Chapter 2 - Types of Stock Orders and Order Routing
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This chapter concerns how you might submit an order to buy or sell a stock, how that order is listed, and when and why you would use market orders or limit orders. There is a section on short sales, and the chapter ends with a detailed discussion the new role of exchanges in order routing, and the controversial topic of large orders and their market impact and the Dark Markets that accommodate those large orders.

Here is what we will cover:

1. Best Bid and Best Ask (Level I) and how these get disseminated.
2. Level II and limit order book quotations.
3. Using market orders and limit orders.
4. Short sales.
5. The role of the stock exchanges.
6. The role of market makers and their replacement by high-speed traders.
7. Large order processing and Dark Markets (Dark Pools).
8. After-market or extended-hour trading.

1. Best Bid, Best Ask, and Market and Limit Orders

We know from **Chapter 1** that you can easily use an online broker to buy some stock, but how do you go about doing that? We know that the stock price changes moment by moment but what price is the current price? What price should you pay for your 100 shares of stock and how do you let the market know that you are interested? The first three sections of this chapter answer those questions, and the best place start is to explain Level 1 quotations and Best Bid and Best Ask.

Figure 1 – Segment of an TDAmeritrade Trading Screen Showing Best Bid and Best Ask for Intel (INTC)
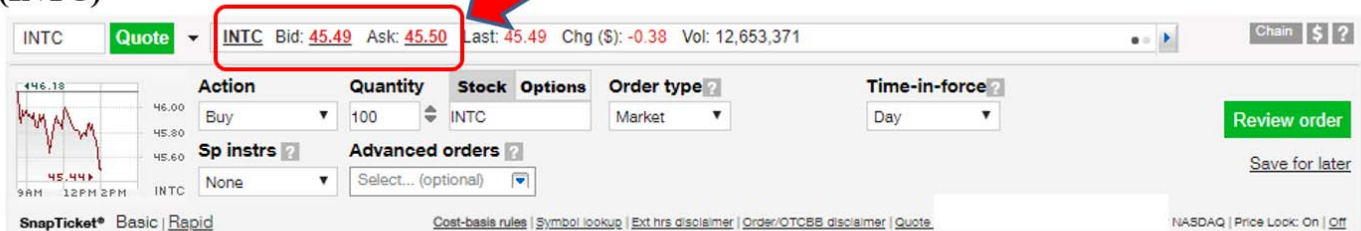
A market order to **BUY** will be executed at **Best Ask** ($45.50 per share) and a market order to **SELL** will be executed at **Best Bid** ($45.49 per share).

If you are not already familiar with these topics you have to be patient. You can't really understand Best Bid and Best Ask completely until you understand limit order queuing and Limit Order quotations, but they can't be explained until after our first attempt at explaining Best Bid and Best Ask. So we have a bit of a chicken and egg problem - where do we start? But by the time we have completed **section 3**, you will understand it all.

Let us start by supposing that you want to buy 100 shares of Intel **(INTC)**. Your first act would probably be to see at what price **INTC** is currently trading. You would go to your online brokerage site and would eventually encounter a screen that includes a segment that would look a lot like **Figure 1** shown above.

There is a price that is labeled *Last*, and as one might guess, that is the price executed on the most recent trade. But we need to know the current price – the prices that traders are asking to sell their stock (*Ask*) or are willing to pay to buy your stock (*Bid*) if you own some. Although the prices are labeled only Bid and Ask, it is understood that the prices shown are *Best Bid* and *Best Ask*. Generally, these are the best prices available from all quotations and all markets.[1] This kind of quotation, showing only Best Bid and Best Ask is called a *Level I* quotation.

If you instruct your broker to *buy* your 100 shares of stock at the best possible price, you will normally pay the *Ask* (the higher of the two prices). If you instruct your broker the *sell* 100 shares at the best possible price, you will be paid the *Bid* price. For heavily traded stocks like **INTC**, the Bid and Ask are typically only a penny apart, as shown here. But for less popular stocks, like Fastly, Inc. **(FSLY)** the spread between Bid and Ask can be much wider, five cents or even more.

An order that instructs a broker to buy or sell stock at the best possible price is called a *market order*. **Figure 2** shows two *trade tickets* from online broker TDAmeritrade, one for a market order and the other for a *limit order* The top trade ticket instructs TDAmeritrade to use a market order to buy **INTC** - the instruction, circled in red, is found in the **Order Type** dropdown box. The market order instructs TDAmeritrade to buy 100 shares of stock at current Ask, which at the moment was 45.50 per share (from the top of **Figure 2** – these quotes were clearly captured at slightly different times).

Figure 2 – TDAmeritrade Ticket to Buy 100 shares of INTC with a Market Order (Top) and a Limit Order (Bottom)

The bottom trade ticket in Figure 2 shows another ordering option (from a few seconds later) - trying to buy 100 shares of **INTC** with a limit order. A limit order allows you to specify a specific price at which you want to make a trade. The limit order shown in **Figure 2** on the bottom trading ticket, circled in green, instructs TDAmeritrade to submit an order to buy 100 shares of **INTC** at a price of **45.30** per share or better (lower). Note that this is below Best Bid at the moment (**45.48**). You can submit any price you want, typically at or below current Best Ask and even below Best Bid, as was done here.

The market order would be executed immediately upon submission, but the limit order to buy, if below Best Ask, would not, and might not be executed at all. If during the trading day, as the price of **INTC** goes up and down, if and only if Best Ask drops down to your limit price, then your limit order to buy 100 shares will be executed. In our example, our limit order will not execute unless Best Ask drops to **45.30**, and it may not even execute then (explained later).

So how long would this limit order stay active? That is determined by the instructions to you have chosen in the *Time-in-Force* dropdown box. The *Day* instruction (called a *day order*) shown in **Figure 2** with both orders, instructs the broker to leave the order in effect only during normal stock market hours, which begin at 9:30 AM and ends at 4:00 PM New York

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[1] The reader should go to one of the two financial sites used in this class (*yahoo* or *google*), get a current quote for **INTC** and find Best Bid and Best Ask. What is truly meant by "best" has to be qualified some, but we will do that later.

time every Monday through Friday except holidays. If a limit order is submitted as a day order if it has not been executed by 4:00 PM, then it disappears from the books.

The *Day+ex* **Time-in-Force** selection leaves the limit order active throughout the day and in the extended-hours market.[2] Other options include *GTC*, which means "Good until ('til) Cancelled," which will keep the order open until you explicitly cancel it, and *GTW*, which means "Good through the Week" and so forth.

Limit orders if not executed can be cancelled at any time[3]. Likewise, the trader can alter the limit order price at any time before it is exercised or cancelled.

2.   Level II and Limit Order Book Quotations

Clearly a limit order is an order than can stand for some period of time but also must be automatically executed if and when the market moves to the price specified by the limit order. This is automatically (by computers) resolved by moving the limit order to its proper location in a special pricing queue. The display of this pricing queue to traders is called *Depth of Market (DOM)* for securities in general (this queuing technique is commonly used in most securities markets, including commodities and FOREX) and is typically referred to as *Level II* (as opposed to Level I, where only Best Bid and Best Ask are shown, as discussed above) for stocks.

Level II
Cisco (CSCO)

Vol	MPID	BID		ASK	MPID	Vol
4	BYX	46.44		46.47	ARCX	1
32	NSDQ	46.43		46.48	PHLX	6
10	ARCX	46.29		46.50	BYX	17
18	CINN	46.27		46.61	NSDQ	12
126	GSCO	46.26		46.64	GSCO	9

Figure 3 shows a stylized Level II screen for technology giant Cisco **(CSCO)**. This is a display of some of the limit order queue that existed for **CSCO** at that moment.

On the right under the **ASK** column (sometimes called *OFFER*) are the limit orders to sell arranged from the *lowest* price at the top (hence the "**best**" from the standpoint of someone who wants to buy) rising as you move down the column.

On the left under the **BID** column are the limit orders to buy arranged from the *highest* price at the top (hence the "**best**") declining as you move down the column.

We can conclude from this that the Level I quotes generally available on all financial websites for free, which shows only Best Bid and Best Ask are simply the top of the Level II queues, shown in yellow. To be clear, the Level I Best Bid for **CSCO** is 46.44 and Level I Best Ask is 46.47.

The *MPID* column shows the *Market Participant ID* (identification) symbol for the exchange or market maker who has submitted this quote to the queue. In the sample shown, **BYX, ARCX, NSDQ, PHLX** and **CINN** are exchanges and **GSCO** is a market maker (explained later in this chapter).

Typically, the Level II quotation shows only the Best Bid and Best Ask from each MPID listed. For example, at **BYX** (one of the **Cboe** stock exchanges, this one located in Kansas) the highest limit order to buy is at **36.44** (Best Bid for all markets) and the highest limit order to sell is at **46.50** (not Best Ask for all markets, but Best Ask for **BYX**). **BYX** may also have a limit order to buy at **46.40**, but it is not listed because it is not best for **BYX.**

The **Vol** column shows the number of shares in hundreds at that limit order price submitted by the identified market participant, and it may, and typically does, represent more than one order. The market participant, like **GSCO** (market maker Goldman Sachs) representing 12,600 shares on the BID side at **46.26** (meaning they want to buy at this price), may have consolidated limit orders from many traders at this price and may be trying to buy some shares for their own account

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[2] Trading during extended hours is discussed in more detail later in this chapter.

[3] And most are. According to *The Wall Street Journal*, only about 1% of all limit orders are ever executed.

at this price. This multiple orders at the same limit price are *time stamped* (the exact date and time, right down to milliseconds are recorded with the order) as they are entered and the oldest orders are executed first.

So to answer the question of where limit orders go, if you were to submit a limit order to buy 300 shares of **CSCO** at **46.40**, that order would be routed by your broker to one of the exchanges or large traders represented in the **MPID** column. Suppose it was routed to **ARCX** (the electronic exchange of the New York Stock Exchange). Then it would typically show up on the BID side below the **NSDQ 46.43** entry and would replace the **ARCX 46.29** entry (and you shouldn't read any further unless you absolutely understand why this is true).[4]

Best Bid will always be below Best Ask in these queues. Why? These are automated markets so if these two prices are the same, someone out there wants to buy the stock at the same price someone wants to sell it, so it doesn't go into the queue - instead the order is transacted!

Given that market orders to buy are executed at Best Ask and market orders to sell are executed at Best Bid, which means they are picked off of the top of the appropriate queue, a market order to sell 200 shares of **CSCO** will immediately be executed at **46.44**. Because **BYX** was offering 400 shares at this price, those limit orders with the oldest time stamp summing to 200 shares would be sold and the **BYX** bid at **46.44** would remain Best Bid, but for only 200 shares.

When is a limit order executed? When it makes it to the top of its respective queue because the market has moved to that price. In other words, our limit order to buy will be executed if, only if, and when the orders in the BID queue above it have cleared and our order at our price has risen to the top and become Best Bid, and then only if someone is either willing to sell it at that price through a market order (automatically) or with a limit order to sell at your price. Also, if your limit order has a time stamp that is younger than the oldest time stamp at this price, your order may not be executed even though some stock was sold at your limit order price. All time stamps older than yours have to be exhausted before yours is executed. Obviously it is possible for your order to sit at the top of the queue without being executed - it happens all the time for less liquid stocks especially.

Ideally there is only one Best Bid and one Best Ask out there for all markets. But market and limit orders can be routed by many brokers through many market makers and other major transactors to any one of multiple exchanges in the United States. So how does a single Level II queue and, more important, how does a single Best Bid and Best Ask price emerge from this?

Since 1978 an organization called the *Securities Industry Automation Corporation (SIAC)* has executed a protocol called the Consolidated Quote Plan resulting in the *Consolidated Quotation System (CQS).* As part of this service **CQS** identified the *National Best Bid and Offer (NBBO*) (highest bid and lowest ask), which was disseminated by **SIAC** to subscribing market participants (including your broker) through the CQS Multicast Line*.*[5]

In 2012, the SEC and market participants began to change the **NBBO** designation to *Protected Best Bid and Offer (PBBO)* to take into account the growing importance of stock quotes from markets that are not included in the **CQS** protocol, such as the *dark markets* that are discussed later in this chapter, whose quotes are not publicly displayed. Although currently the media still refers to the public quotes as **NBBO** quotes, they should now be referred to as **PBBO** quotes.[6]

Again, this **PBBO** quote, the Level I quote, is what you see on an online trading site when you ask for a quote. *Normally* this system insures that no matter what exchange your broker trades through, you will get best bid or best ask on market orders to sell or buy.

Figure 4 shows an actual TDAmeritrade Level II trading display and on the right an Interactive Brokers Deep Book Trader, which is also called the *Limit Order Book*, for Intel *(INTC)* taken on August 15, 2019. Whereas the Level II

[4] Again, the order will appear on Level II only if it is the "best" price submitted by that MPID.

[5] *Securities Industry Automation Corporation, "Consolidated Quote System CQS Output Multicast Line Interface Specification,* May 24, 2010, Version 41, This document shows the coding protocols for disseminating quotes, among other things.

[6] This profoundly complicated issue is important, which is why it is here, but a complete explanation of the distinction being made here isn't possible until dark markets are explained, later in the chapter. For the sake of distinction though, no matter what the media says, all Level I and Level II public quotes that you see as a trader are **PBBO** quotes.

screen shows only the best bid and ask limit orders for each individual exchange or market maker, the Deep Book Trader **NASDAQ Total View** screen on the right shows the entire depth of market for all limit orders within the selected exchange (the images were taken a few minutes apart). All limit orders in the Limit Order Book can be shown (but are not shown in this image – the bottom is cut off).

Figure 4 – TDAmeritrade Level II Display and Interactive Brokers NASDAQ Total View Display for Intel (INTC), August 15, 2019
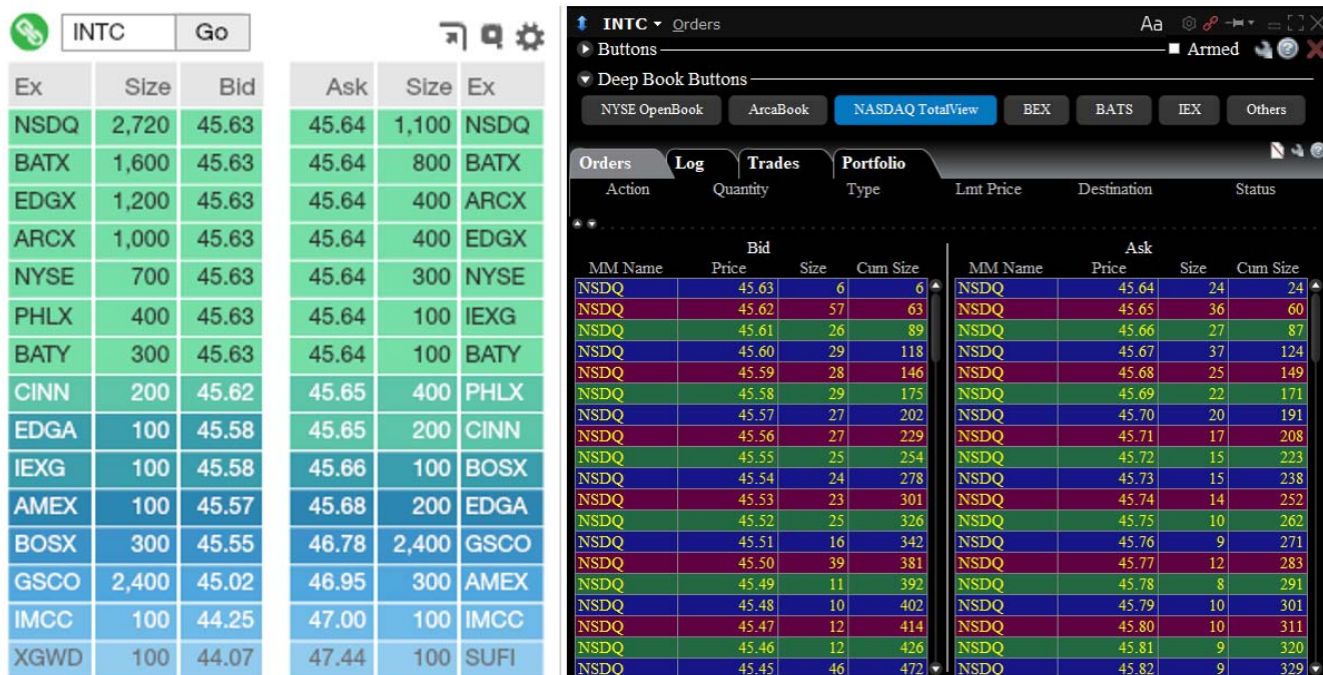
Whereas Level 1 access is available on all brokerage sites and even many financial news sites at no cost, this isn't necessarily true for Level II. Brokerage sites often require the trader to either have a minimum balance in the account or to execute a minimum number of trades. Otherwise they must pay a fee to view Level II. Traders must always pay a fee, usually considerable, to see the limit order books of the primary exchanges.

3.   Using Market and Limit Orders

The static view shown in **Figure 4** does not begin to capture the functioning of the Level II and Limit Order Book interfaces, which are very dynamic.[7] An active stock like Intel might average a thousand shares a second on a very busy day, which implies that this screen becomes very active and Best Bids and Asks may not last very long - maybe less than a second or only a couple of seconds. It is for that reason that on active days for active stocks, you should always use a limit order to place an order. If you use a market order, you might be very surprised at the price you paid for a stock.

Probably the most volatile market you would ever see is on the first day of trading for an active and popular IPO**.** Since no one is sure of what the price should be limits orders just start flying and the queue can swing through dollar differences in Best Bid and Best Ask in just a few seconds. For that reason, brokerages do not allow traders to even use market orders on the first day of an IPO - you are required to use a limit order. I remember trading in the first few minutes of trade for the wildly volatile Las Vegas Sands **(LVS**, pronounced "Elvis" of course) on December 13, 2004. Facing a hectic market, I placed my limit order to buy more than 50 cents *above* the top of the Ask queue to insure that I got the order, and I *did* as a result, and later sold for a nice profit.

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[7] If you are currently a student in Economics 104 then either right now or at the end of this article you should go to the video labeled Understanding Level II Quotations to see an active Level II screen.

I always advise my students to use Level II quotes when trading, even if you must pay a little extra for access to Level II, and to always use limit orders rather than market orders for initiating the trade, even in the quietest market for the calmest stock. It is just a good habit to get into because there are times of high volatility where one *must* submit limit orders. I always use *both* Level II and a couple of market book viewers (like the **NASDAQ Total View** above and the **ArcaBook** for the **NYSE**) when placing orders. They are worth the additional cost for an active trader.

Also, of course, you may want to use a limit order because either you have a target price in mind for buying or selling a stock or you simply think that you can make a trade at a better price than the current price.

Finally limit orders eliminate the necessity of watching the market at every moment once you are in a position.

Figure 5 – Using a Limit Order to Sell Twilio at a Good Price

For example, look at **Figure 5**, a graph showing the market activity of Twilio **(TWLO)** stock during the summer of 2016, right after Twilio had IPOed. After settling in, this stock took off in early August.

First, notice the *discontinuities* (where there is a clear breach in the spread between a price and the next quoted price in the series) in the stock price over the weekend of August 13. This is very common for actively traded stocks, especially in volatile markets.

Suppose, to use the example above, you had bought Twilio for **41.02**, which you could have done with a limit order in July 2016. The stock stays quiet for a few weeks but it begins to rise in the second week in August. On Thursday and Friday, the stock propels above **50** and you are tempted to sell, but you are willing to be patient and are seeking a much

higher price. Just before market close on Friday you place a limit order to sell at the price you want, **64.76**. You don't expect this to happen any time soon, so you set the limit order at **GTC (Good 'til Cancelled)** so you don't have to monitor the market. On Monday, **TWLO** soars to **66.40,** after which it plunges back below **60**. You check your listings and discover that, much to your delight, your order was executed at **64.76**.

That you didn't get **66.40** shows one of the limitations of using limit orders, but clearly limit orders eliminate the need to watch the markets. Also, some stocks are traded after hours and this example might have been one where the order was executed after domestic markets were closed (you have to have permission to trade after hours for this to happen).

Also look carefully at Monday's trade. Had you been in California where the market opens at 6:30 AM you might still have been in bed when your limit order executed. Had you relied upon watching the market and using market orders, the opportunity would have vanished if you are a late riser. By the time you roll out of the sack Twilio might have been trading at **58.25** That's why you always use limit orders.

[As a note of interest, **TWLO** would later collapse in price in late 2016, then recover in 2018, and then explode upward in 2019. Take a moment to look up the long-term chart of the stock price].

4. Short Sales

Normally when you trade a stock, or anything else for that matter, if you don't already own it, then you first buy it and later sell it, hoping in the interim that the price will rise.

But what if you think that the price of the stock or the market in general is going to go down. Is there any way to directly trade based on that belief?

Figure 6 – Short-selling Tesla (TSLA) in summer 2019

Of course there is. These market are highly innovative. If you think that the price of a stock is going to go down you can *sell it short*, and if you do, that is called a ***short sale***.

In a short sale, you reverse the order of a transaction: (1) you sell the stock first and (2) you buy it back later.

Figure 6 shows a hypothetical example. Let us review how an investor might short Tesla stock. As we saw in chapter 1, Tesla Incorporated (**TSLA**) has been a popular but controversial stock since its inception. Founder and Chairman Elon Musk frequently rattles the markets by making bold forward-looking statements that eventually turn out to be exaggerated or inaccurate.

From an engineering point of view, the cars produced by Tesla are the most advanced electric cars in the world, more popular than all other electric brands combined and, in 2019, sales of the new Model 3 were impressive. But from a business point of view, Tesla faces sky-high costs, is deeply in debt, nowhere near profitability, and plowing through cash.

Although **TSLA** has legions of loyal investors, because of its business problems, **TSLA** consistently is one of the most shorted stocks in the market. This implies that a large number of investors are betting that the stock price of **TSLA** will fall.

In this case, knowing that Tesla is going to release an earnings report after market close on Wednesday, July 24, 2019, an investor believing that the company will show poor results decides to sell 100 shares short on Monday, July 22. Prices for that day ranged from **254.19** to **262.12**. Suppose that the investor's first transaction was to submit a limit order to *sell* for **260.05.**

As the historical chart shows, this forecast turned out to be accurate. Tesla's forward guidance and revenue projections were weak when the report was released after hours on Wednesday. **TSLA** had closed at **264.88** but opened the next morning at **233.50**, a staggering loss. The stock would later sink to **225.55**, the low for the day, and closed at **228.82.** Suppose shortly after the market opened our trader submitted a limit order to *buy* at **230.25**.

As a result, the investor made **29.80** per share, a gross profit of **$2,980.00!** Although this example may make it seem easy, clearly had the earnings report been positive and the stock soared, then this would have been an example of a substantial *loss*.

How was it possible to sell before buying? How is this possible to sell something that you do not own?

First, you must have a margin account to execute short sales. You will be borrowing from that account.

Your broker has to give you permission to make short sales in the first place and then if that is allowed, the broker must then be in a position to *lend* you the stock to sell and be willing to do it. Generally, when you make this transaction you are technically borrowing the stock *in-kind* and promising to repay it in-kind later. In other words, you are not borrowing some amount of money, you instead are borrowing 100 (in this example) shares of **TSLA** and are promising to pay the loan back with 100 shares of **TSLA**. So you borrow (technically from your margin account), then sell, then buy, then repay. For the loan you will pay an interest rate determined by the broker and subject to the difficulty of obtaining the stock for shorting. The annualized rate on heavily-shorted stocks can be very high! For example, given that 100 shares of **TSLA** had a nominal value of **$26.005**, you would pay interest at an annualized rate of, say, 12% of that amount over the duration of the period of time that you were holding the short. The interest rate may rise to unacceptable levels if it becomes difficult for the broker to find shortable stock.

Figure 6 has an inset showing a trade ticket for **TSLA** from Interactive Brokers (from your teacher's trading account on a later day). The information inside the red circle (the green dot) tells me that I have permission to short **TSLA** without further query from me. I can just do it.

Typically, the broker is acting as an intermediary, lending you stock lent by someone else and then passing on some of the interest, typically about half, to the ultimate lender. The latter may be a mutual fund, hedge fund, or large investor planning to hold a long position in the stock indefinitely. Knowing that the stock will be returned (and realizing that this is

merely a reversible bookkeeping entry) the large fund, already long in the stock anyway, is willing to earn a little extra by lending the stock to a short trader.[8]

 Figure 7 shows another example of what the trade ticket or transaction screen would look like for a short sale. Look at the pull-down **Action**. In addition to the conventional Buy and Sell options on top, the trader can choose *Sell Short* to initiate a short sale. Then later to exit the transaction the investor would select the *Buy to cover* (which means buy to complete the transaction) and the short position is complete.

Figure 7 – TDAmeritrade SnapTicket trading screen to sell SPY short

This example from **Figure 7** is using **SPY** at more recent date (and at the end of a bad trading day – see the chart) trading at TDAmeritrade. Given Bid and Ask, the limit order is entered at a higher price than either in the effort to begin the trade at a price better than currently available.

When researching a stock, even if intending to take a traditional long position, it is sometimes worthwhile to review any available data about shorts on the stock. These data are normally available for most stocks in the financial variables section of the online research sites like *finance.yahoo.com.* There are two key variables that should be considered. To use a more contemporary example, we will look at shorts for **TSLA** in late July, 2019.[9]

Let's look at some data that confirms that **TSLA** is heavily shorted.

A stock's *short interest* equals the total number of shares that are sold short on any given day for the stock in question. For **TSLA** on July 31, 2019 short interest equaled 39,486,864 shares. *Days to cover* (also called *days short*) equals the number of shares sold short (i.e. short interest) divided by the average daily trading volume. For **TSLA**, average daily volume for the previous 90 days had been 9.308 million shares so the days short equaled 4.24, which is a high number but not excessively so. **AAPL** in comparison had a days short of only 1.83 and **FB** had a days short of only 1.40.

Finally, *shorts as a percent of float* is the percentage of all shares that are in circulation that are shorted. In the case of **TSLA,** 132.6 million shares were in float, so shorts as a percent of float equaled 29.8%, a very high number. It means that nearly one share in three was shorted.

These numbers are useful only when compared to competing companies or values in the past.

If the short ratio is unusually high this is worth knowing for two reasons: (1) it reflects clearly that *someone* out there is pessimistic about this stock and it might be interesting to know why, and (2) on the other hand, shorts must eventually be covered, so a high short ratio suggests that there is a floor of latent demand - at some point short sellers will have to buy to cover their positions.

But short sales are not for the novice investor. You are betting against a market that rises much more than it falls so this is no place for amateurs. For years, professional investors have been placing short bets on Tesla, to continue our example, which has had shorts as a percentage of floats above 25% for years, and for many years, all they got for their trouble had been large losses.

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[8] In recent years it was revealed that many brokers were allowing traders to trade short *without* arranging for a loan of the stock in kind, which is called a **naked short** and is of dubious legality. At the time of this writing, it was apparent that this practice had been discontinued.

[9] One of the best sources of short information is from the free NASDAQ quotation site. The information above for FEYE was taken from http://www.nasdaq.com/symbol/feye/short-interest.

A high prevalence of shorts at times will introduce the phenomenon called a *short squeeze*, which happens when a heavily-shorted stock starts to rise in value, forcing the short sellers to buy to cover their positions, further accelerating the price *increase*. Clearly, an abundance of short trading can make markets more volatile.

5.   The Role of the Stock Exchanges

So far we have made it clear that to buy or sell stock you must open an account at a broker. Also it is clear from the discussion of Level II listings that the orders are routed to some kind of exchange where in effect buyers and sellers are matched up, the trade consummated, and the information disbursed so the rest of us know that it happened.

Figure 8 – Order Routing
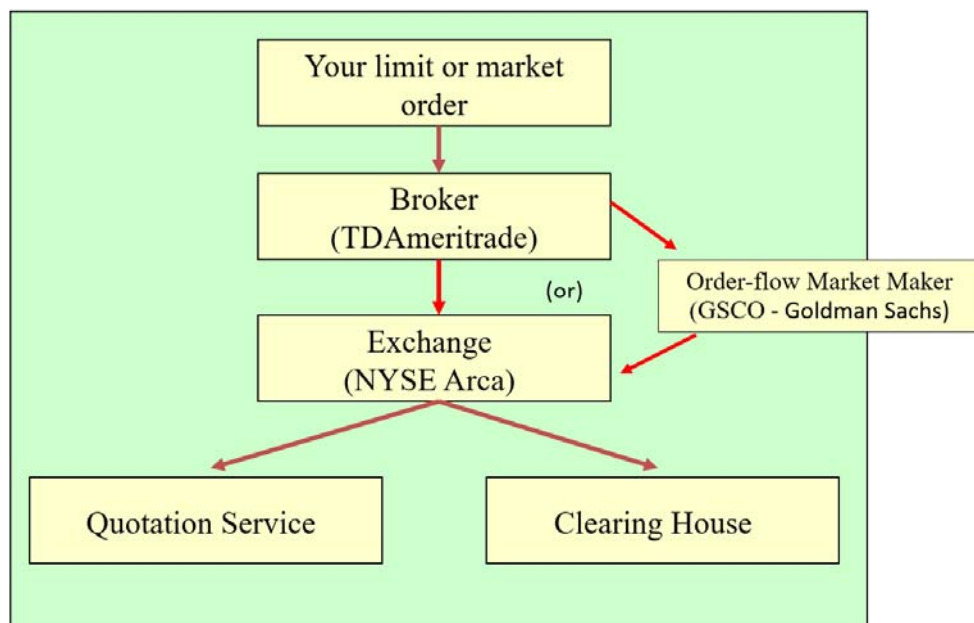
Figure 8 - Order routing shows the typical channel taken by your order. Once the broker receives it, it can be sent directly to any one of a number of exchanges, where once consummated the transaction is sent to a quotation service where it shows up with almost no latency on everyone's computer screen, even if for only a tiny second, and then sent off to a clearing house to insure everyone is paid and all securities transferred.

Sometimes the order is instead routed to a specialized securities firm, typically a market maker (described later) who actually pays for the order routing so that they can match internal orders or generally perform their market maker function. As such, the transaction may be consummated without ever involving an exchange.

The role of any *stock exchange* historically or currently, is to match a seller with a buyer at a price that is agreed to (directly or indirectly) by both. The stock exchange is also responsible for executing and clearing the order.

Back in the good old days when I bought a few shares of Ford from my broker Marvin Arnold, the terms "listing agencies" and "stock exchanges" were synonymous. If a stock was listed on the New York Stock Exchange it was also typically traded on the New York Stock Exchange, which then was a physical exchange located at 1 Wall Street in New York (it's still there, but most trades are now executed electronically away from the floor of the exchange, in New Jersey). **NYSE-**listed stocks could also be traded on one of the many small regional physical exchanges, like the Pacific Coast Stock Exchange in San Francisco (shown in *Figure 9*) and Los Angeles. These regional exchanges have either disappeared altogether or trade securities other than stocks (like options or commodities).

So my order for Ford would likely have been routed from my broker in Fresno to either the New York Stock Exchange or the Pacific Coast Stock Exchange.

Figure 9 – The Old Pacific Coast Stock Exchange (now a fitness center)

At the time there was a competing exchange, the American Stock Exchange, or **AMEX**, also located in New York. The **AMEX** had lower listing standards than the **NYSE.** Over the years though the **AMEX** could not compete and in 2008 the exchange and it listings were absorbed by **NYSE Euronext.** Today the **AMEX,** as a subsidiary of **NYSE Euronext,** has regained some fame by specializing in listing and trading Exchange Traded Products.

The **NASDAQ** market came online in 1971 and it differed from the **NYSE** in that it was the world's first electronic stock market without a physical market place. The "AQ" in **NASDAQ** stood for "automated quotation" (system). This system worked like a very primitive and proprietary version of the internet, powered by huge, expensive and primitive computers (by today's standards) located in Trumbull, Connecticut. The computers sent out stock order and pricing information to brokers nationally for smaller companies that were not listed on the **NYSE** or the **AMEX**.

As **NASDAQ** matured then stocks that were listed on **NASDAQ** were traded on **NASDAQ**.

Up until 2005 the majority of stock orders were executed by the New York Stock Exchange, then largely a non-automated physical exchange where floor traders and specialists standing in trading booths using a physical system called ***open-outcry*** (see **Figure 10** for an archival photo of the open-outcry system) on the **NYSE**, or through the automated **NASDAQ**, along with a small trickle that ended up at **AMEX** or a regional exchange. In the dramatic open-outcry system, ***floor traders*** literally yelled and used coded hand signals to communicate their orders to market makers (again, to be explained later) standing in horseshoe-shaped dedicate trading booths.

But two forces began to change the comfortable and established exchange arrangement which resulted in the radical difference that we see in the multiple and competing exchanges that we see today.

First, trade execution technology began to change in favor of full automation. Automated exchanges were beginning to gain acceptance in overseas markets like Singapore, and specialized fully electronic automated order trading and clearing networks collectively called ***Electronic Communications Networks (ECNs)*** began to appear. The oldest was called Instinet, which had been established in 1960 as an exchange specializing in listing bid and ask quotes for large block trades (typically in excess of 10,000 shares). Instinet was quick to automate. Two other clearing networks called Archipelago (1997) and The Island (1997) began to attract a lot of attention as models for the future. Then in 1998 the SEC passed ***Reg ATS (Alternative Trading Systems),*** which directly authorized and encouraged the formation of ECNs. Although at inception they weren't legally defined as exchanges by the Securities and Exchange Commission (SEC), traders, especially professionals, rather quickly noticed that these new ECNs offered very low-latency trading at potentially a fraction of the cost of human-based trading systems like the NYSE's open-outcry. When the trade efficiencies of the ECNs became obvious, the older systems were doomed.

Figure 10 – Historical Photo of one of the NYSE trading booths

Source: Archival photo from the NYSE Euronext timeline, circa 1985.

The second force for change was a 2005 SEC mandate called The SEC Regulation National Market System, or as referred to by the media in shorthand, *Reg NMS*. This sweeping mandate effectively allowed the ECNs to become exchanges so long as a detailed set of criteria were matched. Among other things, a special Rule 611 required that any new exchange follow the **NBBO** (now **PBBO**) protocol that insured all bids and asks are consolidated to produce Best Bid and Best Ask and to insure that no matter what the exchange used by a customer, that market orders trade at the "best possible price." This was no small task. The automated electronic systems of the old exchanges and these new exchanges had to be consolidated sufficiently to comply with the Consolidated Quotation System (**CQS**) that produces the all-important Level I and Level II quotations discussed in **section 2** of this chapter. These public quotations are referred to in Reg NMS as "*protected quotes*", an obscure distinction that will become important in the next section, hence the term Protected Best Bid and Ask (PBBO).

The result of Reg NMS? Currently in the United States there are over 20 securities exchanges approved by the Securities and Exchange Commission that now compete for order flow, including combinations of the old New York Stock Exchange **(NYSE)** and **NASDAQ.**[10] It didn't take long for the established exchanges to see the writing on the wall – you had to go fully electronic. **NASDAQ** purchased Instinet *(***INET***)* and the NYSE purchased Archipelago (which became the symbols **ARCA** and **ARCX** on the Level II screens).

 Both exchanges also went on a global merger and acquisition binge. The **NYSE** merged with **Euronext** in 2007, which in turn had consisted of the Paris, Amsterdam and Brussels exchanges and later acquired the Portuguese exchange. **NASDAQ** acquired directly or indirectly 10 former overseas stock exchanges and the blended super-exchange became **NASDAQ OMX**.

In the next wave some of the original ECNs began to merge among themselves. On August 26, 2013, **Bats** and **Direct Edge** merged to form **Bats Global Markets**, headquartered in Kansas City, MO, which further demonstrates that in this day of computer automation, you don't have to be located in a large money center top run a global exchange empire. Finally, in March, 2017, the Chicago Board Options Exchange (**CBOE**) purchased all of the **Bats** exchanges.

Of the 20 listed exchanges, not all trade stocks (some trade options only) and some are specialized divisions of the same company, like **Cboe EDGA** and **Cboe EDGX**. Since their authorization in 2005 (in the United States) these pioneering exchanges have gone through wave after wave of consolidation, a process that will continue into the future. To some extent this was guaranteed because some of the smaller exchanges with the best technology simply did not get the order flow to become profitable.

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[10] For the full list, which seemingly changes by the day, see the SEC list of exchanges at https://www.sec.gov/fast-answers/divisionsmarketregmrexchangesshtml.html.

Although electronic trading now dominates, open-outcry trading has not entirely disappeared. The New York Stock Exchange still supports a few hundred floor traders and brokers and their contribution to trading is documented in statistics that refer to the **NYSE/floor**. These traders only account for about 12% of trading on a normal trading day but on critical days of market problems when electronic systems are not to be trusted, the floor traders can account for 25% of all trades! Additionally, on the **NYSE**, the floor traders actively participate in the closing auction (not explained in this chapter) that determines the day's closing price for each stock, which makes them very important for **NYSE-listed** stocks.

As of January 2019, no exchange really dominates the order flow for stocks. For example, approximate shares (rounded off) of the largest three equaled: **NYSE** (25%, half of which is explained by floor trading)**, NASDAQ** (20%), and the two formers **Bats** exchanges, **Cboe BZX** and **Cboe BYX** (17%). The next largest exchange after that was the new **IEX** with only 2.5%. The same data source showed that off-exchange transactions equaled nearly 35%[11]

So even though Ford (**F**) is still a stock listed by the **NYSE**, these days an order to TDAmeritrade to buy or sell **F** is not necessarily routed to the **NYSE**. Likewise, if you look at a Level II listing, which, remember, is a listing of limit orders at different exchanges, you will see a large number of exchanges being represented, all of them somehow queuing their orders properly into Level I and Level II.

6. The Traditional Role of Market Makers and their Replacement: High-Speed Traders

In past versions of this chapter, this section opened with the following somewhat cheerful sentence: In between the brokers and the exchanges are a dedicated and important set of traders called *market makers*.

Alas, by the time we get to 2019, market makers, who have been part of the lore of markets since the earliest years, have been largely replaced with high-speed traders.[12] To understand the current role of the high-speed traders, one must first grasp the traditional role of market makers.

Market makers were a very traditional and very important part of the stock market mechanism up until around 2005. Their primary traditional job was to "make the market," which specifically required them to supply liquidity to the markets at all times and when no one else would, which by example meant that they are willing to supply both bids *and* asks for selected stocks. In a few words, they were expected to simultaneously fill in bids and asks on the Limit Order book queue when no one else would. They were expected to do this in times of crisis - to buy stocks, maybe under restrictions, when there was otherwise no market.

The market makers were (and still are - they still exist) specialized trading houses. Many of them were banks or subsidiaries of banks. The **NYSE** and **NASDAQ** market makers had to be approved by the exchanges, subject to the agreement to participate actively in the markets for only certain stocks, although that list often would have been very long.[13] In the past, if a company had been hired to be one of the underwriters of the IPO (effectively, a financial sponsor that helps finance and promote the IPO while assuring compliance with exchange and SEC regulations) then that company was obliged to be one of the market makers for the stock after it was listed.

Market makers were seen as necessary for the less popular stocks (you don't really need a market maker for Intel) to insure that there was liquidity - established limit orders offering bids and asks to satisfy market orders, especially those coming from small traders. Market makers did this by trading for their own account while often at the same time trading

[11] These data were provided to *The Wall Street Journal* by the Tabb Group. See https://www.wsj.com/articles/wall-street-firms-plan-new-exchange-to-challenge-nyse-nasdaq-11546866121?mod=hp_lead_pos7
[12] This is well documented by Jared Egginton, "*The Declining Role of NASDAQ Market Makers*," **The Financial Review** 49 (2014) 461-480, Eastern Financial Association.
[13] The **NYSE** had stricter trading requirements than **NASDAQ**. Up until the new century, the **NYSE** floor market makers (traders) were called specialists, and stood in horseshoe-shaped trading booths on the floor of the exchange accepting and giving hand signals for stock trades in an occasionally wildly chaotic ritual. **Figure 10** shows a photo of those times.

on behalf of clients. If trading for their own account, that means that they were willing to *either* buy or sell the stock in question at the listed bid or ask. This implies of course that the market maker maintained a large and fluctuating inventory of the stock in question. But between 2005 and the present time, traditional market makers were slowly crowded out by a more efficient and ruthless type of institutional market participant - the ***high-speed trader*** or ***high-frequency trader***.[14] With the 2005 deregulation, the decline in transactions fees that arose in that competitive environment, and tremendous strides in computing capacity, more and more independent traders discovered that they could *mimic* the activities of the market makers in whatever stocks they wanted *without* agreeing to make the market in times of distress.

Figure 11 – GSCO and other market makers providing liquidity to NATH on both sides of the queue (Interactive Brokers)

It is important to understand that during times of crisis - especially during declining markets - the market maker was supposed to stay in the queue, *even when everyone else is withdrawing*, to make sure that *market orders* will find a buyer or seller. In a collapsing market the ask side of the queue should remain robust (this should require no explanation) but the

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[14] There is a difference. High-speed trading is more properly called *low-latency trading*, because the point is to be first in reacting to market signals. High-frequency trading (typically also low-latency) implies a large volume of recurring limit and similar orders jumping in and out of markets. All of this is generically called *algo* (algorithmic) and *quant* trading.

bid side can vanish (everyone wants to sell, no one wants to buy). The market maker is expected to provide bids - even if low bids - effectively offering to absorb inventory even in a declining market.

To better understand the traditional role of the market marker and to understand how this process was crowded out by *high-speed trading*, review **Figure 11.** This shows a frozen Interactive Brokers limit order book screen from hot-dog franchiser Nathans Famous (**NATH**) from a moment in a trading day in August 2019. Unlike **INTC**, **NATH** is a fairly illiquid stock, sometimes with just a few hundred shares traded in a single day. This low liquidity is fairly typical for a small-cap stock. The most obvious effect of the lack of liquidity is the sizable spread between Best Bid and Best Ask, (both submitted on the **Cboe BYX** exchange) which in this example equals $1.05! Compare that to a liquid stock like **INTC**, which is typically a penny. You can see that **GSCO** (Goldman Sachs) has both a bid and an ask represented, as do some of the other market makers like **SUFI** (Susquehanna Financial Group) , **IMCC** (IMC Financial Markets), and **ETMM** (G1 Execution Services).[15] We can't be sure that the 400-share bid at **62.28** and the 400 share ask at **71.17** is for **GSCO***'s* own account or that of a client.

Although market making required huge financial resources, this was normally a very lucrative business. An inspection of **Figure 11** should show why. Although **GSCO** has both a bid and ask, it is plain to see that the ask is $8.89 higher than the bid! Also look at the relative quotes of **VALX** and **IMCC**. An inspection of any Level II or limit order book queue will show that for any market maker (or algo trader) there is *always* a positive spread between bid and ask, for the market as a whole and for any market maker in the market. Given that the market maker adjusts inventory all day, adding to inventory from the bid side and depleting from the ask side, over time he makes money from the spread, even if the spread is only a penny.

Market makers also processed trades for brokers or their own clients and managed client portfolios so fees were also a source of profit.

It was possible for a market maker to lose money. If a market maker went into a sharply declining market with large inventory, then money would be lost as the value of the inventory declined with the falling price, and of course a market maker listing a bid may have to buy at that price, only to eventually see the stock price plunge below it. Market makers, though, generally profited in stable or rising markets mostly because of the spread between bid and ask.

This potential for profit from the spread between bid and ask has created a huge opportunity for high-speed (algorithmic) traders who were *not* market makers. Their trades are largely automated through trading software (hence the term *algo*) - there is little human activity except, of course, in developing the original strategy and the programming. They perform much of the same liquidity using the same strategy as traditional market makers, but in whatever stocks they want at any level they want and in competition with each other. Far more important, they do *not* have the legal obligation to make a market in designated stocks in times of trouble! The algo traders bail in times of trouble, and in fact sometimes they are the cause of the trouble.

Finally, when we say that algo trading replaced market making we don't necessarily mean that companies died (although some did) and others sprang up in their place. Instead, many market makers became algo traders, simply abandoning the legal market-making function.

The automated algo trading technique is called *spread arbitrage*.

Spread arbitrage takes advantage of the spread between bid and ask which is the origin of market makers' profits. But algo trading takes it a step further. Fully automated computer programs seek spreads between bids and asks for a plethora of

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[15] NSDQ, ARCA, BYX, and EDGEA are all exchanges. As is the distinction between market makers and high-speed traders, the distinction between exchanges and market makers and the roles they play are also blurring. For a reliable source of all MPIDs, see http://www.level2stockquotes.com/market-makers-a-list.html

stocks and if they spot an opportunity, the program, with no human intervention, will trigger limit orders, typically on both sides, inside the existing spread, effectively making both limit orders Best Bid and Best Ask (or some similar strategy), even if for a very short period of time (measured in milliseconds or even microseconds)! Now if there is heavy order flow for *market orders*, or if the firm is paying for market order routing, then if market orders come in on both sides while you are at the top of the queue, then you both buy and sell approximately (not necessarily exactly) the same amount of stock at a positive spread.

Go back to **Figure 11** and look at the spread between Best Bid and Best Ask on **NATH**. An automated program wanting to take advantage of this spread might simultaneously establish a *limit order to buy* 100 shares at **66.25** and a *limit order to sell* 100 shares at **67.25**. Both would be established as Best in the ***PBBO*** structure so any market order that comes in for 100 shares would be yours. In this example, 100 shares are too few and liquidity in **NATH** is too low to make any real money, *which actually explains why the spread is so wide* – probably no algo traders are playing **NATH**! It also explains why the spread is so narrow for stocks like **INTC** - algo trading computers are at every second trying to play the spread.[16]

These kinds of high speed trades, with no human involvement, are dizzying in their aggression and speed. These computer-generated limit orders can be generated and cancelled in fractions of a second, causing order flows in and out of limit order books that are staggering in their speed and scope. Why? Once we place our bid at **66.25** and ask at **67.25**, what is to prevent another computer 20 microseconds later placing **66.30** and **67.15**? So we withdraw our limit order. Then someone executes and we start all over again. All in less than a second!!

Market makers are all now algo traders but many algo traders are not market makers, and this *has* caused a problem in recent years. Algo traders doing spread arbitrage are like market makers represented on both sides of the bid/ask queue and they are providing liquidity and marking markets just like the formal market makers, and maybe on a much larger scale. But the algo traders who are not market makers *are not required to stay in position when things get tough, and they don't!* This capacity for algo traders to flee bad markets has more than once caused what is called a *flash crash* - a sudden acute but temporary severe market crash (or at least a crash in many stocks or ETPs) caused by the computers of algo traders abandoning the bid queue in a panic! Basically the bid side of Level II goes blank and prices plunge, all in a few seconds.

Furthermore, computer-automated trades can actually *cause* a market crisis!

This sobering truth became abundantly clear on August 1, 2012. On an otherwise quiet Wednesday, Knight Capital, at the time one of the largest algo traders (and market makers), within 45 minutes lost $460 million, nearly wiping out the company.[17] A huge trading crash was triggered in a legacy computer trading program (or test program, there is some dispute) designed to do proper automated spread arbitrage. According to an investigation by the SEC,[18]

> "While processing 212 small retail orders that Knight had received from its customers, SMARS [the name of the software] routed millions of orders into the market over a 45-minute period, and obtained over 4 million executions in 154 stocks for more than 397 million shares. By the time that Knight stopped sending the orders, Knight had assumed a net long position in 80 stocks of approximately $3.5 billion and a net short position in 74 stocks of approximately $3.15 billion. Ultimately, Knight lost over $460 million from these unwanted positions."

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[16] This example is important to keep in mind when weighing the heavy popular criticism of algo traders, which has been in the news a lot. Through their competition, they **do** keep spreads narrow for the more heavily traded stocks, and that is good for retail investors.

[17] Knight Capital probably would have disappeared for good had it not been for a financial rescue provided by three other trading firms and a private investor. See Halah Touryalal, "*Knight Capital: The Ideal Way to Screw up on Wall Street," **Forbes,*** August 6, 2012.

[18] SEC Release No. 70694, October 16, 2013, Administrative proceeding File No. 3-15570 In the Matter of Knight Capital Americas LLC Respondent.

Effectively bids and asks of nearly 150 companies were sent to wildly arbitrary levels triggering off profitable counter-trades from other market traders. For example, Timken Company (**TKR**), was pulled up 14% suddenly by a series of Knight limit orders and gleeful sellers (some computerized presumably) sold right into it. Another, Corning (**GLW**), a stock that your teacher held at the time, plunged 7% for no reason, possibly because Knight pulled, literally, 15 million shares off of the ask queue.[19] Like the crazy computer that nearly launched a global war in the movie *War Games*, the Knight computers were algo-trading Knight Capital into oblivion.

During this event, the market as a whole was largely unaffected by the Knight Capital fiasco. The indexes barely budged and most of the affected stocks returned to reasonable values by the next day. Nonetheless, this was hardly the first computer-generated disaster (others are documented later or discussed in lectures) and the example exposes potential weakness that are likely to be found in automated markets.

Market makers dominated for decades (centuries really) because they blended a responsibility with a privilege. The responsibility was to make a market for the stocks for which they were accountable by insuring there was a bid or ask reasonably "close to the money" (a term that means close to a recent good price). For that they got the privilege of doing early spread arbitrage, which was very profitable for a long time.

But once the markets were computerized, there was nothing to prevent other traders from competing by putting in bid and ask spreads faster. But these new traders, who could trade any stocks they wanted, were not obliged to make markets and don't and won't. They clearly provide enormous liquidity *and* provide the very obvious benefit of narrowing bid/ask spreads to only a penny for major stocks, which is a *clear* benefit for small traders. You will seldom see stocks like Intel with a spread wider than one cent because of high-speed trades.

Having said that, though, it should be clear that there are potentially two new dangers to these markets, (1) flaky computer programs can send these markets reeling, and (2) we may discover that we need traditional market makers, willing to step in and lose money, on a future very bad day in the market.

7.　　Large Block Orders, Dark Markets and Dark Pools

As if this large and changing structure of exchanges doesn't complicate the picture enough, the neophyte stock trader may be disturbed to know that you are also competing with *dark pools* for attention when making your little stock purchase. These dark pools are certainly important. On any typical trading day they account for more than one third of the trading volume.

This requires some background explanation.

In effect there is a second stock market out there that follows different rules and procedures but overlaps considerably with the stock market that has already been described. In addition to the exchanges described above, there are a group of near-exchanges called *Alternative Trading Systems (ATS)*. This alternative set of exchanges are, in turn, divided into two components. The first are classified as the current batch of ECNs, which is to say those electronic trading markets that aspire to be classified as exchanges or for various reason want to work independently of exchanges, possibly for serving the special needs of larger clients. The second category is called the *dark market*.[20]

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[19] These examples are taken from Taesik Yoon, "*What Knight Capital's Glitches Tells Investors*," **Forbes**, August 2, 2102.

[20] As of August 1, 2015, there were 84 ATSs on file with the SEC. Some of them were multiple ATSs owned by one larger firm like **Barclays** or **Credit Suisse.** How many of these ATSs are true Dark Pools are subject to interpretation. But by summer 2017, it appeared that the number of ATSs operating as dark pools had fallen to only 45. For a current overview, see "*Dark Pools: Private Stock Trading versus Public Exchanges,"* by Sam Mamudi and Annie Massa, **BloombergQuickTake**, July 21, 2017 (update).

To understand clearly the distinction between the two, ECNs display their orders in Level I and Level II just like the exchanges do. Participants in the dark market do not. Consequently, some analysts refer to the traditional **PBBO** market as the *lit market*.

The dark market is a separate set of exchange rules and conventions that are mostly for institutional trades and large-block trades where the traders in questions may want to buy or sell thousands of shares of stock. The dark market allows the

Figure 12 - FINRA Dark Pool (ATS) report for 13 ATSs trading AAPL stock for the week ending June 3, 2018

Alternative Trading Systems Data Details

Symbol	AAPL		Report	NMS Tier 1
Description	Apple Inc. Common Stock		Week of	06/03/2018
Product	UTP			
Total Shares	8,258,888		Total Trades	64,825

ATS Description	Shares	Shares Last Updated Date	Trades	Trades Last Updated Date
UBSA UBS ATS	2,909,233	06/24/2018	28,100	06/24/2018
CROS CROSSFINDER	1,171,161	06/24/2018	9,751	06/24/2018
IATS IBKR ATS	731,492	06/24/2018	3,310	06/24/2018
EBXL LEVEL ATS	384,700	06/24/2018	2,689	06/24/2018
MSPL MS POOL (ATS-4)	380,600	06/24/2018	2,003	06/24/2018
JPMX JPM-X	337,115	06/24/2018	2,167	06/24/2018
XSTM CROSSSTREAM	311,127	06/24/2018	1,273	06/24/2018
LATS BARCLAYS ATS ("LX")	280,100	06/24/2018	2,035	06/24/2018
SGMT SIGMA X2	271,020	06/24/2018	2,561	06/24/2018
MSTX MS TRAJECTORY CROSS (ATS-1)	242,300	06/24/2018	1,432	06/24/2018
KCGM VIRTU MATCHIT	215,123	06/24/2018	2,830	06/24/2018
DBAX SUPERX	214,100	06/24/2018	1,452	06/24/2018
ICBX INSTINET CONTINUOUS BLOCK CROSSING SYSTEM (CBX)	143,641	06/24/2018	892	06/24/2018

trader to list market and limit orders (especially the latter) with no exposure. The listing is in a dark pool, which effectively is a queuing of limit orders (and similar orders, some described below) that are *not* publicly available and do *not* appear in the Level II queue or anything equivalent. Effectively they are secret limit orders known only to a few. Further, unlike ordinary stock trades, which are reported instantly through the Consolidated Quote Plan protocol discussed earlier in the chapter, stocks trades from dark pools are not reported until one month after the transaction, so generally the public does not know about the trade right after it happens. In a few words, dark pools are exempt from the rules that guarantee the "protected quotes" that were defined in the previous section of this chapter.

These dark pools are regulated by the *Financial Industry Regulatory Authority (FINRA)[21]* and are formerly referred to by **FINRA** as Alternative Trading Systems **(ATS)** as stated above. **FINRA** currently requires each dark pool to report the

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[21] FINRA is an independent non-profit organization that was authorized by federal law to regulate certain institutions and practices in the securities industry. They can be thought of as an independent private non-profit arm of the Securities and Exchange Commission,

total number of shares traded and the total number of transactions required to consummate those trades on a weekly basis for each individual stock traded. There are estimated to be about 45 dark pools and the dark pools are estimated account for somewhere between 10% and 35% of all stock trades (an amount that would vary considerably from day to day).[22]

Refer to **Figure 12.** This truncated list (26 **ATSs** were included in the full list) all traded **AAPL** in the five market days ending on June 3, 2018.[23] The descriptor and name of the **ATS** is in the left column. For example, **SGMT SIGMA X2** refers to an **ATS** owned by Goldman Sachs Electronic Trading, a dark pool launched in 2016 as a dedicated platform designed to match buyers and sellers of large blocks of stock. As can be seen in that week, **SGMT SIGMA X2**, on behalf of clients, traded 271,020 **AAPL** shares in 2,561 trades. That averages slightly more than 100 shares per trade.

Although dark pool trading practices are proprietary and secretive, filings with **FINRA** and the **ATS** promotional literature expose a great deal about how these dark pools trade. First, they typically tend to promise clients that they do their best to match **PBBO** prices, which is to say, market Best Bid and Best Ask. From the **FINRA** data it is clear that some **ATSs** break larger orders into a series of much smaller orders, which probably explains why the average trade in **Figure 12** is under 200 shares. (The practice of breaking huge trades into multiple small trades predates electronic trading – specialized large-block trading firms did this when telephone trade was prevalent).

Although most of the ATSs make small trades, some of them like Dealerweb, Liquidnet, Luminex and Barclays Directx make exclusively huge trades, with average block sizes above 10,000 shares.[24]

These large-block traders try to make direct large-block trades on behalf of their clients when that is possible by simply trying to match prices for bids and asks when large blocks are present on both sides of the queue. Such a match is called a *cross.* These transactions, though, are not always undertaken as limit orders at Best Bid or Best Ask. Instead the crosses (matching a buy order with a sell order) are done at the mid-point between Best Bid and Best Ask, which is called a *mid* or a *peg*. For example, if the bid for Ford **(F)** was **11.28** and the ask was **11.32**, the peg would be **11.30** and the cross would be transacted at that price.

As one might guess, there are many critics of the dark markets and the special privileges they impart. After all, if everyone has a right to see your limit order and everyone will know the results of any trade you made, why should large traders be allowed to escape this transparency?

But dark markets are indeed necessary for large traders. They are meant to hide attempts to make trades that will have *market impact* because of their size. Additionally, the market impact would come at the expense of the party trying to make the trade.

Potential market impact is best explained by example. Suppose you are an active trader who seeks to buy 1,000 shares of clothing retailer Tilly's (**TLYS**). You are a savvy trader who puts in GTC limit orders at an attractive price, sometimes well below market, then you just hope for the best. You do a little background research on **TLYS** and see that the company has a float of 19.6 million shares. The stock has been slow, selling about 365 thousand shares per day. You also notice that the stock is lightly shorted at 654 thousand shares, only about 3% of the float. The stock has been doing well

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and responded well to a recent earnings report. The share price has been rising and is currently trading around $**10.90**, and you like that price.

Suppose you then discover that a large institution like a mutual fund wants to sell 500 thousand shares outright! They want to make a sale equal to more than a full days' trading volume. How would they do this? Put in a market order to sell 100 thousand shares at a time and wipe out the entire ask side of the Level II structure each time they did? Perhaps put in a limit order to sell at **10.70** for 200 thousand shares and have it sit there a make it obvious to everyone that some massive trade was underway?

If you saw either happen or just knew in general that a sell-side avalanche was about to hit the market, you might be inclined to rush a limit order to buy - but now with this new information, only at $**10.20**, or even $**9.60**. This kind of market activity, rushing to submit an order because you know of an impending market-impact order, is called ***front-running***.

That's why the seller will want to keep his intentions secret - if he does not, then his mere bidding and offer activity, because of its sheer scale, will have a market impact - meaning it will directly affect the price of the stock, and it will do so in a way that harms the seller. The dark markets allow these large-scale block trades to be secret transactions.

Critics of dark pools are not worried about the general investing public front-running large block trades. Instead, given that the dark pools are typically subsidiaries of large banks or brokerage companies, they complain that it would indeed be very easy for other traders within the same firm to front-run trades managed by the parent company's dark pool. Imagine the **TLYS** trade described above except transacted by an insider working for the same finance house!

Stiff regulations require the dark pool to ***firewall*** all of their transactions from other financial activities and retail traders of the same firm (from *everyone* actually). This means that dark pool bids and asks or trading intentions in general are restricted from even other employees who work for the same firm. Those regulations are supposed to prevent that and currently these kinds of regulations largely seem to be working.

There are some small examples of abuse.

In 2013 the SEC reached a enforcement settlement with a small ATS, Pipeline Trading Systems LLC, requiring that they pay a $1.2 million fine for allowing their own traders to effectively front-run large orders by advising their own clients about impending orders[25]. But this was a relatively small breach by a small player that was quickly nipped in the bud.

Strangely, other punitive regulatory actions taken by the SEC or FINRA have claimed that the dark pools simply didn't do a good job of taking care of their own clients! In summer 2014 **SIGMA-X** parent company Goldman Sachs agreed to a fine of $800,000 (relatively small) paid to the Financial Industry Regulatory Authority because they did not insure that their client's positions were traded at the best possible prices., then again fined them $1.8 million again in July 2015 because they transmitted large levels of inaccurate trade clearing data. [26] Because of this Goldman Sachs outsourced the operation of their dark pool to **NASDAQ** in October 2016.[27]

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[25] See Jacob Bunge, "'Dark Pool Settlement Shines Light on Potential Abuses," **The Wall Street Journal,** October 24, 2011. Strangely, the traders seemed to be more interested in impressing their own clients about how smart they were than making money from the trades. This was seen as a marketing ploy more than a case of direct front-running.

[26] See Bradley Hope, "*Goldman Agrees to $800,000 Fine Over Dark Pool*," **The Wall Street Journal**, July 1, 2014 and **FINRA** press release July 27, 2015, "*FINRA Fines Goldman Sachs Execution and Clearing L.P. $1.8 million for OATS and Trade Reporting Failures.*

[27] Annie Massa, "*Goldman Sachs Hires Nasdaq to Run Its Sigma X Dark Pool,"* **Bloomberg Markets,** October 31, 2016.

Barclays Capital Inc. has also been fined twice by FINRA, once for $3.75 million and again for $800,000 for data reporting errors. [28]

Earlier **Figure 8 - Order routing** did not show the possibility of a retail order being routed specifically to a dark pool, although it did allow for the possibility of the order being tracked to an ATS market maker who might process it internally, possibly in a dark market. It has become apparent in recent years that some order processors or exchanges (like **Cboe BYX** and **BZX**, which advertises that they do this) may temporarily route a retail order through a dark pool to sample prices to see if they can beat or at least match the **PBBO** price. There is really no reason for a large order processor in a dark pool to avoid the small retail market if order flow will chip away at a large established position. One way to sell a million shares of **INTC** is to slowly sell a large block 100 shares at a time if that will help move the block. In this case the dark pool would actually improve the retail environment for small investors.

It is clear why the existence of dark markets and dark pools and any other protocol that hides prices and trades from immediate public scrutiny is controversial.[29] The environment for dark pools appears to be changing rapidly in 2019, with operational costs rising and the pools themselves subject to greater scrutiny and more complex regulations.

Despite the earlier discussion of regulatory actions, your teacher does not yet see any clear evidence that dark pools are harmful to the interests of small retail traders (of course a single large scandal could reverse this sentiment!) and hidden trading intentions really are necessary for the execution of large block trades undertaken by mutual funds. In fact, given that a considerable amount of retirement wealth is tied up in these very mutual funds, requiring **PBBO** transparency on all mutual fund trades might work *against* the interests of retail investors.

In fact, this discussion might encourage the small retail trader to consider that you might have a slight advantage in making your trades. Nothing you do has market impact so you can slip in and out of the market unobserved. In fact, the retail trader might have an advantage of you develop some means to detect the occasional market impact of large traders.

As a note of interest not directly connected to the theme of this chapter, large dark pools have now been formed for the trading of bonds in addition to stocks.[30] This is partly because banks were stepping back from this activity, but also because market impact issues are now just as likely in bond markets as they are in the stock market, partly because of the growing popularity of bond exchange-traded products.

8.   Extended hours trading

Normal trading hours for stocks traded on exchanges in the United States begin at 9:30 AM Eastern Time (New York) and end at 4:00 PM Eastern Time. But most brokers also allow what are called *extended-hours trading*, which consists of two components, *pre-market trading*, which is allowed before the normal market open, and *after-hours trading*, which begins at the 4:00 market close and effectively keeps the market open for a few more hours.

If you have a broker's permission, which is usually granted automatically upon request, you can technically buy or sell your stock in these extended hours. There are, however, some practical limitations and higher risk associated with trading during extended hours.

To understand why, one must understand where the trades are made. Current law allows individual exchanges to set their own extended-hours trading limits and the time allowed varies greatly between exchanges. Both the traditional NASDAQ

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[28] See **FINRA** press release December 26, 2013, "*FINRA Dines Barclays $3.75 Million for Systemic Record and Email Retention Failures,*" and John McCrank, "*Barclays to Pay $800,000 fine for U.S. data reporting errors,*" **Reuters Business News**, July 26, 2015.

[29] A typical popular critique, of which there are many, include **Dark Pools: The Rise of Machine Traders and the Rigging of the U.S. Stock Market,** by Scott Patterson, 2012, Crown Publishing.

[30] See Bradley Hope and Katy Burne, "*Investment Technology Group to Launch Dark Pool for Bond Trading,*" **The Wall Street Journal**, Sep. 3. 2014.

and New York Stock Exchange (**NYSE**) don't offer extended hours. But the **NASDAQ/Island** exchange and **NYSE ARCA**, advanced electronic exchanges that were created by the **NASDAQ** purchase of **The Island** and the **NYSE** purchase of **ARCA** (both were independent exchanges before the merger) open for trading at 4:00 AM and close trading at 8:00 PM Eastern Time. Because every stock listed by **NASDAQ** and **NYSE** is eligible for trade on **Island** or **ARCA**, these effective hours are available for anyone who wants to trade listed stocks.

Some other exchanges offer extended-hour trading that is more restricted than that offered by **Island** or **ARCA**. **IEX** opens at 8:00 AM and stops trading at 5:00 PM (ET) for example. And most morning pre-market trading is concentrated between 8:00 AM and 9:30 no matter where traded.

However, not very many traders choose to trade in extended hours. When first offered, market promoters and brokerages enthusiastically believed that trading would expand considerably making the transition from traditional market hours to extended hours seamless and popular. But it didn't turn out that way. Professional traders wanted the day to wrap at 4:00, and one gets the impression from watching popular TV coverage of the market on channels like **CNBC** that the market just shuts down.

But it is still possible to trade, a bid and ask may still be active (but may be very far apart), and if brokerage settings were correct, a trader can submit a limit order to buy or sell (one would never use a market order after hours) just as one can during normal market hours.

But the lack of volume curbs liquidity, which can pose a problem. For example, on August 28, 2019, total **NASDAQ** extended hour trade volume equaled 91,738,684 shares. Trade volume during normal hours on the same day equaled 1,659,283,560 shares. Extended-hours trade barely exceeded 5% of normal trade. And much of the extended-hour trade was in only a handful of popular stocks. Less popular listed stocks that are not in the S&P 500 may register no trade at all.

There are some limitations and risks associated with extended-hour trading:

1. The market is far less liquid than the normal market, which will imply large spreads between bid and ask, which further implies that only limit orders should be used for trades, never market orders. Many brokers will not even allow market orders after or before normal hours.
2. Market makers are not required to make a market in extended-hour trading. None of the orderly trading that is the consequence of market-maker activity is present or guaranteed. This can result in a very volatile and disorderly market, especially when news arrives that might have market impact.
3. There is no PBBO price discovery process that discovers and publishes national best bid and best ask. There is no "smart" search for national best bid or ask. Your broker has to allow you access to market data from **NASDAQ/Island** at a minimum to allow a reasonable bid or ask, and after 8:00 AM to assure that the trader is getting anything close to best bid the broker has to allow access to the quote flow from, in addition to **Island**, **ARCA**, **Cboe**, and **IEX**. Some brokerages charge a fee for this kind of data access. The trader must know how to access these quotes and act on them.

This is not really a market for the novice trader, although it doesn't take much to learn enough about extended-hours trading to actually use it.

The trader may also notice on her online broker setting that the limit order length setting (time-in-force) may offer a choice between *day* and *day+ext*. If the trader chooses the latter, then a limit order set during the trading day does not self-cancel at 4:00 ET. It remains active until 8:00 PM but is not carried over for the 4:00 AM pre-market open (although this rule may vary from broker to broker).

But, again, using *day+ext* is not advised unless the trader understands this market.

9.   What's next

This chapter should have given you a general understanding of how you place a limit or market stock order. But how do you determine what to buy (or sell), and equally important, *when* to buy and sell.

Although this text is not going to provide a complete answer to those questions, we can explore it in depth in the next two chapters. The next chapter is a bit of a diversion. It introduces an abstract stock market model tablet that might be helpful in our analysis. Then in **chapter 4** we start discussing about stocks rise and fall and why markets cycle, among other subjects.