

The foundation for market microstructure is the study on efficient markets, or rather, the criticisms thereof. The fundamental theories of asset pricing are Efficient Market Hypothesis (henceforth EMH), Capital Asset Pricing Model (henceforth CAPM), Arbitrage
Pricing Theory (henceforth APT) and the Optimum Portfolio Theory (henceforth OPT). The issues of these theories and the origin of market microstructure are discussed.

These theories are based on some basic assumptions. The first of these assumptions mention that there are no taxes. There are no transaction costs. When investors trade on the stock market, they assumed to trade without any cost. There are no limits on borrowing and lending at risk free rate of interest. It is assumed that when investors borrow funds, the interest charged includes only the compensation for using the funds. It is also assumed that there are no limits on short selling. Short selling is a term used to denote the selling of shares before owning them. The authors always assume of perfectly liquid markets. Perfect liquid markets are those where the investors can buy or sell any number of shares without much difference in price of the asset. It is finally assumed that investors do not want to take risk. They are risk averse in nature. The investors too have the same expectations about the future price of the share.

In reality, it is impossible to think of the mentioned conditions. Taxes have to be paid for the trading on securities. The Securities and Exchange Board of India (SEBI) calls this as the Securities Transaction Tax. Securities Transaction Tax is levied on all transactions of sale or purchase of equity and derivatives. The Security Transaction taxes during March 2010 are given in Table 2.1.

<table>
<thead>
<tr>
<th>S.No</th>
<th>Taxable securities transaction</th>
<th>Rate (%)</th>
<th>Payable by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Purchase of equity share in a company where</td>
<td>0.125</td>
<td>Purchaser</td>
</tr>
</tbody>
</table>

TABLE 2.1

Percentage of Securities Transaction Taxes during March 2010
(a) The transaction of such purchase is entered into a recognized stock exchanges and
(b) The contract for the purchase of such shares or units is settled by the actual delivery or transfer of each share or unit

Sale of an equity share in a company where
(a) the transaction of such sale is entered into a recognized stock exchange
(b) the contract for the sale is is settled by the actual delivery or transfer of such shares

<table>
<thead>
<tr>
<th></th>
<th>2</th>
<th>3</th>
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<tbody>
<tr>
<td></td>
<td>(a) The transaction of such sale is entered into a recognized stock exchange and (b) The contract for the sale of such share or unit is settled otherwise than by the actual delivery or transfer of such share</td>
<td>0.125</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.025</td>
</tr>
</tbody>
</table>

Source: NSE Fact Sheet

Trading cannot take place without payment of commissions or charges. At the NSE, two types of charges are payable. They are the Brokerage charges and Transaction charges. The maximum brokerage chargeable trading member in respect to trades in the securities admitted to dealing on the Capital Markets segment is fixed at 2.5% of the contract price. This excludes statutory levies like securities transaction tax, SEBI turnover fees, service tax, and stamp duty. The transaction charges are based on the turnover of the Stock broker (SEBI Notification). This charge is to be paid to the stock exchange. During March 2010, the following were the transaction charges to be paid by investors

**TABLE 2.2**

*Transaction charges on the total traded value*
<table>
<thead>
<tr>
<th>S.No</th>
<th>Total Traded Value in a month</th>
<th>Transaction Charges ( per Rs 1 Lakh of traded value)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Up to first Rs 1259 crores</td>
<td>Rs. 3.25 each side</td>
</tr>
<tr>
<td>2</td>
<td>More than Rs 1250 crores up to Rs 2500 crores (on incremental volume)</td>
<td>Rs. 3.20 each side</td>
</tr>
<tr>
<td>3</td>
<td>More than Rs 2500 crores up to Rs 5000 crores (on incremental value)</td>
<td>Rs 3.15 each side</td>
</tr>
<tr>
<td>4</td>
<td>More than Rs 5000 crores up to Rs 10000 crores (on incremental value)</td>
<td>Rs 3.10 each side</td>
</tr>
<tr>
<td>5</td>
<td>More than Rs 10000 crores up to Rs 15000 crores (on incremental value)</td>
<td>Rs 3.05 each side</td>
</tr>
<tr>
<td>6</td>
<td>Exceeding Rs 15000 crores. (on incremental value)</td>
<td>Rs. 3.00 each side</td>
</tr>
</tbody>
</table>

Source: NSE fact sheet.

The Reserve Bank of India has set limits on borrowing and lending. It is not possible to borrow or lend at a risk free rate for all investors. These assumptions, which are a theoretical abstraction and very simple which are not possible in real life. The remaining assumptions form the basis for the emergence of “Market Microstructure”. Market Microstructure seeks to address the issues of the remaining assumptions.

Liquidity is the central theme of this study. Liquidity exists when the investor sells or buys any number of shares without changes in the expected or the last traded price. At this price any number of shares is available to be traded. If liquidity is not present, it is called the Bid Ask spread. In a perfectly liquid market, the bid ask spread is zero. In a stock market transaction, either the sellers initiate a trade or the buyers do it. The seller initiated trade happens at the bid price or a price close to the bid price, whereas the buyer initiated trade takes place at the ask or close to the ask price. Since both the sellers and the buyers are present at the time of trade, this creates a bid-ask bounce, that is, trades happen alternatively.
at the bid and at the ask, which induces negative autocorrelation in transaction prices (uptick is more likely to follow a downtick than an uptick) and accentuates short term volatility.

The Optimum Portfolio Theory developed by Harry Markowitz (1952)\(^2\) say that risk averse investors seek to maximize returns and minimize his risk. Markowitz developed an “Efficient Frontier” representing shares or percentages of investment which has the lowest risk and the highest return. Any investment not on the efficient frontier is said to be unoptimal, which would not meet the objective of lowest risk and highest returns. Based on the information he receives about companies and if he should create a portfolio, the investors would create different “Efficient Frontiers”. The shares on the “Efficient Frontier” are the ones with lowest risk and highest returns.

One of the most important and far reaching assumptions of the CAPM is that the investors have the same expectations about the future returns. One dimension of the investors’ decision making process is how information gets reflected in securities prices. Markets are said to be efficient if it is not possible to make profits from ;

- Past prices (This is called Weak form of Efficiency).
- Publicly available information (also called Semi–strong form of efficiency)
- All available information – public or private (Strong form of efficiency).

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These statements form the Efficient Market Hypothesis. The weakest form of market efficiency postulates that future prices cannot be predicted from past prices. If successive price changes are statistically independent and identically distributed, such price process is called “Random Walk” (Fama, 1970)\(^3\). If it was possible to make profits from past prices, investors would plan their investment accordingly and would benefit for a few periods. The pattern of past prices would disappear. The Efficient Market Hypothesis tells how prices must behave in perfectly frictionless markets; any deviation from this behavior is an evidence of operational inefficiencies in the real world markets, which is precisely what this study will explore. It is not possible to follow the semi-strong form or the strong form of efficiency.
When any new information is made available, the market prices instantaneously adjust to the new information. Even the non-public information gets reflected in stock prices through anticipation and continuous financial analysis.

Since it is assumed that all investors have homogenous expectations, everyone would agree on the same price, and there will be a single price where investors can trade. So investors trade only to accommodate their risk preferences. In real world, investors have divergent expectations and they do not agree on future return distributions. This is because investors assign different weightages to the factors which affect the stock prices. Since there is no single price to trade upon, investors constantly try to fix prices. This process is called the “Price Discovery.” It is a dynamic process where traders with divergent valuations negotiate in the market place. The manifestation of this on-going process of negotiations is the short term volatility. This volatility affects the true value of the security. Prices bounce around non-stop, while new information relevant to any share arrives. So it seems impossible to have frictionless and efficient markets. There are frictions in the markets and this leads to the study of Market Microstructure.

2.5 MARKET MICROSTRUCTURE MODELS

Market microstructure focuses on the sources of price variations. Specifically, a trade might influence the two components of the price by the fact and the time of its occurrences, the price and volume and whether it is buyer initiated or seller initiated (Demsetz, 1968). Bid ask spread is also the compensation to market makers for providing liquidity. Market makers quote different prices for the bid and the ask to cover three different costs – the order processing cost, inventory control cost and the asymmetric information costs. These costs arise from traders’ desire of immediate execution of orders. In the simple bid ask spread model, the error pricing term represents the bid ask bounce, driven by the current trade (buy or sell) and is stationary random process whose increments are not trade related. Roll (1984) assumes a simple order processing costs model in which the bid ask bounce induces a negative serial correlation in price changes. The order processing costs are the basic operating costs.
costs related to the trading mechanism. One component of the bid ask price is the cost for holding unwanted inventory. The next is the cost of asymmetric information. These models are explained in the following sections.

2.5.1 Inventory model

The key factor in this model is the holding of unwanted inventory position due to lack of liquidity. The trading process is a matching problem in which the investor faces an unbalanced risk, uses the prices to balance the demand and supply across time. Market makers achieve the inventory control by shifting the quotes (bid and ask) to elicit the imbalances of buy and sell orders. The focus here is on dealer’s optimization and on the way in which they deal with price and inventory uncertainty and how market prices are set by the investors. (Calamia, (1999)\(^6\),


Garman (1976)\(^7\) and Ho and Stoll (1983)\(^8\). The general idea here focuses on the market maker with a balancing problem who moderates deviations in the order flow. The investor’s affect on price is temporary. At the end of the adjustment process, price and inventory have completely reverted. Here the revision is not immediate, but there is no permanent price impact in this model because trades are independent of information. In other words, the permanent component of price change is not trade related but it is due to public information. The market maker changes the quote midpoint (average of bid and ask quotes) and therefore the price, depending on the trading costs, on the dealer’s previous inventory position and on the net demand to the dealer. (Calamia, (1999))\(^6\).

2.5.2 Information based model

Also known as the adverse selection costs, these costs arises because some investors are better informed than the other investors about the security’s value and trading with them, the market maker would, on average, incur into a loss. Since the market maker is unable to
distinguish the uniformed traders and the informed traders, a portion of spread is the compensation for taking the other side of a potentially information based trade. Market makers quote a wider spread when there are informed traders, to compensate the losses from trading with them. This model assumes the presence of heterogeneous traders. If a trader is motivated by a superior trade, the occurrence of a trade will communicate to the market something about this private information. The trading process is viewed as a game involving traders with asymmetric information regarding the asset’s true value.

The asymmetric information component of the price reflects the public information, the market’s estimate of the information contained in the trade, and it is serially uncorrelated if and only if buy and sell orders arrive randomly. The adverse selection component has implications for transaction price dynamics, while the order processing and inventory cost component exhibit reversal and induce negative serial correlations in returns.

According to Hasbrouck, (1991)⁹, the adverse selection component has an additional impact on the means and covariance of returns that tends to be permanent and the reversion is not complete.

2.6 MODERN FINANCIAL MARKETS

2.6.1 Trading mechanisms and markets

Securities are traded on different market settings and with different procedures. The first major trading mechanism is the frequency of trading. Markets are distinguished as call auctions (batch markets), continuous auctions or dealership markets. In the former, agents submit orders during certain periods of time to a central system, which accumulates and aggregates the demand and supply schedules. Buy and sell orders accumulate during some interval and then all trades are executed simultaneously when the auction is called and at a single market price. In continuous auctions, there is a sequence of buy and sell transactions that are completed during the opening hours of a market, at different market prices. In continuous markets, trading is carried out through market makers who quote bid and ask prices at which they are willing to buy or sell. Investors, who wish to sell, trade at the bid
price established by resting buy orders. Investors, who wish to buy, trade at the asking price established by resting sell orders. National Stock Exchange is an example for continuous auction market.

A dealer market is one in which dealers post bids and offers at which the investors cannot directly trade with one another but must buy shares at the dealer ask and sell at the dealer bid. Bond market and currency markets are example of dealer markets.

The second trading mechanism is the location of trading. Markets are centralized or decentralized. Centralized markets are floor markets (open cry ) or computerized markets where the trade matching mechanism is automated and information is being electronically displayed and transmitted to all market participants (located in physical distinct offices). So all transactions are visible to all market participants and explicit trading rules are imposed and monitored to minimize transaction costs or to improve market efficiency.

The next category, called the decentralized (or over the counter) markets, accommodate multiple market makers who work in distinct locations quoting their bid and ask requirements. They are linked by telephone and/or computer and trade among themselves and with external customers.

The third important factor of trading market is the order flow. First, orders that are submitted by traders are market order or limit orders. Market orders are executed upon arrival in the market according to the priority rules given by price, time and size, while limit orders are executed contingent on the price level. Orders are contingent on time (example market – at- close orders), on quantity or on price (example stop orders, limit orders). Both types of orders are used in continuous markets. Second, markets are quote driven or order driven. On quote driven markets prices are fixed before quantities while on order driven markets, prices and quantities are set altogether.Of paramount importance is the way the orders are matched. The role of market maker is central in determining liquidity and price discovery.

Finally, other specific institutional and trading arrangements are to be considered. This includes the different trading hours, initial margins, trading unit, delivery date, last trading date and the speed at which publication must take place. All these features influence the price determination process. Most theoretical and empirical research on market microstructure deals with the comparison of alternative structures of securities markets and with the impact of the trading mechanism on market dynamics and on the statistical properties of prices and returns.

The analysis of the impact of the trading mechanism on market performance focuses on some characteristics of the markets. The first is the pricing efficiency. Prices accurately and instantaneously reflect all available information. The level of information based trading is crucial for the market design. The speed of price adjustments based on information is viewed as a measure of market efficiency. The second issue is the liquidity. Liquidity is the ability of markets to accommodate large orders with minimum price impact, as well as market stability and the speed in absorbing external shocks without incurring into market crashes. The matching between the trading desires of the buyers and sellers dictate the market performance. The matching process involves the provision of liquidity, which arises from the market maker and from other aspects of the trading mechanism. Liquidity is related to transaction cost and it is one of the most important features of actual markets. A related issue concerns the desirability of market transparency. Greater transparency is related to a greater and faster diffusion of information and prices should be more efficient. The price efficiency is greater in quote driven markets than order driven markets, as the quote driven markets are more transparent. Greater transparency which involves reduced anonymity should reduce adverse selection thereby reducing spread. Less transparent transactions induces competition among market makers for the order flow and therefore smaller spread. (Madhavan, (1995)\textsuperscript{10}).

Bloomfield and O’Hara (1999)\textsuperscript{11} find that trade disclosure increases the informational efficiency of transaction prices and the bid ask spread, by reducing market makers’ incentives to compete for order flow. They also find that quote disclosure has no significant effect on market performance. A few theoretical studies concern with market fragmentation and cross listing of securities as well as linkages between markets where identical or closely related securities are traded. Liquidity and information efficiency appear to be related to multi market activity. The inter-relations among markets affect trading behavior, liquidity and information flow. Hasbrouck (1995)\textsuperscript{12} examines homogeneous or closely linked securities traded in multiple markets.
2.6.2 Statistical properties of Microstructural Data

The time of actual trade is complicated. Trades are not equally spaced but arrive at random during the day. The frequency of price changes is also related to the frequency of the order arrival and transaction occurrence. Market microstructure studies how prices are derived from an explicit modeling of the trading process and from the interactions of agents’ decision rules. Therefore it refers to the transaction data which are real time data sampled at irregularly spaced random intervals whenever trades occur and observations that are unlikely to be identically distributed. The timing of trades is not regular and there are time intervals in which no transactions occur. The time interval between quotations is a signal conveying information. When no information occurs during a period of time, it is sign of bad signal. This time varying and irregular frequency generates intra-day seasonality in trading volume, price volatility and spread.

Empirical investigation using transaction data may turn out to be biased because it ignores the informational content of non trading intervals. This sampling bias is reduced when using the bid ask quote series, continuously updated by the market maker. Price and quantities are discrete variables. Transaction sizes are discrete and prices are quoted in discrete units (tick size) and this discreteness can induce dynamic patterns and generate price clustering. The term price clustering refers to the tendency of prices to fall more frequently on certain values than on others, especially with the transaction data. Schwartz and Whitecomb (1981) discuss the role of limit orders and market orders, the bid ask spread and the need for the market maker, observe the existence of transaction costs limits trading activity and induces discreteness in the price process.

2.6.3 Returns, Quotes and Trades


The empirical literature has found evidence of negative autocorrelation in quotes and returns, particularly strong at very high frequency. Negative first order autocorrelation is consistent with models of price adjustment based on transaction costs and inventory control. Transaction costs introduce a short run bounce (bid ask bounce) in price movements as buy and sell orders arrive randomly. (Roll (1984), Stoll (1989)). If market makers care about


inventories, price changes exhibit negative serial correlation since they skew the spread in one particular direction to rebalance inventory. Price reversals compensate providers of immediacy for inventory and order processing costs. If data do not distinguish between buy at the ask and sell at the bid, the first order negative autocorrelation is accentuated by the bid-ask bounce and is stronger the higher frequency of the data. In some cases, when limit orders are allowed, the presence of positive serial correlation in returns as well as in quotes and trades is explained by the clearing on incoming large orders against the existing one.

Beja and Goldman (1980), Amihud and Mendelson (1987) find evidence of higher order serial correlation and lagged price adjustment arising from lagged adjustment of quotes by market makers to new information or from a lagged dissemination of information. This has been interpreted as evidence of an information effect. A characteristic of information based models is that price adjustment is not immediate and tends to be more permanent. There is strong evidence of negative serial correlation in quotes at very high frequency. There is also evidence of strong positive autocorrelation in trades, that is, a trade at the ask or bid is more likely to be followed by a trade at the ask or bid respectively. The positive autocorrelation in trades is stronger for stocks with a high volume, or when they trade with a limit order procedure, while if stock has low volume, there might be negative autocorrelation in trades as a consequence of inventory control by dealers, and whereas transaction size posted as orders or asymmetric information tend to generate a positive correlation.
It is however not very clear which trades drive prices. A larger trade should be associated to larger price effects because of inventory positions of the market maker and because large trades should reveal more information. Easley and O’Hara (1987) suggest that market

prices vary with trade size, with large trades occurring at worse prices even though some theoretical models suggest that informed trades might prefer smaller trades to disguise their identity. Hasbrouck (1991), on using data on NYSE finds that prices adjust to trades with a lag and that the change in quotes is increasing in trade size. Spread size is positively related to trade size and the trade impact on prices is greater when spread is wider. The price impact and the extent of information asymmetry are more significant for firms with smaller market values.

2.6.4 Relationship between Volume and Volatility

Beside the serial correlation, a number of studies, based on intra-day and inter day data, have reported evidence of other patterns in the behavior of prices or returns, such as the Heteroskedasticity, Kurtosis and Skewness in daily price changes. Volume and Volatility exhibit a serial correlation and cross correlation. Price volatility seems to be irregular and to exhibit persistence, long memory and clusters based on the predictions of the ARCH and GARCH models. Market intra-day patterns are also found in measures of trading activity such as transaction frequency, trading volume rates and bid ask spreads. Intra-day studies confirm short and long term memory for the volatility and other variables. The other variables include tick size, the tick frequency, and give some insights on the origin of these clusters. One interpretation may be that due to the clustering of news as the market adjusts perfectly and immediately to it. Another possibility may be the learning process of traders with different priorities who takes some time to resolve their expectational differences after the arrival of important news. This results in volatility spillover, according to Cho and Engle.
The daily trading volume which is used as a proxy for the information arrival explains the reasons for variance of daily returns which is an implication that daily returns are subordinated to intra-day equilibrium returns. Volume is used as a proxy for information arrival or in other cases; number


of changes in price is used as a proxy for information arrival. The empirical research has identified a strong link between volume and the absolute value of price changes. The positive correlation between volume and volatility has a possible interpretation in terms of news arrivals.

Information based models imply that uninformed liquidity traders prefer to trade when markets are liquid and deep, so that trading costs are expected to be lower. This increases the market depth and liquidity leading to concentration of trade. Informed traders also trade to disguise their identity and information. Thus, more information is revealed and prices become more volatile. This explains the observed positive relationship between volume and volatility. The variance of the daily price change and the mean daily trading volume depend upon three factors: the average daily rate at which new information flows arrive to the market, the extent to which traders disagree when they respond to new information, the number of active traders in the market. In particular, given the number of traders, an increase in volume due to diversion of beliefs is associated with an increase in volatility. If the number of traders is growing, mean trading volume increases linearly with the number of traders and the variance of price change decreases with more traders.

2.6.5 Effect of market closure

In most of the research, the trading activity and the price volatility exhibit a U-shaped pattern during the trading period. They concentrated at the opening and at the closing periods. This structure is particularly evident at the New York Stock Exchange, National Association Securities Dealers and Quotes and London Stock Exchange. In general, markets with a well defined daily opening and closing times produce these intra-day patterns in volatility and spreads, while markets with round the clock trading produce more complex patterns. These
patterns appear to be quite robust with respect to different market microstructure and to arise from time of the day phenomena such as opening and closing, lunchtime and gap between close and opening.

In actual markets, trading takes place usually during organized trading sessions, separated by periods of non-trading or market closure. Research proves that weekend returns are lower than weekday returns (French (1980))\textsuperscript{20}. Returns over trading periods are more volatile than the returns over non trading periods (French and Roll (1986)\textsuperscript{21}, Amihud and Mendelson (1987)). Intra-day mean return and volatility are U shaped (Andersen and Bollerslev (1994)\textsuperscript{22}, Foster and Viswanathan (1993))\textsuperscript{23}. According to Amihud and Mendelson (1987)\textsuperscript{24} open to open returns are more volatile than close to close returns. The transactions demand at the open and close are greater and less elastic than at other times of the day. (Brock and Kliedon (1992))\textsuperscript{25} This greater desire to trade is motivated by the arrival of information during market’s closure and when closure approaches, by the fear of not being able to readjust before the closure. As market order reveals private and public information, volume and volatility as well as spread rise. Biais, Hillion and Spatt (1998)\textsuperscript{26} find that orders in the pre-opening convey information, particularly in the last few minutes before the opening and contribute greatly to price discovery.

2.6.6 Types of orders

Orders are classified into two categories. They are the market orders and limit orders. A market order directs the broker to trade immediately at the best price available. A limit order to buy sets a maximum price that will be paid and a limit order to sell sets a minimum price that should be accepted. The best limit order to buy and the best limit order to sell establish the market and the quantity at those prices represents the depth of the market.


2.6.7 Types of traders

2.6.7.1 Active and Passive Traders

Traders are active and normally employ market orders. Active traders demand immediacy and push prices in the direction of their trading. Passive traders employ limit orders. They supply immediacy and stabilize prices. They tend to earn profits from active traders.

2.6.7.2 Liquidity and informed traders

Liquidity traders trade to smooth consumption or to adjust the risk return profiles of their portfolios. They buy stocks if they have excess cash or have become more risk tolerant, and they sell stocks if they need cash or have become less risk tolerant. Informed traders trade on private information about an asset’s value. Liquidity traders trade on the portfolio whereas the informed traders trade on the asset in which they have private information. Liquidity traders seek to identify their counterpart whereas informed traders seek to hide their identity. Liquidity traders lose if they trade with informed traders.

2.6.7.3 Individual and institutional traders

Institutional traders are the financial institutions which trade on shares. They hold and manage the majority of assets and account for the bulk of share volume. They trade in large quantities and face the problem of minimizing trading costs and in benefiting from any private information. Individual traders trade in smaller amounts and account for bulk of trades. Individual investors also include a new category called High Net worth Individuals.

2.6.7.4 Public and professional traders

Public traders trade by placing order with the broker. They are also called as clients. Professional traders trade on their own behalf and on behalf of their clients. The NSE has
permitted proprietary trading and trading on behalf of their clients. The SEBI and the NSE have fixed stringent norms for brokers. Their trading activities are constantly monitored by watchdog SEBI. They also have to comply with the margin requirements fixed by the Clearing Corporation of the NSE.

2.6.8 Types of trades

The types of trades has four dimensions on which classifications are made. They are based on price, volume, time and counter party. Based on the price, they are classified as Limit orders and Market orders. Limit orders are those orders whose price and volume are specified whereas market orders are those whose volume alone is specified. Based on volume dimensions, they are categorized as Fill or Kill orders and hidden orders. Fill or Kill orders are those types of orders which are traded only if the full volume is obtained. Otherwise these orders will be removed from the books. Hidden orders are those orders where only a part of the order is displayed. Based on the time dimension, they are classified as Good till day order or good till cancel orders. Good till day orders are those orders that remain in the system throughout the day or till the specified period. Good till cancel orders are those which remain in the book till they are cancelled.

2.6.9 The trading process

The trading process is divided into four components. They are information, order routing, execution and clearing and settlement. First, a market provides information about past prices and current quotes. The real time dissemination of these prices makes markets more transparent and allows investors to determine which markets have the best prices, thereby enhances competition. A mechanism for order routing is required. Orders are routed through the exchanges. The exchange uses satellite to communicate to all the computers connected to the central server of the NSE. The third component of the trading process is called the execution. It is the process of matching the incoming market order with a resting quote. At the National Stock Exchange, order matching is done on a price – time priority. Two orders are matched first based on price of the buy and sell order. Then the time of the order entry is found. The orders are placed on a first come first serve priority.

The last component is the clearing and settlement. At the NSE, clearing is activity of registering the identity of the counterparties to every trade. In clearing, the obligation of
every counterparty is calculated and recorded at the exchange and then sent to the Trading Members as the “Settlement obligations” of their customers. Clearing is done at the end of the trading day – for those trades which have not been reversed at the closing of the market. The clearing activity is carried out by a separate entity called the National Securities Clearing Corporation Limited (NSCCL). Margins are collected from all the exchange members before the trade and returned after the settlement of the trade. The margins act as a buffer against default and the NSCCL retains this amount.

2.7 THE NATIONAL STOCK EXCHANGE OF INDIA

The NSE was incorporated in 1992 and received recognition and started functioning as a stock exchange in 1993. It is established under the Securities Contract (Regulation) Act, 1956. It is management by professionals who are not connected to the NSE in any way. This period has seen a remarkable change in markets, from how capital was raised to how transactions were cleared and settled. From an average trading volume of Rs 17 crores in the cash segment in 1994-95, the trading volume has grown to Rs 16,959 crores in 2009-10. The market capitalization of listed companies went up from Rs. 3,63,350 crores at the end of March 1995 to Rs. 60,09,173 crores at the end of March 2010. The Indian equity markets are today among the most deep and vibrant markets in the world.

NSE offers a wide range of products for multiple markets. The list includes equity shares, exchange traded funds, mutual funds, debt instruments, index futures and options, stock futures and options, currency futures and interest rate futures. Index futures and options traded on four indices. Currency futures contracts are traded in four currency pairs. Interest rate futures are contracts based on 10 year 7% Notional Government of India bonds are also available for trading.

The National Stock Exchange of India is regulated and monitored by the Ministry of Finance, the Securities and Exchange Board of India and the Reserve Bank of India. The Ministry of Finance regulates through the Department of Economic Affairs, Capital Markets Division. The division is responsible for formulating the policies related to the orderly growth and development of the securities markets, which includes shares, bonds and derivatives as well as protecting the interest of the investors. It is responsible for the Institutional reforms in the securities markets, Building regulatory and market institutions, Strengthening investor protection mechanism and Providing efficient legislative framework for securities markets.
2.7.1 Market segments and products

The NSE provides trading in four segments viz., wholesale debt market, Capital Markets, Futures and Options and the Currency Derivatives Segments. The wholesale debt market segment provides the trading platform for trading in a wide range of debt securities which includes state and central government securities. Examples includes T-bills, state development loans (SDL), Bonds issued by public Sector Enterprises (PSUs), floating rate bonds (FRBs), Corporate Bonds, Commercial Papers, Certificates of Deposits, bonds issued by financial institutions and bonds issued by foreign institutions and mutual funds. Along with these products, the NSE has also launched other products Fixed Income Money Market Derivatives Association of India (FIMMDA) – National Stock Exchange - Mumbai Inter Bank Operating Rates (NSE- MIBOR), Zero Coupon Yield curve, Gilt Mutual funds, and government Securities index.

The capital market segment offers a fully automated screen based trading system, known as the National Exchange for Automated Trading (NEAT) system. This system operates on a price time priority basis and enables members across the country to trade with great ease and efficiency. Various types of securities including warrants, bonds, equity shares and units of mutual funds are traded on this system. The average daily turnover in the Capital Market Segment of the exchange during 2009-10 was Rs 16,959 crores (US $ 3,757 million).

The NEAT – CM application has a spilt architecture wherein the split is on the securities and users. The application runs on a three stratus systems with communication over TCP IP protocol. The application is benchmarked to support 60,000 users and handle more than 30 million trades daily. There is a two way communication between the NSE main system and the front end terminal of the trading member.

Futures and options segment of the NSE provides trading in derivatives instruments like index futures, index options, stock futures and stock options. The futures and options segment of the NSE has set a mark for itself globally. The average daily turnover in the F&O segment of the exchange during 2009-10 was Rs 72,392 crores (US $ 16,097 million).

Currency derivatives segment at the NSE commenced operations on August 29, 2008 with the launch of currency futures trading in the US Dollar Indian Rupee (USD – INR). On the very first day of operations, a total number of 65,798 contracts valued at Rs. 291 crores
were traded on the Exchange. Since then trading activity in this segment has been witnessing a rapid growth. Trading in Currency Futures contracts in other pairs- Euro-INR, Pound Sterling-INR and Japanese Yen-INR commenced on February 01, 2010. The average daily turnover in the Currency Futures during 2009-10 was Rs. 7,428 crores (US $ 1,646 million). Trading in Interest Rate Futures (IRF) commenced on August 31, 2009. Interest Rate Futures contracts are based on 10 year 7% Notional Government of India Bond. On its first day of trading, 14,559 contracts were traded with a total value of Rs. 267.31 crores.

2.7.2 NSE Family

The entities which assist the functioning of the NSE form the NSE family. They are the NSCCL, NSDL, NSE.IT, IISL, DOTEX International Ltd, NSE InfoTech Services Ltd, NCDEX, NCCL and the PXIL.

2.7.2.1 The NSCCL

The National Securities Clearing Corporation Limited (NSCCL) is a wholly owned subsidiary of the NSE, incorporated in August 1995 and commenced operations in April 1996. Being the first clearing corporation in India, it was set up to sustain and bring confidence in clearing and settlement of securities; to promote and maintain short and consistent settlement cycles; to provide counter party risk guarantee, and to operate a tight risk containment system. It carries out the clearing and settlement of the trades executed in equities and derivatives segments of the NSE. It operates on a well defined settlement cycle and established the Settlement Guarantee Fund (SGF) in June 1996. NSCCL has also introduced the facility of direct payout to client account to both the depositories viz., NSDL and CDSL.

The National Securities Depositories Limited (NSDL) was set up by the NSE, along with UTI and IDBI, to promote dematerialization of securities. The NSDL is the first depository in India. Dematerialized delivery constitutes almost of 100% of total delivery based settlement.
2.7.2.2 IISL

India Index Services and Products Limited (IISL), a joint venture of CRISIL and NSE, was set up in Mat 1998 to provide indices and index services. It has a licensing and marketing agreement with Standard and Poor’s (S&P), the world’s leading provider of investible equity indices for co-branding equity indices. It provides a broad range of services and products. It maintains over 96% of the equity indices comprising broad benchmark indices, sectoral indices and customized indices. Many investment and risk management products based on IISL indices have developed in the recent past, within India and abroad. These include index based derivatives on NSE and on the Singapore Exchange, India’s first exchange traded fund, a number of index funds and licensing of the index for various structured products.

2.7.2.3 DOTEX International Ltd

The data and information vending products of NSE are provided through a separate company called Dotex International Ltd., a 100% subsidiary of NSE, which is a professional set up dedicated solely for this purpose. Dotex data provides products like Online streaming data feed, intra-day snapshot data feed, end of the day data and historical data. In fact, the data for this research was collected from Dotex International Ltd.

2.8 SUMMARY

Market microstructure, the study of frictions in the stock trading, depends on a number of factors. These factors include types of orders, trading rules, communication network, the type of market and the type of markets. This area of finance which studies the cost of trading challenges the founding theories of capital asset pricing. The assumptions are challenged and proved that they are just a theoretical abstraction. Instead the efficiency of trading and the stock exchange depends on the trading systems and procedures followed in the exchange. One such exchange studied is the National Stock Exchange of India.