The Stock Exchanges and Automated Trading Centers

Listing versus trading

Listing

NYSE  NASDAQ

NYSE (Arca)  NASDAQ  BATS  EDGA
(plus regionals and others)

Trading
This massive mandate, created in 2005 and now being implemented, was intended to create a competitive, self-regulating, and largely automated national market system for securities.

Among its features:

1. “Consolidated tape” for all exchanges.
2. Rule 611 – orders trade at the best possible price (NBBO).
3. **Standardized trading rules** to be followed.
4. Rule 610 - Equal access to all markets by all players.

**Electronic Communications Networks (ECNs)**

now being called Automated Trading Centers (ATC), and most becoming exchanges

- Fully electronic trading and clearing networks
- Most were originally independent, and designed to compete with NASDAQ and NYSE, but many were absorbed (Instinet, Archipelago, the Island) and others have become exchanges.
- Oldest was Instinet (1960), specializing in institutional trades, purchased by NASDAQ.
- Some specialize in **after-hours** trades (normal trading hours are 9:30 to 4:00 EST).
- They introduced low-latency full automated (computerized) trading.
So what, precisely, is a stock exchange?

A stock exchange is any ATC or physical exchange that legally adopts rules for itself and its members that comply with the requirements of Reg NMS, subject to approval of the SEC. The technology used by the exchange, for example for order routing, must be capable of insuring this compliance. There are currently 3 large trade groups that meet this criteria:

1. NYSE Euronext
2. NASDAQ OMX
3. BATS Global
4. (Direct Edge)

All of these have global components. They are competitive.

The current list of SEC-approved Exchanges

There is also the, 
... ahem ..
Arizona Stock Exchange

Major Exchanges – NYSE Euronext

- Retains physical exchange - 1 Wall St. NYC
- Oldest and most traditional of US exchanges 1792
- Still relies in part upon open outcry system, but rapidly converting to hybrid pure electronic.
  - which was formed by merging Amsterdam, Brussels, and Paris exchanges (2000), then acquired London derivatives market (LIFFE) and Portuguese exchange, making it the largest cross-border market in the world.
  - Euronext stocks are not (yet) traded directly in the US but they do have a Universal Trading Platform now, for large clients only?
- 8,000 listed companies, many European
- Listing standards higher than NASDAQ and companies tend to be larger, more mature, but many exceptions.

NYSE – 4 US dedicated exchanges

1. **NYSE** – the traditional open-outcry physical exchange located at 1 Wall Street.*
2. **NYSE Arca** – the fully electronic exchange
   - Purchased Archipelago, an ECN, in 2005.
3. **NYSE MKT** – formerly old Amex business dedicated to lost and trading small-caps and mid-caps
   - Purchased AMEX, a failing competitor, in 2008
4. **NYSE Alternext** – dedicated to small-cap and mid-cap companies trying to list.

*I no longer describe the workings of the physical exchange in these lectures.
Observations about NYSE

- Your order, if routed to NYSE, would go to NYSE Arca.
- NYSE tried for too long to fight automated exchanges because (IMHO) it was a profitable good ‘ol boy system, then the conversion came a little too late.
- … consequently NYSE continues to loose market share.

Note: These are NYSE-listed only.

Source: James J. Angel, Lawrence E. Harris, Chester S. Spatt, Equity Trading in the 21st Century, February 23, 2010

NASDAQ and BATS Global
The fully automated markets
NASDAQ OMX Group

- National Association of Securities Dealers Active Quotation system - no longer associated w/ NASD
- Decentralized electronic exchange since 1971
- 3,600 companies listed on NASDAQ OMX in 50 countries, 10 former overseas stock exchanges
- INET global high-speed trading platform (former ECN acquired in 2007)
- NASDAQ listing and trading are separate functions
- Still the biggest player, but fighting off the competition.

The newest – BATS Exchange and Direct Edge, merged into BATS Global on Aug 26, 2013 (the pure technology plays)

- Both started as ECNs (ATCs)
- Both aspired to SEC Reg NMS compliance
- Both are global
- Both sell mostly speed and low cost (and NMS compliance)
  - The secret on speed is order routing that is NMS Rule 611 compliant.
- Both are active in options trade (Tape B trade)
- Between them they seem to have at least 20% market share.
- BATS scans against dark pools (explained later).
- Direct Edge is directly marketing speed, cost, and compliance.
- Both appear to be aggressive at attracting algos and market makers.
Over-the-Counter Bulletin Board (OTCBB) stocks

- 30,000 stocks listed on the "Pink Sheets"
- Go to www.otcmarkets.com, find WAMUQ (Washington Mutual)
- Many delisted companies these days
- Some reputable ADRs (NSRGY - nestle)
- Some illiquid and extremely speculative
- FAX and chatroom stocks
- Odd hi-priced stocks (see HSNTF; on Jan 23 09 stock went from $1.62 to $143.32 exactly 100K share, because of Obama wind/solar speech? – now gone)
- Minimal listing requirements
- A good way to enable shareholders of privately-held company to find venue for selling shares

Market Makers

- Market Makers are large trading firms who are committed to provide market liquidity through active bidding, buying and selling in designated stocks.
- For NASDAQ, market makers have a Market Participant ID (MPID) ... these you see as 4-letter symbols on NASDAQ TotalView (Level II).
- Many of these market makers also accept order routing from trading sites (like NITE).
- Underwriters for an IPO are required to be market makers for the new stock.
- For trading, market makers have additional privileges on order type (see material on open/close NASDAQ OMX) and trade with proprietary software, NASDAQ Workstation, or through firms like Neovest (see neovest.com as an example).
Example: Market Makers / MPID who provided liquidity for NASDAQ securities in June 2013.

Source: http://www.nasdaqtrader.com top liquidity providers

Who are the algo traders? short pipes!!

Algo(rhythm) traders, also called hi-frequency traders and hi-speed traders, use completely or partly computer programs to generate many low-latency bids and asks, and by so doing, provide liquidity to the markets.

Most market makers are now also algo traders but not all algo traders are market makers. Market makers are required to make a market in their designated stocks, but algo traders in general are not (you can be an algo trader).

Some market makers pay for market order routing to come to them. Suppose the MM pays for XYZZX market orders. Suppose the Level 1 Bid and Ask above is represented by the MM. Then if MM gets a market order to buy and another to sell they execute at these prices and the MM makes a penny.

Algo traders now have sophisticated strategies for trying to get the most out of ISOs and large block trades — they put in bids and asks all the way down the queue, then often withdraw them quickly — like some sort of bid/ask chess.
Market Makers, Algo Traders, Spread Arbitrage, and Mudd Algo Traders

Image captured on September 10, 2013. This is meant to amplify the material discussed in Chapter 2, and is a memo slide.

Points:
1. How the market maker plays this and makes a profit through spread arbitrage
2. How the algo trader could trade it but might bail.
3. How you the Mudd algo trader might play this.

<table>
<thead>
<tr>
<th>EX</th>
<th>SIZE</th>
<th>BID</th>
<th>ASK</th>
<th>SIZE</th>
<th>EX</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSDQ</td>
<td>410</td>
<td>53.63</td>
<td>54.1</td>
<td>100</td>
<td>NSDQ</td>
</tr>
<tr>
<td>BATX</td>
<td>300</td>
<td>53.63</td>
<td>54.1</td>
<td>100</td>
<td>ARCX</td>
</tr>
</tbody>
</table>

Hmmm … maybe a few bugs?

The flash crash of May 6, 2010

At 10:42 AM PDT I and millions of others watched the DJIA fall about 700 points in 15 minutes in an otherwise quiet day. Then it recovered nearly as fast. PG, a DJIA component, is shown here. Accenture and a handful of other stocks fell to one cent, and thousands of share were traded at the price.

What happened? Nobody is yet quite sure to this day. It appears that (and when I saw it happen I judged it to be this) that a large series of computer generated ISOs wiped off the top of a couple of key queues (like Dow component PG) which sent indexes tumbling, which triggered circuit-breaker shutdowns of algo trades, which removed liquidity and depleted the ask stacks and remaining algo traders and probably ISOs took them down to nothing. (I have seen an entire ask stack disappear from time to time).
Large institutional traders like mutual funds and hedge funds often want to trade huge blocks of the same stock (e.g. 100,000 shares) over a short period of time. But they want to do it anonymously, because if the market knew their intentions, other traders could game the transaction. They want to trade without market impact!

So the market must provide liquidity to these traders (have enough stock out there being sold and bought on spec and arbitrage to offer sufficient volume for these large block trades) without market impact. REG NMS doesn’t do this.

Traditionally these large block trades were broken up and handled anonymously in pieces, and they still are to some extent, but now the are more likely to be handled by dark pools and intermarket sweep orders (ISOs).

### Intermarket Sweep Orders (ISO)

Suppose a large-block trader wants to quietly buy 6,000 shares of **XYZZX**. Shown above are the internal DOMs (like NASDAQ Total View) of three exchanges. Best Bid is 22.10 at Exchange A. Knowing this is a fairly illiquid stock, the trader sends a Limit Order to Buy 6,000 at 22.20 to Exchange A, which in turns initiates an **ISO**. What is the result?
ISO result:

<table>
<thead>
<tr>
<th>Internal DOM</th>
<th>Internal DOM</th>
<th>Internal DOM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exch A</td>
<td>Exch B</td>
<td>Exch C</td>
</tr>
<tr>
<td>XYZZZX</td>
<td>XYZZZX</td>
<td>XYZZZX</td>
</tr>
<tr>
<td>ASK</td>
<td>ASK</td>
<td>ASK</td>
</tr>
<tr>
<td>Vol (200s)</td>
<td>Vol (200s)</td>
<td>Vol (200s)</td>
</tr>
<tr>
<td>22.10</td>
<td>22.11</td>
<td>22.12</td>
</tr>
<tr>
<td>14</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>22.11</td>
<td>22.14</td>
<td>22.13</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>22.15</td>
<td>22.15</td>
<td>22.15</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>22.21</td>
<td>22.20</td>
<td>22.18</td>
</tr>
<tr>
<td>12</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>22.28</td>
<td>22.24</td>
<td>22.24</td>
</tr>
<tr>
<td>5</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>22.34</td>
<td>22.33</td>
<td>22.35</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>22.35</td>
<td>22.40</td>
<td>22.38</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

**Executed and removed from queue.**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3 of 4 removed and this becomes Best Ask.</td>
<td></td>
</tr>
</tbody>
</table>

Across three exchanges the ISO accepts the ASKs shown in yellow and removes them for the queue. 22.18 at Exch C partially fills and the remaining 100 shares become the new Best Ask. This would have happened also for a market order for 6,000 shares and the 6,100 shares colored here would have been a partial fill for a limit order for 10,000 shares at 22.20. (Why?)

### Dark Markets and Dark Pools

- **Dark markets do not publicly post their transactions**
  - you won’t see large block transactions on NASDAQ TotalView, although you will see pieces of them if and when they are broken into smaller trades
  - **Crossing Networks** that match large blocks off-market (non PBBO)
  - around 40?

- **Dark pools are ECNs that trade dark market transactions**

- **The SEC allows them to facilitate secret large block trades**
  - because an informed market would go against the trades
  - What if someone knew you were trying to sell 300,000 shares of F?

- **Dark pools must report trades monthly on Reg NMS Rule 605.**

- **Dark pools seem to account for between 15% and 30% of total market volume.**
Order Management Systems

A broker (including online), market maker, and ECN will have an Order Management System consisting of:

- A java interface for clients to enter orders and send instructions (ETrade) or an API to allow users to design their own interface (MBTrading)
- A computing link to a proprietary routing network or a FIX hub and spoke network (see later slide)
- A FIX 4.x or 5 standardized software installation for routing (or accepting) trading orders, execution, and reporting.
- An accounting system to maintain records for clients and other transaction parties.

Example: Dark Pool reference point crossing

The NYSE crossing procedure involves finding a reference price from the mid-point of the NBBO quote randomly selected from predetermined one minute pricing periods. Periodically participants can cross at that price.

See http://www.nyse.com/pdfs/Matchpoint_One_Sheet.pdf. Also for a discussion and example of how ISOs can fit into this in procedures used by the NYSE, see NYSE: Hybrid Market Training Program, Sept. 2006, available from the NYSE in pdf.
The FIX (Financial Information Exchange) Protocol

- See [http://www.fixprotocol.org](http://www.fixprotocol.org)
- Software standardizing protocol used for routing trading orders (market and limit), execution, and reporting.
- Globally an estimated 80% to 90% of global equity trades transacted through FIX protocols.
- Now rapidly expanding into yield-bearing, derivatives and FOREX.
- Began in 1994 as a proprietary experiment between Fidelity and Salomon Brothers.
- Programmers first learn FIX protocol specs (from website above) then design their FIX engine, buy a canned one, or tweak an open-source engine like QuickFix.(next slide).
- I notice that neither BATS nor Direct Edge use it.

All algo trading systems, which can be developed in any language (Java, C++, VB, MatLab, etc.) typically rely on one of the FIX protocols for the execution instruction set. One especially good open source set, robust, complete, with good documentation, and **free!** is QuickFIX, found at [http://www.quickfixengine.org/](http://www.quickfixengine.org/)
A Fix 4.2 example

```plaintext
BeginString(8)=FIX.4.2
BodyLength(9)=190
MsgType(35)=E
SenderCompID(49)=INST
TargetCompID(56)=BROK
SendingTime(52)=20050908-15:51:22
MsgSeqNum(34)=200
ListID(66)=14 BidType(394)=1
TotNoOrders(68)=1
NoOrders(73)=1
ClOrdID(11)=order-1
ListSeqNo(67)=1
Symbol(55)=IBM
Side(54)=2
OrderQty(38)=2000
OrdType(40)=1
```

Sample take from a forum on fixprotocol.org provided by Raj Rao Bandu, posted on Sep. 28, 2005. Evans changed the commands some (to shorten).

Actual script is typically not written with field descriptors.

Circuit Breakers

Generally exchanges have trading stops called “circuit breakers,” where trade is suspended for a period of time because of extreme market declines. Circuit breakers are set for the market as a whole and for individual securities. Some examples:

NYSE:

Level 1 halt: 1,300 drop in DJIA before 2:00 PM halts trading 1 hour, ½ hour if 2:00 to 2:30, none if thereafter (market closes at 4:30).

Level 2 halt: 2,600 drop in DJIA before 1:00 PM halts trading 2 hours, 1 hour if between 1:00 and 2:00, for the rest of the day after 2:00.

Level 3 halt: 3,900 drop suspends trading for the rest of the day.

These NYSE circuit breakers are reset every quarter.
Stock Supply and Demand (from the reading)

Make sure you understand the examples from Chapter 3 – only a couple are shown here.
Using the model for an index ...

Figure 5 – The Market for MMI after GOOG shock the markets with the surprise August 15, 2011 announcement that they are buying Motorola Mobility (MMI) for $40 per share.

Supply Curve is relatively unaffected

Demand Curve explodes out because Google shocks the market with announcement that they want to buy MMI

Figure 10 – (Actual) On Monday September 29, 2008 the S&P 500 has a record decline of 106.85, or 8.8% of its value, on a day which saw a surge in volume to 7.305 billion shares, on news that a $700 billion financial rescue plan failed a passing vote in the House of Representatives.

Supply Curve shifts out sharply in a panic during a very disconcerted market

Demand Curve falls back (here less than the supply curve shifts out) because few investors are willing to buy in such an uncertain market.
.. and quadrant analysis ..

Figure 11 – Four-quadrant analysis, discussing likely scenario interpretations given the interactions between Supply and Demand the impact upon the Price and Volume pairing.

Quadrant II
Price change
Price or index increase on falling volume, which implies relatively stable Demand while Supply recedes. Turnover is declining and investors are holding their portfolios. Probably a quiet news period.

Quadrant I
Price or index surge on rising volume, which implies a strong surge in Demand relative to Supply. Very news-sensitive. Heavy momentum phases and speculative surges will be in this quadrant.

Quadrant III
Price or index drop on falling volume, which implies relatively stable Supply as Demand atrophies. This is a quiet, discouraged market, with distracted investors, relatively little news.

Quadrant IV
Price or index drop on rising volume, which implies a strong surge in Supply relative to Demand. Likely to be news-sensitive. This could represent panic sales or large portfolio shifts. Very dangerous.

because we come back to it and will use it later ...