

Chapter 4: Market Microstructure

Reading this chapter you will be introduced to the following key concepts:

- Where assets are traded: exchanges, over the counter, and electronic communication networks
- Market participants: investors, traders, brokers, and dealers
- Market types: order driven, quote driven, or hybrid markets
- The costs of trading, issues of information and disclosure, and market maker and investor behaviour
- Financial Trading System: market microstructure issues

Introduction

Market Microstructure is the branch of finance which is generally concerned with the details of how the actual exchange of assets, i.e. trading, occurs in markets. While the theory of market microstructure applies to the exchange of real or financial assets, more evidence is available on the microstructure of financial markets due to the availability of transactions data from these markets. The major part of market microstructure research examines the ways in which the working processes of a market affects determinants of transaction costs, prices, quotes, volume, and trading behaviour. All of these issues are clearly of importance when trading in general and for traders who make the living by trading in particular.

Maureen O'Hara, one of the pioneers on this field of research, defines market microstructure in the following way:

Market microstructure is 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.

Microstructure deals specifically with issues of market structure and design, price formation and price discovery, transaction and timing cost, information and disclosure, and market maker and investor behaviour. In this note we deal with all of these issues in sequence. However, since the issue of market microstructure is closely related to where assets are traded we start out by examining the different types of markets on which financial assets are traded.

Where are assets traded¹

When we talk about trading financial assets many immediately think about one of the most important exchanges, the New York Stock Exchange. In fact, if you close your eyes you may even be able to see a bronze figure of the bear and a bull in front of it. However, actual physical exchanges are only one of the places where financial assets are traded. In particular, in addition to the exchanges markets exist which are over the counter, or OTC, and recently electronic communication networks, or ECNs, have evolved on which a large volume of assets are traded.

Exchanges and exchange trading

The Amsterdam Stock Exchange is considered the oldest in the world. It was established in 1602 by the Dutch East India Company for dealings in its printed stocks and bonds. It was subsequently renamed the Amsterdam Bourse and was the first to formally begin trading in securities. However, of much more importance to present day trading is the New York Stock Exchange, or the NYSE. In New York, it is said, that stock trading started when dealers met each day at noon at Wall Street. This then evolved into the New York Stock Exchange and Board in 1817 inspired by the success of an organisation set up by brokers in Philadelphia (see also the boxed text). In London, the story goes that dealers would meet in various coffee houses. However, in order to regulate the trade New Jonathan's Coffee House was converted into the Stock Exchange in 1773. The story of the first exchange in Canada began somewhat later in 1832 as an informal stock exchange at the Exchange Coffee House in Montreal, Canada. In 1872, Lorn MacDougall, along with his brothers Hartland St. Clair MacDougall and George Campbell MacDougall, James Burnett and Frank Bond were the driving force behind the creation of the Montreal Stock Exchange, a name that was used until 1982 when it became the Montreal Exchange.

The beginning of the NYSE – a story about a buttonwood tree:

The origin of the New York Stock Exchange can, according to history, be traced back to May 17, 1792. On this date the Buttonwood Agreement was signed by 24 stock brokers outside of 68 Wall Street under a buttonwood tree. This original agreement regulated their commission and how they traded with each other.

On March 8, 1817, the organization drafted a constitution and renamed itself the "New York Stock & Exchange Board". Anthony Stockholm was elected the Exchange's first president.

The New York Stock Exchange stopped regulating brokerage commissions in 1975, 183 years after the original agreement was signed. The main reason for this was the increase in over the counter trading of exchange listed companies, the so-called *third market*.

Source: Wikipedia and Harris (2003)

The number of exchanges and the structure has changed dramatically through time. In fact, in 1850 the US actually had 250 exchanges, but shortly thereafter New York became the

¹ It is assumed here that the assets already have been issued. Why and how these assets are issued is not the topic of this class but you should have learned about it in your basic "Investment" class!

undisputed center. Here in Canada there used to be five larger stock exchanges, but now there is one major exchange in Toronto. On an international level the exchanges in Amsterdam, Brussels, and Paris formed the Euronext in September 2000. Thus, it is seen that within the exchanges a lot of consolidation has occurred. This development is tightly linked to the legal structure of exchanges. In particular, stock exchanges originated as mutual organizations owned by its member stock brokers. However, recently members have sold their shares in initial public offerings, IPO's. Thus, in this way the mutual organization becomes a corporation, with shares that are listed on a stock exchange.

Some of the most important stock exchanges in the world are without a doubt the NYSE and the NASDAQ. On an international level the Tokyo Stock Exchange and the London Stock Exchange are very important. However, the exact ranking depends on what is used to rank the exchanges; market value or share turnover. And this ranking often changes through time. In Table 1 the top 10 exchanges in the world based on the market value of the assets in 2008 is shown. As you can see the Toronto Stock Exchange was ranked in top 10! Note also that the ranking would change if "Total Share Turnover" was used instead of "Market Value". For more information you can check out the [World Federation of Exchanges homepage](#).

Table 1: This table shows the top 10 exchanges worldwide based on market value in millions of US dollar in 2008.
Source: Wikipedia.

Region	Stock Exchange	Market Value (millions USD)	Total Share Turnover (millions USD)
Americas	New York Stock Exchange	9,363,074.00	1,517,615.70
Asia-Pacific	Tokyo Stock Exchange	2,922,616.30	301,781.50
Americas	NASDAQ	2,203,759.60	2,325,238.30
Europe	Euronext	1,862,930.90	146,173.30
Europe	London Stock Exchange	1,758,157.70	241,151.10
Asia-Pacific	Shanghai Stock Exchange	1,557,161.30	142,144.20
Asia-Pacific	Hong Kong Stock Exchange	1,237,999.50	80,696.80
Americas	Toronto Stock Exchange	997,997.40	84,323.00
Europe	Frankfurt Stock Exchange	937,452.90	264,970.30
Europe	Madrid Stock Exchange	871,061.40	114,994.00

Who can trade on an exchange

In general, only members of an exchange can trade at the exchange. Non members can only trade by asking member brokers to trade for them. Because of this, the right to trade on the exchange has a value, and in fact, there used to be a market for this "right". At the NYSE the right to directly trade shares on the exchange is conferred upon owners of the 1366 "seats". The term comes from the fact that up until the 1870s NYSE members sat in chairs to trade. In

1868, the number of seats was fixed at 533, and this number was increased several times over the years. In 1953, the exchange stopped at 1366 seats.

These seats are a sought-after commodity. Seat prices have varied widely over the years, generally falling during recessions and rising during economic expansions. The most expensive inflation-adjusted seat was sold in 1929 for \$625,000, which, today, would be over six million dollars. In recent times, seats have sold for as high as \$4 million in the late 1990s and \$1 million in 2001. In 2005, seat prices shot up to \$3.25 million as the exchange was set to merge with Archipelago and become a for-profit, publicly traded company.² Seat owners received \$500,000 cash per seat and 77,000 shares of the newly formed corporation. The NYSE now sells one-year licenses to trade directly on the exchange.³

Benefits of trading on exchanges

From the discussion above, it is clear that physical exchanges are something that evolved out of a need for a centralized place to traded assets; a place where buyers and sellers could meet. However, this is only one of many benefits of having an exchange. In particular, exchanges also provide a price formation mechanism and it may provide information through the publication of trade data and prices. Moreover, exchanges regulate the company listings and authorization of members and they provide supervision of trading and of settlement of transactions.

Over the counter, or OTC, trading

The opposite of exchange trading is in principle trading over the counter, or OTC, which is also sometimes referred to as off-exchange trading. The term over the counter refers to the trading of financial instruments such as stocks, bonds, commodities or derivatives directly between two parties. While in principle any asset could be traded OTC, in reality this particular market is much more important for some product than for other. In particular, the OTC market is relatively more important for bonds than for stocks, and it is estimated that less than 0.1 percent of all corporate bond trading appears at NYSE or AMEX.⁴ Interesting enough the NYSE claims to be the largest exchange for bond trading while the traded volume is very small.

In the US, over-the-counter trading in stock is carried out by market makers that make markets in OTC and Pink Sheets securities using inter-dealer quotation services such as Pink Quote, which is operated by Pink OTC Markets and the OTC Bulletin Board, or OTCBB. OTC stocks are not usually listed nor are they traded on any stock exchanges also, though exchange listed stocks can be traded OTC on what is then referred to as the *third market*. Although stocks quoted on the OTCBB must comply with U.S. Securities and Exchange Commission reporting requirements, other OTC stocks, such as those categorized as Pink Sheets securities, have no reporting requirements.

² You can find prices of seats @ <http://www.nyse.com/about/newsevents/1174040353411.html>.

³ See Wikipedia @ http://en.wikipedia.org/wiki/New_York_Stock_Exchange.

⁴ See Harris (2003).

NASDAQ – an exchange or organized OTC trading

NASDAQ was founded in 1971 by the National Association of Securities Dealers, or NASD, as the National Association of Securities Dealers Automated Quotations, or NASDAQ. At first, it was merely a computer bulletin board system and did not actually connect buyers and sellers. Hence initially it was classified as a successor to the OTC trading system. In fact, as late as 1987 the NASDAQ exchange was still commonly referred to as the OTC in media and also in the monthly Stock Guides issued by Standard & Poor's Corporation.

However, over the years, NASDAQ became more of a stock market by adding trade and volume reporting and automated trading systems. In 1992, it joined with the London Stock Exchange to form the first intercontinental linkage of securities markets, and in 1998 it merged with the American Stock Exchange to form the NASDAQ-Amex Market Group. As a result of this, at the beginning of the 21st century it had become the largest electronic stock market both in terms of dollar value and share volume in the United States.

NASD spun off NASDAQ in 2000 to form a publicly traded company, the NASDAQ Stock Market, Inc. The stock was listed on its own stock exchange beginning July 2, 2002, under the ticker symbol NDAQ, and is regulated by the Securities and Exchange Commission.

Source: Wikipedia.

The OTC market is very important for particular parts of the market for derivatives. In particular, swaps and forward contracts are prime examples of such contracts. Trade in these assets is mostly done via the computer or the telephone. In fact, one of the major differences between a forward contract and futures contract is that the latter is traded at exchanges using standardized agreements, which are usually governed by an International Swaps and Derivatives Association agreement. However, just like some exchange traded stocks trade OTC, contracts which are in accordance with the ISDA also trade OTC. In practice many of these contracts are issued by investment banks to its clients directly and may have special agreements for how particular trade or agreement is to be settled in the future. Other examples of OTC derivatives contracts are credit default swap, or CDS, contracts, which have been blamed, at least in part, for the current financial crisis, see the appendix to this chapter for more details on the evolution of this market and the relationship to the current crises.

The lack of regulation in the OTC market

One of the potential problems with OTC trading is the lack of regulation when compared to the trading which happens at regulated exchanges such as the NYSE for stocks and bonds and the Chicago Board of Options Exchange and the Chicago Mercantile Exchange for options and futures. This not only means that contracts are generally not standardized which makes them harder to trade and to correctly value, but it also means that issues such as counterparty risk become extremely important.

The example in the appendix illustrates some of the problems with a specific OTC market, and the recent developments which the current crisis has brought about when it comes to CDS trading.⁵ Along the same lines the NYMEX has created a clearing mechanism for a sample of commonly traded OTC energy derivatives. This allows counterparties of many bilateral OTC transactions to mutually agree to transfer the trade to ClearPort, the exchange's clearing house. In doing so, credit and performance risk of the initial OTC transaction counterparts is eliminated.

Benefits of trading over the counter

The first major benefit of OTC trading is that it allows for trading of assets which do not fulfill the requirement to be listed on actual exchanges. Secondly, the products which are traded OTC can be structured to fit the investor's objectives. Specifically, this means that OTC it is possible to trade assets which are not traded at any exchange or combinations of multiple exchange traded assets. Structured products are examples of such assets; a pre-packaged investment strategy based on derivatives, such as a single security, a basket of securities, options, indices, commodities, debt issuances and/or foreign currencies, and to a lesser extent, swaps.

Electronic Communication Networks, or ECNs

The term Electronic communication networks, or ECNs, denotes a type of computer system that facilitates trading of financial products outside of stock exchanges, and ECNs are the best known alternative trading systems, or ATS. ECNs are by now responsible for the major part of trading in the *fourth market*, which refers to direct trading between investors without benefit of a broker. The primary products that are traded on ECNs are stocks and currencies. In the US, ECNs came into existence in 1998 when the Securities and Exchange Commission authorized their creation. Some of the benefits of ECNs is that they increase competition among trading firms by lowering transaction costs, giving clients full access to their order books, and offering order matching outside of traditional exchange hours. It is important to realize that some ECNs are in fact regulated exchanges, others are sidelines of broker-dealers, and others still are in principle unregulated. ECNs exclude broker-dealers' internal crossing networks – i.e., systems that match orders privately using prices from a public exchange.

From the time of their collective rise through present day, ECNs have used NASDAQ as their proving ground. In fact, Instinet, Island and Archipelago, the three largest ECNs, currently account for close to 40 percent of NASDAQ's trade volume. The most important ECNs are: Archipelago (ARCH), BRUT ECN (BRUT), Instinet (INCA), Island (ISLD), and REDIBook (REDI). As a testament to their importance New York Stock Exchange announced a merger with Archipelago, which operates a fully electronic stock exchange called ArcaEX. The move was expected to give the NYSE a competitive advantage over its leading stock market rivals, NASDAQ and Instinet. As of 1 March 2007, NYSE Arca is the second largest ECN in terms of shares traded. Approximately one out of every six shares traded on the American financial markets is traded on the system. For New York Stock Exchange-listed securities, ECN trading accounts for just over 10% of the shares traded. For NASDAQ-listed securities, NYSE Arca accounts for approximately 20% of the

⁵ A very interesting program is available @ <http://www.pbs.org/wgbh/pages/frontline/warning/>.

trading volume. For exchange-traded funds, NYSE Arca accounts for 30-40% of the traded volume. Nine other ECNs are linked to NASDAQ through SelectNet 29. This link allows each ECN to display its best orders for NASDAQ securities in the NASDAQ system, and allows the public to access those orders.

Who can trade on ECNs

To trade with an ECN, one must be a subscriber or have an account with a broker that provides direct access trading. ECN subscribers can enter orders into the ECN via a custom computer terminal or network protocols. The ECN will then match contra-side orders (i.e. a sell-order is "contra-side" to a buy-order with the same price and share count) for execution. The ECN will post unmatched orders on the system for other subscribers to view. Generally, the buyer and seller are anonymous, with the trade execution reports listing the ECN as the party.

Benefits of trading on ECNs

When trading on ECNs orders are matched up between traders, and hence there are no bid-ask spreads to be paid. Instead a small price is paid per trade. In addition to this, since trading happens electronically trades are executed with very high speed. A final benefit of the ECNs is that they provide traders with greater anonymity than they could otherwise achieve. For big traders this is important since they may not want to publicly signal their desire to buy or sell as this may move the market against them.

Clearing and settlement Agents

Several agencies exist which facilitates trading by clearing and settling trades, which traders have agreed upon. These agencies also help prevent problems which may arise due to mistakes noted in the trades or directly fraudulent behaviour by one part or both parties to the trade. Finally, these agencies often mitigate the problems arising when one part to a trade is not trustworthy or creditworthy.

Clearing agents

Clearing agents match the buyer and seller records for a particular trade and makes sure that both parties to the trade agree on the terms. A trade is only said to clear if both buyer and seller report that they traded with each other, and that their reported terms of trade are identical. If this is not the case, the clearing agent will report the discrepancies to the traders, who will then try to resolve them. The largest securities clearing agency in the United States is the *National Securities Clearing Corporation*. The clearing of trades is trivial most of the time, especially when automated order-matching systems are used. Note that clearing agents are generally not involved in trades which are OTC.

Settlement agents

Settlement agents help traders settle their trades once these have been cleared. They do so by receiving cash from the buyer and securities from the seller. Only when both sides have honoured their contractual agreements, the settlement agent gives the cash to the seller and the securities to the buyer. Since clearing and settling are closely connected it should come as

no surprise that the largest settlement agency in the United States is also the *National Securities Clearing Corporation*.

The main reasons for using settlement agents are that they are very efficient, and they can help avoid losses due to trading with an untrustworthy counterparty or one who is not creditworthy. The efficiency mainly comes from the fact, that only net transactions are settled. That is, if a trader for instance during a day has bought an asset and resold part of the position again, only the net position at the end of the day is required to be settled. This reduces vastly the number of transactions required to settle the trades, and this is particularly so if all traders use the same settlement agent.

The speed at which settling happens is obviously of interest to traders. In particular, most parties would like to settle traders as quickly as possible in order to minimize trader exposure to credit risk. Until June 1995 the US securities industry settled stock and bond trades on T+5, i.e. within 5 days of the trade. It then moved to T+3 and is currently thinking about going to T+1, which would implicitly require that traders deposit money and securities with their brokers before they trade.

Clearing houses

In the futures, options, and swap markets many exchanges have clearing houses associated with them. A clearing house clears and settles all trades in the derivative contracts traded at the particular exchange. Moreover, the clearing house guarantees that both parties will perform on their contracts. To do this, the clearing house acts as the buyer for every seller and the seller for every buyer. This means that all trades conducted in this market are with the clearing house, and therefore counterparty risk is essentially eliminated.

Since the potential losses in this market can be large the clearing house requires their members to post collateral, a dollar amount, which is also called *margin*. In addition to this, positions are marked to market on a daily basis. This means that the contract is marked to its present market value. If the position has increase in value on a given day the exchange adds this profit to the margin. On the other hand, if the position has lost value the losses are subtracted from the margin, and should the margin fall below a certain fraction of the total exposure the clearing house issues a call for additional margin funds, a so-called margin call.

Regulation

Considering the size of the markets it should come as no surprise that regulation is needed. This comes both from the government and from self-regulatory organizations. The exchanges and the clearinghouses are examples of the latter, which also counts trader associations. In the US the two main associations of traders are the *National Association of Securities Dealers*, or NASD, and the *National Futures Association*, or NFA.

The main players in the US when it comes to regulatory agencies are the *Securities and Exchange Commission*, or the SEC, and the *Commodity Futures Trading Commission*, or the CFTC. The SEC regulates the markets for stocks, bonds, warrants, investment company shares, and

unit trusts. In addition to this, they regulated the market for equity options and for cash-settled equity index options. The CFTC regulates commodity spot, forward, and futures markets. These agencies not only regulate the markets they also collect and publish information about the market conditions and large trader positions. In Canada trading is regulated on a provincial level. In Québec the regulating authority is the *Commission des Valeurs Mobilières du Québec*.

Market structure

In finance the issue of market structure essentially deals with the different market participants in the market and how they interact. In some markets, for instance, assets are traded through dealers who keep an inventory, e.g. the market for new cars, while other markets are dominated by brokers who act as intermediaries, e.g. the case with houses. One of the important questions in microstructure research is how market structure affects trading costs and whether one structure is more efficient than another. As such it has little to do with the more general definition of market structure which refers to whether a market has perfect competition with many buyers and sellers, or whether the market considered is an oligopoly with several large sellers, each of which have some control over the prices, or a monopoly, where a single seller has considerable control over supply and prices.

Market participants

In general we distinguish between the following market participants:

1. **Traders:** A person or a firm who wishes to buy or sell an asset on the market. Note that this is not exactly the same as an investor although traders might invest.
2. **Broker:** A person or a firm who trades without taking a position in the market. The broker works as an intermediary, and this is in fact the term used for brokers in the UK securities law. Note that brokers are present in many other types of markets such as the market for real estate as real estate brokers/agents.
3. **Dealer:** A person or a firm executing trades for their own account. Unlike the situation with a broker, when dealers trade this always has an effect on the inventory. Other types of dealers are the market makers which, at various exchanges, are charged with continuously quoting bid and ask prices. Another example of a dealer is sports bookies who also take on one side of a given bet.

Note that in many cases brokers are also dealers and vice versa. In particular, securities bought from clients or other firms in the capacity of dealer may be sold to clients or other firms acting again in the capacity of dealer, or they may become a part of the firm's holdings. Technically, if the securities are traded again immediately, the firm acted as a broker although this may not have been the intention at the outset of the trade. Note that, although many broker-dealers are "independent" firms solely involved in broker-dealer services, many others are business units or subsidiaries of commercial banks, investment banks or investment companies.

Finally, it should be noted that the term “investor” in principle refers to a person which is strictly speaking not a market participant. In particular, as mentioned above while traders sometimes do invest this is not their main function in the market. In general the term “investor” is used to describe the particular type of people and companies that regularly purchase equity or debt securities for financial gain. In general the flow of an order from an investor to an exchange may be characterized by the following diagram:

Investor -> Broker -> Brokerage Firm (a commission broker) -> Floor Traders

Thus, instead of participating actively in the market investors use the market participants to execute a trade.

The buy side and the sell side

In the trading industry sometimes participants are said to participate either on the buy side or the sell side. However, this has nothing to do with whether a trader is buying or selling an asset. Instead, it refers to buyers and sellers of exchange services, or more generally the services provided within a particular market structure.

The buy side consists of traders who buy services from the market place. The most valuable service provided by an exchange is liquidity, i.e. the ability to trade when you want to trade. Traders on the sell side “sell liquidity” to the buy side among other things. To do this they provide liquidity by continuously standing ready to trade.

Traders on the buy side

The buy side of the industry includes individual, funds, firms, or even governments who trade primarily to invest current wealth for future benefit typically using stocks and bonds. In may also be traders doing the opposite, i.e. borrowing money against future wealth, using mortgages and other fixed income instruments. This category of traders corresponds to the investors we discussed above. Another important type of traders on the buy side is hedgers, who use financial markets to reduce risk. This group of traders often use forward contracts, futures, and other derivatives.

Traders on the sell side

The sell side of the trading industry includes dealers and brokers, and it exists only because the buy side will pay for its services. Dealers accommodate the trades their clients want to execute at the time at which they want to trade and profit from buying low and selling high. Brokers help their clients to trade by finding other traders who are willing to trade, and profit from the commission charged for providing this service.

Price formation and discovery

The issue of price formation and discovery focuses on the process by which the price of an asset is formed. For example, in some markets prices are formed through an auction process, e.g. eBay, in other markets prices are negotiated, e.g. new cars, or simply posted, e.g. local

supermarket, and buyers can choose to buy or not. An important issue in market microstructure focuses on the relationship between the type of markets and how this affects the market's ability to correctly determine or discover the fair value of an asset.

In the following we first discuss the types of order which are used in financial markets. We then discuss the two polar types of markets, the order driven market versus the quote driven market. Finally, we discuss the intermediate case; the hybrid market.

Order types

The issue of price formation is closely related to the types of order which can be used in a given market. In financial markets several types of orders are used. Each of these involves specific instructions to the brokers on how to complete the order. The most important of these are:

1. Market orders: Buy 100 shares of IBM at market prices.
2. Limit orders: Buy 100 shares of IBM at no more than \$25.
3. Stop orders: Buy 100 shares of IBM at best price once the price climbs above \$27. This is also referred to as stop-loss orders.
4. Stop limit orders: Put in a limit order once the price reaches a certain level.
5. Time limits on orders: Day order, good-till cancelled orders, and Fill or kill orders.

Depending on the price and the specification of the order in general it may be executed or not. Table 2 shows the different market conditions and the resulting action for the various types of orders above. The exception to this is the market order, which is always executed irrespectively of the current market price. Note that in some cases the orders are executed in

Table 2: This table shows the result of each of the orders conditional on the current market prices.

		Condition		
		Price \leq The limit	Price = The limit	Price \geq The limit
Action	Buy	Limit-buy order	Stop-limit (buy) order	Stop-buy order
	Sell	Stop-loss order	Stop-limit (sell) order	Limit-sell order

the sense that once the condition is satisfied they become market orders and hence are executed immediately. This is the case for the stop orders.

Order driven markets

The basis of the order-driven system is the orders entered with a quantity and a price limit, i.e. the limit orders. In an order driven market the broker does not take positions in the market, and as a result of this a counterparty is always needed to complete the transaction. This used to happen on a physical floor with the broker for a given share surrounded by others calling out buy and sell orders. Today, computer systems are usually used at least for large stocks. A classical example of this is the Computer Aided Trading System, or CATS, which is used in

Toronto, and on several exchanges in France and Spain. In CATS the orders are entered into a computer system and the equilibrium price is calculated automatically.

Example of how prices are formed in an order driven market

At the beginning of each trading day a “book” with such orders exist – the limit order book. However, in order to establish the price at the opening of trade a pre-opening call market is used. This is essentially like an auction which determines the optimal price in terms of the number of trades which can be executed.

Suppose that the limit order book prior to any trading is given by the orders shown in Table 3. Based on this the price at which the largest number of trades can be executed is calculated. It turns out that the price is 153 which would lead to a combined ask, that is buyers, of 1700 shares, and a combined offer, that is sellers, of 1750 shares.

In fact, it is easy to check that by either lowering the price to 152 or increasing it to 154 fewer trades would be executed. With a price of 152 the buy side would increase with 1000 units to 2700 shares, but the sell side would decrease with 600 units to 1150 shares. On the other hand, with a price of 154 the sell side would increase with 1250 units to 3000 shares, but the buy side would decrease with 750 units to 950 shares.

Given the established price of 153 market orders are then filled, and the total volume at the opening of trade is 2150 shares. The updated book corresponds to that found in Table 4. As orders arrive through the day they are matched immediately or added to the book. Suppose that an order to buy 250 at 154 arrives. This would be matched against a fraction of the first sell order and the price would be 154. Alternatively, suppose that an order to sell 1000 at 156 arrives. This order, on the other hand, would enter the book.

Potential problems in order driven markets

Two problems may occur in an order-driven market. The first problem is that there may be no orders! Secondly, there may be few but very big orders. The problem with this type of orders, which are often of institutional nature, is that they may take long time to be executed and the mere presence will tend to change the price. To solve this problem such orders are often broken

Table 3: This table shows an example of a limit order book for IMB prior to trading.

Limit order book for company IMB			
Buyers		Sellers	
Quantity	Price limit	Price limit	Quantity
500	Market	Market	400
200	156	150	250
250	155	151	400
500	154	152	500
750	153	153	600
1000	152	154	1250
3000	151	155	1700

Table 4: Limit order book at the opening of trade for IMB.

Buyers		Sellers	
Quantity	Price limit	Price limit	Quantity
50	153	154	1250
1000	152	155	1700
3000	151		

up. Alternatively, such orders are executed “off the floor”. An example of this is the Portfolio System for Institutional Trading, or POSIT, which is used on NYSE.

Exchanges using an order drive system

In fact most exchanges are order driven. Of the top 10 exchanges in the world the following use the pure order driven system are: Tokyo Stock Exchange, Euronext, Shanghai Stock Exchange, Hong Kong Stock Exchange, Toronto Stock Exchange, Frankfurt Stock Exchange, and the Madrid Stock Exchange. In many cases these exchanges use electronic platforms for order matching and execution.

As mentioned above the Toronto Stock Exchange, or TSX, uses an order driven system with a computer-based central limit order book. In fact, the TSX was one of the first exchanges in the world to computerize stock market trading when CATS was introduced in 1977. Although originally used for the quotation of less liquid equities through time more of the trading was automated and on April 23, 1997, the TSE's trading floor closed leaving only the electronic trading environment. The exchange is currently considered a global leader in stock market trading speed and reliability. Figure 1 shows an example of the limit order book for Canadian Imperial Bank of Commerce, or CIBC, traded at the Toronto Stock Exchange, or TSX, available from Thomson ONE.⁶

Flex Monitor		Co. News		Chart		4 in 1		Time & Sales	
Symbol: <input type="text" value="CM-T"/>		<input type="text" value="MBP"/>	<input type="text" value="MBO"/>	<input type="text" value="MBB"/>	CANADIAN IMPERIAL BK OF COMM				
		50.05	51.02	+0.82	200	981973			
Orders	Size	Bid	Ask	Size	Orders				
2	500	51.010	51.040	200	2				
3	5300	51.000	51.050	2100	4				
2	400	50.990	51.070	500	3				
4	700	50.980	51.080	500	5				
5	1500	50.970	51.090	1200	6				
1	100	50.960	51.100	400	3				
1	200	50.950	51.110	1300	3				
1	100	50.940	51.140	1000	1				
3	700	50.930	51.150	1000	2				
2	3700	50.910	51.160	3000	1				
1	800	50.860	51.180	700	2				
1	500	50.810	51.190	500	1				
1	400	50.800	51.200	500	1				
4	3500	50.790	51.230	800	2				

Figure 1: Screen dump from Thomson ONE of the limit order book for Canadian Imperial Bank of Commerce, or CIBC, traded at the Toronto Stock Exchange, or TSX.

⁶ Because of the potential value of this information for traders this service is only available when extra fees are paid and for this reason may not be available.

Order driven markets as auction markets

It should be noted that the order driven exchange in principle works as a continuously run auction. For this reason sometimes such a market is referred to as an auction market. However, sometimes the auctions are in fact not run continuously. This is for example the case with the Taiwan Stock Exchange. This exchange has normal trading sessions from 09:00am to 01:30pm and post-market sessions from 02:00pm to 02:30pm on all days of the week where auctions are held every 15 minutes. This last session is also referred to as a call market, and works similarly to the pre-opening call market used to establish the opening prices above.

Pros and cons of order driven markets

One of the problems with the order driven market is that prices are only available if a counterparty is available. That is, if a trader wishes to buy or sell an asset this is only possible when a counterparty is found. This may not always be the case for very illiquid markets for which no price exists. Off course, the trader could submit a limit order anyways. However, even if this is done there is no guarantee that the order will be carried out. Again this depends on whether or not a counterparty can be found.

One of the major strengths of the order driven market is the availability of information. In particular, investors in general have access to the entire limit order book. This means that it is always possible to figure out at what price one can trade what amount. More generally, the limit order book has a lot of information about the overall sentiments of the market. In particular, if there is much more volume on the sell side than on the buy side this probably means that investors are worried that the price could drop in the near future.

Quote driven markets

In a market which is quote driven, market makers offer quotes, i.e. bid and ask prices, continuously. Their profit comes from the spread between the ask price and the bid price. In general market makers are not required to hold positions in the market, although they are allowed to, if they should so desire. Moreover, to ensure competitive prices oftentimes there are multiple market makers. This also ensures that spreads are kept low since a lack of liquidity would lead to high spreads!

NASDAQ is the prime example of a quote driven market. To qualify for listing on the exchange, a company must be registered with the SEC, have at least three market makers, and meet minimum requirements for assets, capital, public shares, and shareholders. Another example is the London Stock Exchange which uses the Stock Exchange Automated Quotation system, or SEAQ, for trading mid-cap stocks. Stocks need to have at least two market-makers to be eligible for trading via SEAQ.

It should also be noted that in many cases some of the ECNs have a structure which resembles that of a quote driven market. Specifically, networks of dealers exist through which brokers or traders can access the best bid prices and ask prices for various assets. Finally, it should be noted that most of the markets for derivatives are quote driven also.

Pros and cons of a quote driven market

On a quote driven market, traders, which are not market makers, buy at the ask and sell at the bid. That is they pay slightly more when they buy than what they get when they sell, and this is a bad thing for traders. The difference is the spread between the bid and the ask, and the bigger this is the larger the costs of trading on this market. However, one of the pros of a quote driven market is that trades happen immediately. That is, buy paying the cost associated with the spread in return traders are ensured that the trade is carried out. Note that this is not guaranteed in an order driven market. Another bad thing about the quote driven market is the lack of information. Thus, while a trader can see the best bid and ask no information is in general available about the depth of the market. If a trader wishes to trade a large quantity of securities the price at which this can be done may not be known.

Hybrid markets

Sometimes markets are both order driven and quote driven and in this case we refer the market structure as a hybrid market. The classical example of this is the New York Stock Exchange, the NYSE, but the system is also used at the American Stock Exchange, the AMEX. At the NYSE each stock is allocated to what was previously termed a specialist but is now called a designated market maker. There are around 60 specialists at the NYSE and each specialist may have several stocks.

The specialist acts both as a broker and as a market maker and is required to maintain an “orderly market”. This means specifically that the specialist is required to provide a required amount of liquidity in the specific asset and to always take the other side of trades even when there are short term imbalances. Moreover, the exchange may require that the specialist attempt to prevent excess volatility in the markets. In return for all this the specialist is the only one who may trade the particular asset and has access to all the information available in e.g. the limit order book.

The London Stock Exchange is also an example of an exchange which is of the hybrid type for a fraction of the market. At this exchange a system known as the Stock Exchange Trading Service, or SETS, is used. This is the London Stock Exchange's premier electronic trading service which combines electronic order-driven trading with integrated market maker liquidity provision making it essentially a hybrid system. The system is used for trading FTSE100, FTSE250 and the FTSE Small Cap Index constituents as well as other liquid securities.

While it is often the case that hybrid markets have designated market makers, or specialist, this is not always the case. Markets do exist where traders can make the market by submitting bids and asks through limit orders, and take the market by hitting bids and asks, which have been submitted by others. Hitting bids and asks is what happens when a market order is submitted by a trader. In this situation we often talk about liquidity suppliers and liquidity buyers or removers. A trader submitting a limit order is providing liquidity to the market if the order is not crossed right away, whereas a market order removes liquidity from the market. This type of market is sometimes referred to as a continuous double auction.

Transaction cost and timing cost

Whenever a trade is executed there are costs associated with it. These costs may come from multiple sources. Examples are the cost of processing the order, the costs associated with the trade's impact on the market prices, or the costs of not being able to execute a trade. In market microstructure the impact of such costs on investment returns and execution methods are examined.

When talking about transaction costs we normally group these in three: Explicit costs, implicit costs, and missed trade opportunity costs. The explicit costs are the easiest to measure and basically involve all that a cost accountant would easily identify. These costs involve commissions paid to brokers, fees paid to exchanges, and taxes paid to the government. Explicit costs also include any resources that traders devote to the trading process. For example, the cost of setting up and staffing a trading desk counts as explicit costs. In many cases the explicit costs an investor faces vary between full service brokers and discount brokers.

Implicit transaction costs

The implicit transaction costs are the costs associated with passing a trade and arise because trades generally have an impact on prices. The most obvious implicit cost is associated with the bid-ask spread because traders buy at the ask price and sell at the lower bid price. However, this type of costs also includes the impact a large trade has on the market of either pushing prices up for buy orders or down for sell orders.

The most common way of estimating transaction costs is by using a benchmark price method. The per unit transaction cost is then measured as the difference between the trade price and this benchmark price. For a purchase, the cost is the excess of the trade price over the benchmark price. For a sale it is the opposite. To estimate the total cost of a trade this difference is multiplied by the trade size. Thus, we may write the per unit cost of a purchase as

$$UnitCost(purchase) = Execution\ Price - Benchmark\ Price,$$

and for a sale it is

$$UnitCost(sale) = Benchmark\ Price - Execution\ Price.$$

Unit transaction costs are therefore high if buyers pay high prices or if sellers receive low prices. Note that for buyers and sellers together the implicit transaction costs sum to zero, i.e. transaction costs on one side is trading profit to the other side.

The question is which benchmark price to use. Ideally we would like to use the price that would have prevailed if the trader had not tried to trade. The difference between this price and the trade price would be entirely due to the trade and thus a good measure of the implicit trading cost. Unfortunately, this price is not available! Instead traders commonly use an average of the bid and ask prices near or at the time of trade or volume-weighted average prices for a time interval surrounding the trade.

Market spreads and midquotes

The spread is the difference between the quoted ask and bid, and as such it measures one of the implicit costs of trading. From the spread the midquote is defined as the average of these quotes. This price is very often used as the benchmark price when estimating transaction costs in the formula above. In fact this method exactly measures implicit transaction costs of trading a round trip when the midquote does not change.⁷

To see this, consider a trader who buys at the ask price and sells at the bid price. This trader has done nothing but trade, and the unit costs of the two trades is the bid-ask spread. The implicit costs of trading are thus half of the bid-ask spread. Using the midquote as the benchmark gives us exactly this result: the cost of the purchase is the ask price minus the midquote, or half the spread, and the cost of the sale is the midquote minus the bid price, again half the spread.

When the midquote is used, traders refer to the transaction cost as the liquidity premium, and two times this is referred to as the effective spread. Thus, the effective spread is found by comparing the price of execution with the midquote:

1. For buy order: The effective spread = 2 x (Execution price – midquote).
2. For sell order: The effective spread = 2 x (midquote – Execution price).

The effective spread equals the quoted bid-ask spread when all purchases are executed at the bid price and sales at the ask price. However, this may not always be the case as dealers or brokers may offer to trade within the spread to arrange price improvements. In this case the effective spread that traders pay is smaller than the quoted spread. Likewise, when large orders are filled at prices outside the original bid-ask spreads the effective spread is greater than the quoted spread.

Example

Consider the following data:

	Market Bid	Market Ask
Quote	\$12.00	\$12.10

And assume that a trader places an order to buy 200 stocks. However, upon passing the trade a market maker offers a more competitive price of \$12.08. This is then the execution price. The quoted spread is calculated as: $\$12.10 - \$12.00 = \$0.10$. The midquote is given by: $(\$12.00 + \$12.10) / 2 = \$12.05$. The effective spread is given by: $2 \times (\$12.08 - \$12.05) = \$0.06$. Thus, in this example the effective spread < quoted spread due to the price improvement.

⁷ A round-trip means buying and then selling the asset or selling and then buying the asset, with no net change in position.

Spreads for large orders

When institutional traders trade large amounts it may make sense to divide these large trades into several smaller trades in order to manage market impact and the associated risk.⁸ However, when a large order is divided into several smaller orders the spread is not simply the difference between the most competitive bid and ask price. The reason for this is that each of the orders in itself changes the spreads. In addition to this since the orders are executed at different times the effective spread may have changed.

Thus, instead we use what is called the average effective spread. The average effective spread uses the effective spread of each of the several smaller trades, and can be calculated in two ways: as the simple average or as the volume weighted average of these several effective spreads.

Consider the following data:

Trade	Stocks	Effective spread
1	100	0.07
2	200	0.06
3	300	0.05

The simple average spread is easily calculated as $(0.07+0.06+0.05)/3=0.06$. The volume weighted spread on the other hand is given by $(100*0.07+200*0.06+300*0.05)/600=0.057$.

Realized spread

The realized spread is calculated the same way as the effective spread but uses a midquote observed at some later time following the trade instead of the midquote at the time of trading as with the effective spread. If the midquote remains constant the two spreads are equal. However, in real life prices often increase as a result of aggressive buyers and decreases as a result of aggressive sellers. Thus, realized spreads tend to be lower than effective spreads.

One argument for using realized spreads is that dealer's profits depend not only on the price at which they establish their positions but also on the prices at which they can subsequently liquidate the position. The realized spread attempts to measure this and is therefore a valid measure of implicit transaction costs.

Volume-weighted average prices, or VWAP

Another very commonly used benchmark price is the volume-weighted average price, or the VWAP. The VWAP is the average price of the day where each trade price is weighted by the size of the associated trade. Traders like the VWAP because at the end of the day they would like to have traded at least as well as the average trader on that day. The VWAP is calculated as

⁸ Sometimes this is referred to as algorithmic trading.

$$VWAP = \frac{\text{Dollar Volume}}{\text{Trade Volume}} = \frac{\sum_t \text{TradeSize}_t * \text{Price}_t}{\text{Trade Volume}} = \sum_t w_t * \text{Price}_t,$$

where $w_t = \text{TradeSize}_t / \text{Trade Volume}$.

The VWAP is used by many large traders, e.g. institutional traders and investment sponsors. These traders oftentimes have little or no information about when, during the day, their trades were made. Oftentimes they only receive reports of the share-weighted average prices of trades they made that day. For these investors it is possible to analyse the implicit transaction costs using the VWAP.

Missed trading opportunity costs

The missed trading opportunity costs arise when traders fail to fill the orders, either partially or fully, or when they fail to fill them in an orderly manner. This type of costs is also referred to as the opportunity costs. Oftentimes missed trading opportunity costs may be more severe than the costs of actually trading. Specifically, informed traders lose profits when their orders are not filled, and for hedgers a missed trade is also costly, as it leaves them exposed to the risk factors against which they wanted to be hedged at the outset.

A common way of estimating the missed trading opportunity costs of an unfilled buy order is to multiply the size of the order which was not filled with the difference between a subsequent price and a benchmark price. For a sell order the unfilled size is multiplied by the difference between the benchmark price and the subsequent price instead. In practice the subsequent price is measured at some time interval after the first decision to trade or after it is finally decided to give up trying to fill the order.

A major issue with measuring missed trading opportunity costs is to decide whether the order that goes unfilled was in fact a serious order which could have been filled under the most favourable conditions. This can be done by using a benchmark price which reflects the price at which trades could have taken place under these conditions. However, this price is very difficult to obtain. Instead traders often opt for simply using the same price as was used when measuring the implicit transaction costs.

Finally, it should be noted that there may be tradeoffs between the opportunity costs and the transactions costs, and as such monitoring or attempting to measure both is of importance to the trader. In fact, a trader can figure out if trading more or less aggressively would yield smaller overall trading costs, when monitor both of these. Specifically, if the increased transaction costs incurred when trading more aggressively are less than the saved opportunity costs the trader should decide to trade more aggressively.

Information and disclosure

This factor focuses on the availability of information and transparency of the markets, and on the impact of these issues on the behaviour of the market participants. Specifically when it

comes to the available information this depends very much on the type of market considered. For example, the hybrid market form used at the NYSE only allows for very limited information to flow to the general investor as the specialist is the only one with access to the limit order book. For the order driven market the entire limit order book may be made publicly available and this of course contains a lot of information.

When it comes to the issue of disclosure, this is tightly related to the regulation in place on a given market. Thus, while the trading system in place at the NYSE may in principle provide little information, due to the regulation in place at exchanges various types of information have to be disclosed. Note also that many exchanges are publicly owned companies who make money when trades are carried out. Because of this it is in the interest of the exchange to provide information so as to attract these trades.

Market maker and investor behaviour

As we have already seen market makers play an important role in many markets. For this reason alone it should be clear that the analysis of their behaviour is an important element of the issue of market microstructure. Although this may seem to be only an issue of rationality it may be much more than this. As an example consider the designated market makers, or specialists, at the NYSE. As we saw above their behaviour is to a certain degree governed also by the obligation to maintain an orderly market.

Investor behaviour may be affected by multiple things related to the microstructure of a particular market. The most important of these things is without a doubt, the price formation mechanism. This is important as it determines not only the costs of trading but also the issue of immediacy. Also the types of orders which can be submitted are important, and so is the actual type of exchange. It is, unfortunately, well known that investors tend to trade more when “doing it” themselves. Unless this leads to better returns this would be costly due to higher trading costs.

Market classification

When it comes to market structure various forms of classifications may be used. First of all we may classify exchanges according to the level of regulation, i.e. is it a centrally organized market or does trade happen primarily over the counter. Secondly, classifications can be according to the types of execution systems used and the intermediaries. Here we often distinguish between two major classes: quote driven versus order driven markets. Thirdly, exchanges can be classified according to the types of trading sessions. Here distinctions are usually made between continuous versus call markets, i.e. all traders trade at the same time. Fourthly, classification according to the system used for order matching is possible as these may be automatic versus non-automatic or electronic versus non-electronic. Finally and more generally, markets can be classified according to the level of information: is it a transparent versus non-transparent market.

Some examples are:

- Euronext: organized, order-driven, continuous, automatic, centralized, and transparent.
- NASDAQ: organized, quote-driven, continuous, automatic, centralized, and transparent.
- NYSE: organized, specialist (hybrid market), continuous, non-automatic, fragmented, and less transparent.
- Taiwan Stock Exchange: organized, order-driven, call market, automatic, centralized, and transparent.

Financial Trading System

In the trading room we will oftentimes use the Financial Trading System, or FTS, to illustrate how trading happens. For this reason it is important to know what type of market is used in these cases. In fact all of the above market types can be used, and the system allows for pure order driven or pure quote driven markets as well as hybrid markets using the continuous double auction. In addition to this markets can have a pre-open call market, or in fact be entirely a call market.

In the continuous double auction all traders can make market and take market as defined above and each trader can see all the bids and the asks posted in the system. Thus, this market is truly a hybrid market. In the pure order driven market only limit orders can be submitted and these are shown in the limit order book. All traders can submit limit orders. Trade takes place when a bid comes in that exceeds an existing ask, and here trading takes place at the ask price, or when an ask comes in that exceeds an existing bid, and here trading takes place at the bid price. Finally, in the pure quote driven market a certain number of traders are designated as market makers, and these are the only traders that can submit quotes. The best quotes are visible to all traders. Traders which are not market makers are market takers, and these can only submit market orders to buy or sell.

Trading with FTS

The benchmark market type used in the FTS trading cases is the continuous double auctions. That is, both limit orders and market orders can be used. When submitting limit orders traders become market makers, whereas a trader submitting a market order is implicitly a price taker. Figure 2 shows a screen dump of the trading interface from a generic trading case. In the following we describe how orders are submitted.





Figure 2: Screen dump from the Financial Trading System trading interface.

Submitting limit orders


As we saw above a limit order requires both a quantity and a price. Thus, to submit such an order a trader specifies both these elements in the interface in Figure 2, by filling out both the field with price and quantity. When clicking the “bid” button the order becomes a limit buy order, and the order appears on the bid side of the limit order book. When clicking the “ask” button the order becomes a limit sell order, and the order appears on the ask side of the limit order book. If the order happens to be either the most competitive bid or ask it will also appear in the little windows next to the respective asset.


To see the entire order book double click on the asset name. This will open a new window with the book which in general shows all the submitted orders and the trader who submitted them. If a trader wishes to clear all the submitted orders which have not been executed yet this is done by clicking on the “clear bids” or “clear asks” button, respectively.

Once limit orders appear in the limit order book traders may in addition use the available hand signals to submit orders. To be specific, when clicking on the symbol  next to an available ask price the system automatically submits a limit order to buy for the trader with a price which is higher than the one presently in the book. The trader thus becomes the most competitive market maker on the buy side by doing so. Clicking on  will lower the best available ask and make the trader the most competitive market maker on the sell side.

Submitting market orders

Market orders only require the specification of a volume. Hence such orders are simple to submit and this is done by simply filling out the volume field and clicking on “sell to bid” to sell and “buy at ask” to buy. Such orders are filled immediately or killed if this is not possible.

Market order can also be submitted using the hand signals once limit orders are available in the system. For example by clicking on  next to an available ask the trader immediately sells the asset to the market maker with the most competitive ask. Although the quantity can be filled

out if this is not the case the entire best order is “lifted”, i.e. the quantity sold corresponds to that specified in by the limit order. To buy the trader simply has to click on .

Submitting limit market orders

One of the problems with the pure type market order is that in a fast moving market the price may change before the order is executed. To protect yourself from this you can submit a limit market order. This order type is similar to a market order in that it sells to the best bid or buys from the best ask, but a market limit order is executed only if it meets or beats your pre-specified price.

A market limit order specifies both a price and a quantity. The price represents the limit that must be met or bettered before the order is processed. It is executed the same way a market order is, but requires filling in the price also. In the FTS hand signals cannot be used to execute this type of order.

Summary

Whenever traders trade they need to keep in mind how the particular market on which they trade works. That is, what is the microstructure of the market? Markets can be order driven, quote driven, or a mixture of the two which is called hybrid market. In each of these markets different orders can be used and they are processed in different ways. Depending on the market different information may also be available to the trader. For example, in the order driven market a trader may have access to the entire limit order book, whereas in the hybrid market used at the NYSE this information is available only to the specialist. Lastly, the market microstructure may affect the costs of trading incurred by the trader.

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Appendix: The market for credit default swaps

One of the asset classes which have been blamed for the current financial crises is credit default swaps. A credit default swap, or CDS, is a swap contract in which the buyer of the CDS makes a series of payments to the seller and, in exchange, receives a payoff if a credit instrument, typically a bond or loan, goes into default. Like most financial derivatives, credit default swaps can be used by investors for speculation, hedging and arbitrage.

As the market has matured, CDSs came to be used less by banks seeking to hedge against default and more by investors wishing to bet for or against the likelihood that particular companies or portfolios would suffer financial. The market size for CDSs began to grow rapidly from 2003; by the end of 2007, the CDS market had a notional value of \$45 trillion.

The CDS market in 2008

The market for CDSs attracted considerable concern from regulators after a number of large scale incidents in 2008, starting with the collapse of Bear Stearns. In the days and weeks leading up to Bear's collapse, the bank's CDS spread widened dramatically, indicating a surge of buyers taking out protection on the bank. It has been suggested that this widening was responsible for the perception that Bear Stearns was vulnerable, and therefore restricted its access to wholesale capital which eventually led to its forced sale to JP Morgan in March. An alternative view is that the surge in CDS protection buyers was a symptom rather than a cause of Bear's collapse; i.e., investors saw that Bear was in trouble, and sought to hedge any naked exposure to the bank, or speculate on its collapse.

In September two additional events spurred the public's interest. The first of these was the bankruptcy of Lehman Brothers which caused close to \$400 billion to become payable to the buyers of CDS protection referenced against the insolvent bank. The second event was when American International Group (AIG) required a federal bailout because it had been excessively selling CDS protection without hedging against the possibility that the reference entities might decline in value. This exposed the insurance giant to potential losses of over \$100 Billion.

Regulation introduced in 2008-2009

Eventually, the CDS on Lehman were settled smoothly, as was largely the case for the other major credit events occurring in 2008 which triggered payouts. And while it is arguable that other incidents would have been as bad or worse if less efficient instruments than CDS had been used for speculation and insurance purposes, the closing months of 2008 saw regulators working hard to reduce the risk involved in CDS transactions. In particular, until and during 2008 there was no centralized exchange or clearing house for CDS transactions; they were all done OTC. However, considering the events of 2007 and 2008 regulators called for this market in particular to open up in terms of transparency and regulation.

In November of 2008, the Depository Trust & Clearing Corporation, or DTCC, which runs a warehouse for CDS trade confirmations accounting for around 90% of the total market, announced that it would release market data on the outstanding notional of CDS trades on a weekly basis. The data could be accessed on the DTCC's website.

In addition to this, the U.S. Securities and Exchange Commission granted an exemption for InterContinental Exchange to begin guaranteeing CDSs. The SEC exemption represented the last regulatory approval needed by Atlanta-based InterContinental Exchange in its attempts to become the clearing corporation for CDSs, and the central clearing operations began in March 2009.

The CDS market after 2009

The changes which were seen in the CDS market were major by all accounts, and according to Deutsche Bank managing director Athanassios Diplas: “the industry pushed through 10 years worth of changes in just a few months”.⁹ In addition to the above mentioned regulation on the US market, there were some globally agreed standards falling into place in March 2009, administered by International Swaps and Derivatives Association (ISDA). Two of the key changes are:

1. The introduction of central clearing houses, one for the US and one for Europe.
2. The international standardization of CDS contracts, to prevent legal disputes in ambiguous cases where what the payout should be is unclear.

⁹ See Wikipedia @ http://en.wikipedia.org/wiki/Credit_default_swaps.