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# MARKET MICROSTRUCTURE

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The success of any financial market depends on the ability of the market to determine the proper price for the assets traded in the market. This can be achieved by matching the demand and supply in an efficient and effective manner. An efficient market should provide enough liquidity for the assets traded in the market. The role of the market maker in providing liquidity is widely recognized, but liquidity can also arise from other aspects of the trading mechanism. Liquidity in the market depends on many macro-economic factors like country's financial policy, regulatory environment, interest rates, inflation and market micro-factors like the type of asset that is traded, the price of the asset, the structure of the market or the market design, the protocol that is followed in determining the price, information about the asset that is traded, market participants, ability of the participants to observe the information and use the same for making purchase and sale decisions and finally the transaction cost involved in the process of buying and selling.

This white paper studies the impact of some of the important market micro-factors mentioned above on the price of the asset traded in the market. The study involves an understanding and analysis of how these micro factors affect the asset price and liquidity in the market.



WHITEPAPER



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## INTRODUCTION

Past research on the market microstructure has thrown light on many practical issues involved in the exchange of assets in the financial markets. This paper presents some of the key factors of market microstructure. An effort has been made to explain the impact of information, trading cost and the market structure and design on the price discovery process of an asset traded in the financial market. The topics discussed in the paper are based on theoretical and empirical research conducted in the area of market microstructure. The paper doesn't address the characteristics of any specific market but discusses only those key factors, which are common for all financial markets. Each topics discussed in this paper can be taken as a separate area for research and can be applied to study the microstructure of any specific marketplace.

## CONCEPT

The past two decades have seen a tremendous growth in the financial markets resulting from rapid structural, technological and regulatory changes. This change has made market microstructure an interesting field in the area of finance for academicians, market participants, stock exchanges, regulators and policy makers. Since then a lot has been written in this area.

Academicians and practitioners have defined the concept of market microstructure in different ways by focusing on different aspects of it. Following are some of the extracts from the literature

Ananth Madhavan, Managing Director - Research, ITG Inc. New York, NY in his research report 'Market Microstructure: A Survey' defines market microstructure as "the area of finance that studies the process by which investors' latent demands are ultimately translated into prices and volumes".

Maureen O'Hara Johnson, Graduate School of Management, Cornell University and President-elect of the American Finance Association define market microstructure as "the study of the process and outcomes of exchanging assets under a specific set of rules. While much of economics abstracts from the mechanics of trading, microstructure theory focuses on how specific trading mechanisms affect the price formation process".

"Market microstructure deals primarily with the market for transaction services and with the price of those services as reflected in the bid-ask spread and commissions", says Hans R. Stoll, Financial Market Research Center, Owen Graduate School of Management, Vanderbilt University, Nashville, in his working paper.

## SCOPE OF THE STUDY

This study focuses on the following dynamic market microstructure factors and their impact on asset pricing and liquidity.

**Price formation and price discovery:** This factor focuses on the process by which the price for an asset is determined.

**Transaction cost & timing cost:** This factor focuses on transaction cost and timing cost and the impact of transaction cost on investment returns and execution methods.

**Market structure and design:** This factor focuses on the relationship between price determination and trading rules.

**Information and disclosure:** This factor focuses on the market information and the impact of the information on the behavior of the market participants.



## ANALYSIS

### Price Formation and Price Discovery

Price formation for an asset is based on the demand and supply conditions. Investors have different views on the future price of an asset, which makes them trade these assets at different prices. Price discovery happens when these prices match and a trade is executed. There are different mechanisms through which the price for an asset is determined. Call auction is one of the mechanisms followed by marketplaces for determining the asset price traded in that market. In a call auction the orders are accumulated for a period of time and are matched at a specified time, at the price, which results in maximum trading volume. Some market places match the accumulated orders at the average of the prices generating maximum trading volumes. Continuous auction is another mechanism where the orders are checked for possible match as and when it is received and is executed at the price available on the counter side of the order book. In case of continuous auction sometime orders are executed at a single price (mid price of worst executable buy and worst executable sell price) for a quantity based on pro-rata allocation. So all the matchable orders on the counter side of the book will get execution for quantity on proportionate basis. Price discovery can also happen through negotiation process.

According to the studies conducted by Madhavan on price efficiency of 'order driven' and 'quote driven' markets, quote driven markets are more price-efficient than order driven market. In a quote driven market the investors trade against the prices quoted by the market makers and the price discovery happens quickly where as in an order driven market investors must submit order to create the book and then the price discovery happens based on any of the price determination mechanism mentioned in the above paragraph.

The process of price discovery also depends on the pre-trade transparency of the order book. An opaque order book makes investors to search for price information by calling the markets to give their quotes. So the investors spend more time in getting exact price information from multiple market makers than actually executing the trade. This will slow down the price discovery. If the pre-trade price information is disclosed to the market, the investors can quickly react to the price and execute trade. Hence quick price discovery.

### Transaction Cost & Timing Cost

Trading cost or transaction cost forms an important factor in determining the returns on investment and the execution method adopted by market participants. When an investor trades in the market, he/she incurs two types of cost i.e. explicit cost and implicit cost. Explicit costs are those costs, which can be easily identified and measured. These are costs like brokerage fee, exchange levy and the taxes applicable on the transaction that is executed. Implicit cost is often described as the hidden part of an iceberg and is difficult to identify and measure. These implicit costs include market impact cost and the timing cost. Market impact is the change in price caused by trading a large order in a short period of time. From the point of view of the initiator of the trade, the price change is usually adverse (selling, for example, drives prices down) and thus the initiator is spending a portion of his funds under management to purchase liquidity. Market impact cost increases in proportion to the size of the order i.e. large size orders are exposed to high impact cost as putting large orders reveals the intention of the trader and the market will move against the trader expectations. Timing cost is the price variation between the observed price of the market at the time of the decision to initiate the transaction and the actual execution price.

In the current market scenario, competition among brokers to attract more number of investors has lead to significant reduction in explicit cost. Implicit cost depends mainly on the market conditions, over which the investor has hardly any control. Reduction of the implicit cost is the key factor for enhancing the returns on the investment.



Market impact cost mainly depends on the volume of the transaction and the market liquidity. Studies have shown that for a given liquidity condition, investors executing a transaction for larger volume end up incurring larger market impact cost compared to the investor executing a transaction for smaller volume. But market impact cost is more dependent on the liquidity condition of the market rather than the size of the transaction. If the market is more liquid even a large volume transaction can be easily executed with less market impact cost as the spreads are narrowed down in a highly liquid market. One more technicality to be considered is the market depth. If the depth for a stock is not sufficient to complete the transaction the transaction will result in partial execution. This will result in adverse price movement as remaining part of the transaction has to generate additional depth on the counter side, which may result in a higher price in case of buy and lower price in case of sell.

Timing cost is purely dependent on the speed of execution.

Transaction cost is also dependent on the execution methods that are adopted by the investor. An order can be executed using different execution methods like agency or principal. The orders can be sent to the market through an agency. As the agency assumes no market risk, the entire market impact cost falls on the investor. An agency execution is charged less compared to the principal execution. Investors who want to assume the market impact cost at a lower explicit cost would prefer to execute their orders through agency.

Agency trading is the most commonly used execution method. The investor sends an order to the broker specifying the name of the stock and the quantity to be bought or sold. The agency then executes the order in the market and the time of execution depends on the size of the order and the liquidity of the stock. Some times agency trades are executed with an objective in terms of price and that price can be VWAP of the day or a price at a given time of trading hours for example market close. The average brokerage fee for this type of trade is relatively low.

On the other hand principal trades reduce the market risk to the investor as the risk is passed on to the broker from the investor. Generally principal trades are charged more fees for undertaking the market risk from the investor. The investor sends the broker only partial information i.e. amount to be invested, destination, direction, name of the basket stocks and the weight-age given for each stock in the basket. Based on this the broker gives a commitment to buy or sell the basket at a specified time decided by the broker and investor at the price observed on the market. The complete information like the quantity to be bought or sold in each stock will be communicated to the broker only after specified time. The brokerage fee for principal trades depends on the amount of risk associated with the execution of the basket. Some times if the constituents of the basket are the stocks of the index then the broker can hedge his risk by taking a position in the derivative market and there by reduce the brokerage fee for the investor. The broker can internalize the transaction and thereby reduce the market impact cost, which enables him to offer competitive fees to the investor.

A common strategy adopted by the buy side firms to reduce the market impact cost is to disaggregate the orders into smaller parcels and trade them over several days to mask transactions that comprise a large total trading strategy. These firms can also adopt a strategy to divide the trades among several brokers in order to reduce the possibility that information accrues to a single broker.

Execution methods such as internal crossing have significantly reduced the market impact cost. Internal crossing networks accumulate large orders from the buy side firms and the orders are not disclosed to the participants. The orders are matched at specific point in time and execution details are sent to the buy side firms who have sent the orders. This ensures liquidity and reduction in market impact cost for buy side firms.

Transaction cost also impacts market efficiency. Increase in transaction cost will result in lesser trading volumes and investor will have to hold positions for a longer duration to get a better price, which will enable him to get higher returns after recovering the high transaction cost. Lower transaction cost enables the investors to speculate on small price variations with larger volumes and thereby reducing the cost of holding positions for longer period.



Lastly when it comes to transaction cost, online trading plays a significant role. Online trading has drastically reduced the cost of transaction (both explicit and implicit) by providing easy access to different markets and market information. Online trading has reduced the information advantage that few market participants used to enjoy and thereby reducing their profit margins. Online traders are equally informed about the stock price as compared to other market participants and this has enabled them to react rapidly on common information. Online trading has brought more and more investors to the market and has increased the market efficiency through proper price formation resulting from larger participation.

## Market Structure and Design

Market structure and design has a major impact on price discovery, liquidity and trading costs. Market structure and design refers to attributes of a market defined in terms of trading rules. These attributes include:

- Degree of continuity
- Dealer presence
- Transparency
- Price discovery
- Automation
- Order types
- Protocols
- Information dissemination
- Anonymity
- Off-market trading

Some markets operate on a continuous matching system where full transparency is provided of the limit order book. Some markets operate on a call auction system where the orders are matched periodically at the mid price of the quotes. The latter system doesn't provide any independent price discovery mechanism. No single system is ideal for a market. The decision to adopt continuous or periodic call auction matching depends on the market dynamics. A market system which prefers more transparency and favors retail investors would more likely want to adopt a continuous matching system enabling the investors to view the full limit order book and decide on the price of the instrument traded. This limit order book disclosure may not be favorable for a large institutional investor who generally places orders of large quantity. Disclosure of full order book will result in more impact cost for the institutional investor. An institutional investor would rather prefer to hide its order from the market and execute at an average price. Normally markets, which operate on continuous matching system, tend to adopt call auction mechanism and single price execution whenever the trading is resumed from market halt. The reason being is to ensure that the information accumulated during the halt period should be factored in the price of the asset once the trading is resumed from halt. So a brief pre-opening session is held (before the continuous trading is resumed) to accumulate the orders and orders are executed based on call auction mechanism.

The presence of dealer market i.e., quote driven market has lot of impact on liquidity. Quote driven markets have narrower spreads and informed traders are less likely to take maximum advantage of the special information that they have on an instrument's future value. The spread also depends on the market makers inventory as market makers trade based on their inventory position. A balanced inventory position of a market maker will result in more narrow spreads as the pressure on the market maker to maintain his inventory is less. But too many long or short position will result in high pressure on market maker's inventory that results in wide spreads in the market maker quote.



Transparency relates to the degree of disclosure of the market information that includes price, volume of transaction, source of order flow and the identity of the market participants. Transparency can be explained in terms of pre-trade and post-trade scenario. Pre-trade transparency refers to wide dissemination of order book information, indicative trade price and indication of large orders in the book. Post-trade transparency is the timely and quick dissemination of past and current trade price and volume information as and when a trade is executed. Theoretical models on the transparency have given a mixed conclusion. Transparency can reduce the chances of adverse selection and thus spread, by allowing dealers to screen out traders having private information. But transparency may not always result in better price discovery. Studies have shown that a higher degree of transparency has an adverse effect on an illiquid market. Empirical studies on transparency have shown that in a highly transparent market, traders are reluctant to place limit orders as limit orders essentially represent free options to other traders to pick the order. Large institutional traders, whose orders are filled in multiple trades reducing their expected execution cost, prefer nondisclosure. These institutional traders can split their trades over time without attracting much attention of other market participants. Hence transparency is a highly complicated issue and the degree of transparency depends purely on the market requirements.

Most market places have an independent price discovery mechanism and few operate on the price discovered by another market as a basis of transaction. Markets providing independent price discovery generally aggregate the orders for a specific period of time and orders are executed at a single price that forms the reference price for the continuous trading of the day. Some of the crossing networks do not provide for an independent price discovery. The orders are matched at the mid price of the quote in the primary market. Independent price discovery mechanism helps in building an efficient market by attracting more number of investors to trade in the stocks listed in the market. Pooling large number of buy and sell orders results in proper and fair price discovery. This attracts more number of retail investors, as they want to reduce market impact cost. Markets operating on a reference price may be more suitable for institutional investors who want to execute bulk orders.

Automation of the trading system places an important role in the liquidity creation and transparency. Markets vary in the extent to which the trading is automated. With the advancement of technology in stock trading, it has become easier for the investors to access markets beyond their geographical boundaries. Automation has given rise to program trading, which enables the institutional investors to execute their orders in multiple execution venues and achieve better execution price. At the same time access to multiple markets may result in shifting of volumes from one market to another resulting in failure of some markets.

Order types refers to different types of order options like limit, market, stop and hidden orders provided by the market place. These order types enables the traders to adopt different strategies at various stages during a trading session. Iceberg orders enable the traders to place large volume orders to get executions in multiple slices without incurring a large impact cost. Market orders enable large liquidity traders (i.e. traders of institutional trading desk) to take liquidity from the market at the same time meet their daily targets. Order expiry conditions like GTC, GTD and Day meet the requirements of different categories of market participants.

Protocols are the rules governing the day-to-day trading. These refer to lot size, tick size, instrument price band parameters, trading halt, circuit breakers etc. These protocols vary from market to market and have a direct impact on the volatility, trading volumes and price spreads. Take for example the lot size of an instrument. Lot size is the minimum number of shares that can be bought or sold. The trading volume for an instrument with lot say 1000 varies significantly from the trading volume for an instrument with lot as 1. Studies have shown that reduction in the lot size leads to greater participation from the retail investors compared to higher lot size. Similarly tick size has direct impact on the price spreads. If minimum tick is reduced then the profit from providing liquidity will reduce i.e. reduction in tick size will bring down the spread there by reducing the margin gain for market makers but at the same time it is advantageous for retail and liquidity traders.



Markets differ in information dissemination to brokers, information vendors and general public and the speed of information dissemination. Real-time broadcast of information is the key factor for determining the trading strategy to be adopted by traders. This information may be disseminated by market on trade-by-trade basis or in batch process where information is broadcast with some time delay. Based on the participants accessing the information, the speed of information broadcast is decided. Information that is accessed by the general public may be broadcast in batch mode while information that is accessed by the traders is broadcast in real-time.

Anonymity is the non-disclosure of trader information along with the transaction details broadcast to the market. The disclosure of trader information will enable the other participants in the market to identify the intention of the trader to execute the transaction. This impacts the order price of other market participants. Generally most markets are anonymous where the counter party information is hidden in a transaction. Most markets emphasize on hiding counter party information as disclosure may lead to improper price variations. But disclosure of counter party information is very much required in an OTC market where transactions are executed through the negotiation between the parties involved in the transaction.

Some markets provide for off-market trading/after hours trading. After-hours trading is the trading of securities, on organized markets (ECNs) and exchanges after regular business hours. ECNs providing after hours trading generally operate based on their own set of rules and regulations. Most ECNs are associated with online brokerage firms. Some brokerage firms are associated with multiple ECNs and provide order execution in multiple venues. These ECNs differ in the level of transparency. Generally these markets have fewer participants and hence securities traded in these markets lack liquidity resulting in larger spreads. It is not advisable for investors who are not familiar with working of this kind of market place to participate in this market. This after hours trading especially helps those institutional investors to do cross border trading and execute large blocks of orders. The price movement in the after hours trading may not follow the same pattern of a regular market and it is an early indicator of what may happen in the market the following day.

When we analyze the above factors, which constitute the market structure, it is evident that no single market structure is ideal for all the markets. The structure of each market is derived from different aspects such as market participants, regulatory environment, need of market participants, type of financial assets traded in the market, liquidity, transparency etc. The objectives of the market place itself play an important role in arriving at the market structure and design. Traditionally exchanges were meant as non-profit organizations. However, the new breed or execution venues are highly tuned for profit making and creating wealth for their shareholders and their participants.

## Information and Disclosure

Information plays a significant role in determining the behavior and strategies that market participants adopt to create or take liquidity. A better-informed trader is more likely to mitigate the risk involved in the trading compared to less informed trader. Although the Theory of Efficient Market assumes that market is anonymous and all the participants in the market are equally informed about the instruments traded, in reality there is disparity in the amount of information that is accessible to each market participant. Some market participants have a definite information advantage over the others. Here market information means that information, which directly affects the market value of the asset traded.



Information also influences the bid-ask spread in the market and hence liquidity. Bid-ask spread is the difference between the best bid price and the best ask price. In a trading session before the information is publicly available the spread tends to be wider and there would be a lot of volatility in the market. This kind of scenario results in adopting different trading strategies by the traders. More informed traders tend to take the liquidity from the market by executing trades at the available prices, as they know that the spread will narrow down once the information is available publicly. Hence better-informed traders tend to place more market orders before the information is actually broadcasted to the market as a whole. As the trading session progresses and the information like the company's revenue details, merger details, corporate action etc. becomes publicly available, the informed trades are more likely to provide liquidity by placing limit orders. This will enable them to place the orders at the price, which is nearer to the fair market value and thereby making profits out of the difference between the price in the initial hours of the trading session and the later hours of trading when the spread is narrowed down.

Less informed traders or traders who don't have access to the information, which affects the market value of the instrument, tend to adopt a different trading strategy compared to informed traders. These traders are exposed to more risk in the initial hours of trading, as the spread is wider in the market. These traders tend to place more limit orders and on the same side of the book as placing a market order or a limit order to pick up the quantity on the counter side will result in a trade at adverse price. But as the trading session passes the spread tends to narrow down because of the availability of information to the market as a whole and market tends to arrive at the fair value for the instrument traded. At this point of time the risk for a less informed trader reduces and the trader tends to take liquidity from the market by placing more of market orders.

Apart from the above set of traders there is another set of traders in the market called liquidity traders. These traders represent the trading desk of an institutional investor who has given them a target of stocks to buy/sell during the trading session at best price possible for the day. These traders are open to more risk in the initial trading hours as the spread is too high and any trade executed during the initial hours of trading may result in adverse price as a result of which the average traded price of these traders at the end of the trading session may not be close to the day's average trade price. So these traders tend to place limit order in the initial trading hours so as to avoid trade at adverse price. But as the trading session progresses these traders tend to realize that they have to meet day's target of buying/selling the stocks assigned by the institutional investor. This makes them to adopt the strategy of placing more market orders at the end of the trading session and thereby taking the liquidity from the market.

When we analyze the above scenarios we can say that information is asymmetrically distributed among the market participants and this determines the behavior and trading strategies adopted by them.



## CONCLUSION

Based on the analysis of the above three major factors of market microstructure we can conclude that price formation basically depends on the demand and supply conditions and the price determination mechanism adopted by the marketplace. Price determination mechanism like call auction are used mostly in the opening session of the market in which the orders are accumulated and are executed at a single price. The studies on price formation have shown that market is more volatile during the opening session as the overnight interruption of trading clouds the process of price formation by the trading itself.

When we consider the transaction cost, it is the implicit cost that matters more compared to explicit cost. Implicit cost is more especially in cases of large orders as compared to small orders. Execution techniques like principal trading, internal crossing has significantly reduced the explicit cost which is driving the institutions to such execution venues.

Market structure components like degree of continuity, transparency, price discovery, level of automation, information dissemination, protocol etc. are very dynamic factors, which vary from market to market. Market structure is defined by mixture of these factors in different proportion. One important thing to be noted here is 'one size fits all' approaches to regulate and policymaking should be avoided. For example greater transparency may not always increase liquidity. It may result in informed traders not providing liquidity (by placing limit orders) as the spreads are very narrow and the margins reduce drastically.

The disparity of information that each market participant has about the price of an asset enables him or her to adopt different trading strategies, liquidity and spreads.

## GLOSSARY

**Liquidity:** The degree to which an asset or security can be bought or sold in the market without affecting the asset's price. Liquidity is characterized by a high level of trading activity.

**Illiquid Market:** A market with few bid and asks offers; characterized by low liquidity, high spreads, and high volatility. Small changes in supply and/or demand can have a dramatic impact on market price

**Liquidity Trader:** These traders represent the trading desk of an institutional investor who has given them a target of stocks to buy/sell during the trading session at best price possible for the day.

**Take Liquidity:** Buying or selling a stock at whatever best market price at the time of order execution. This can be achieved by placing market order which executes at the best price on the counter side of the order book.



## REFERENCES

SI No	Book/Article Title	Author/s
1	'A Century Of Stock Market Liquidity And Trading Costs Version', November 2000,	Charles M. Jones
2	'Economics of Financial Markets', 2003, Chapter 10 Asset Market Microstructure,	R. E. Bailey
3	Trading Costs of Institutional Investors in Auction and Dealer Markets 'Auction Versus Dealer Markets: Which Delivers The Lowest Trading Costs For Institutional Investors?',	Andy Snel
4	'Overview: Market Structure Issues In Market Liquidity',	Maureen O'Hara
5	'Dealership Markets And Transparency: A Brief Review Of The Academic Literature',	Allison Holland
6	'Does the pre-opening period facilitate price discovery? An experimental investigation',	Bruno Biais
7	'Global Equity Trading Costs',	Ian Domowitz Jack Glen Ananth Madhavan
8	Market Microstructure: A Survey,	Ananth Madhavan
9	'Market Microstructure: A Practitioner's Guide',	Ananth Madhavan
10	'Market Microstructure',	Hans R. Stoll
11	'Measuring the Impact of Regulation on Market Stability: Evidence from the US Markets',	Colin Beardsley John R. O'Brien
12	'Price Formation on Stock Exchanges: The Evolution of Trading within the Day',	Mason S. Gerety
13	'Should Securities Markets Be Transparent?',	Ananth Madhavan David Porter Daniel Weaver
14	'The "Make or Take" Decision in an Electronic Market: Evidence on the Evolution of Liquidity',	Robert Bloomfield Maureen O'Hara Gideon Saar
15	'The Effects of Market Reform on Trading Costs of Public Investors: Evidence from the London Stock Exchange',	Narayan Y Naik Pradeep K Yadav
16	'The Effects of Transaction Costs on Stock Prices and Trading Volume',	Michael J. Barclay
17	'Transaction Costs and Trading Strategies: An Empirical Analysis on Global Equity Markets',	Meriam Boussema Alain Bueno Pierre Séquier
18	'Using Internet Information in Transaction Cost Control',	David Leinweber



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Giridhar works as a Business Analyst in the Securities Practice of Finance Solutions. Giridhar has worked on securities trading solution for market place like alternative trading system and internal market place which provides execution based on order driven, quote driven and hybrid market models. He has also worked on primary market solution which provides for distribution of securities through fixed price and book building issues. For many of these assignment he has worked with clients like TradingLab, Milan, Italy; OPEX, Lisbon, Portugal; UNEX, Chicago, USA.



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