High Frequency Trading
Man vs. Machine

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## Agenda

What we will be discussing today

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Trading: Then
Trading: Now
What it is

- A type of algorithmic trading where very large amounts of securities are traded within fractions of a second
- Uses mathematical models and algorithms to make decisions, limiting human decision and interaction
- Characterized by high speeds, high turnover and high order-to-trade ratios
- Became popular when exchanges started adding rebates for companies to add liquidity to the market
- Traders with faster execution speeds are typically more profitable than traders with slower execution
- High Frequency Traders invest millions of dollars into super computers and advanced technology to ensure their technology is state of the art

Framework

Asset Class Prominence

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<th>Asset Class</th>
<th>Prominence</th>
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<tr>
<td>FX</td>
<td>26%</td>
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<tr>
<td>Bonds</td>
<td>36%</td>
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<tr>
<td>Options</td>
<td>58%</td>
</tr>
<tr>
<td>Futures</td>
<td>67%</td>
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<tr>
<td>Stocks</td>
<td>83%</td>
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Adoption Rate

- High Frequency
- Other
The Trading Process

**Old-School Trader**
- Investor: You
- Executor: Financial Advisor
- Time: 15 Minutes

**Modern-Day Trader**
- Investor: You
- Executor: Online Trading Platform
- Time: 1 Minute

**High Frequency Trader**
- Investor: Algorithm
- Executor: HFT Computer
- Time: 10 Nanoseconds
Trading Strategies

**Market-Making**

- Out-compete everyone else by updating their quotes quickly and bringing bid-ask spread down
  - Trader is willing to make little money per transaction because they can scale their operations up to extremely high volumes
  - E.G. Place a limit order to buy a stock at $11.20 and sell the same stock at $11.25

**Momentum Ignition**

- Attempt to cause a spike in the security price with the goal of triggering other algorithmic traders to also trade that security
- Trader knows that the price rise of the security is artificial, so they sell off the stock early to profit
- Very controversial trading strategy which can have legal repercussions

**Statistical Arbitrage**

- Arbitrage strategies try to capture small profits when a price differential results between two similar instruments
- E.G. The price movement between S&P 500 futures and SPY (ETF) should move in line with each other. If the price movement differs, arbitragers would instantly trade on that difference to capture profits

**Liquidity Rebates**

- Electronic Communications Network (ECN) and some exchanges pay HF traders for providing liquidity
- E.G. setting and executing a limit order gives the trader a rebate of fractions of a penny per share
  - This can add up quite quickly when thousands of shares are being traded per second
  - Many HFT firms employ trading strategies to maximize their liquidity rebate
The Location Advantage

Time Is Money in the World of HFT

Speed Illustrated

Blink of an Eye
300 ms

My Computer → Google
20 ms (20MM ns)

High Frequency Trade
20 ns

Timing is Everything

- Data latency measures how long it takes for information to get from A to B – the lower, the better
- Latency arbitrage exploits the fact that HFTs take less time to receive information than the market
  - HFT firms see the NBBO (National Best Bid and Offer) faster than what is publicly available
- HFT firms gain a timing advantage (reduce latency) by:
  - Co-location involves locating HFT firm’s servers next to exchange’s servers. Exchanges have set up locations for HFT servers and charge a hefty price for the service.
  - Premium data feeds and cutting edge equipment help HFT firms maintain an edge on competitors.

Case in Point: Options Arbitrage

- Equity exchange servers are located in New Jersey, while options exchanges are located in Chicago
- Traditional Link: 17 ms
- “Spread Networks” Direct Construction Cable: 13 ms
- Microwave Transmission: 8.5 ms
Benefits of HFT

Increased Liquidity

- U.S. stock market volumes have increased, leading to tighter bid-ask spreads
- HFT firms are most active during heightened volatility (i.e. 2007/2008), when bid-ask spreads are widest
- Undoubtedly, HFT firms provide important liquidity to the market

Increased Market Efficiency

- As a result, bid-ask spreads have tightened for large-cap stocks but widened for small-cap stocks
  - This suggests that trading & HFT has concentrated in the most liquid, large-cap stocks
- A tight market allows large trades to be made with little impact on the market and indicates abundant liquidity in a security
Problems with HFT

Spoofing

- Spoofers influence the market by sending buy/sell orders that they have no intention of filling to manipulate other investors into buying or selling
- Removing spoofing is integral to convincing investors that markets are fair
- The SEC has had the authority to punish spoofing as a civil violation since the 1930s. Despite that, the Dodd-Frank Act formally defined spoofing and made it criminal
- Despite this, regulators and exchanges have difficulty separating legitimate orders from spoof orders
- Biggest challenge is that traders frequently cancel orders – jurors in a HFT case acquitted an UBS trader
- Case in point: Citigroup was fined $25mm for manipulating the U.S. treasury market in January 2017

Dark Pools

- Dark pools are private “secretive” stock exchanges inaccessible to the public
- Order book (list of buy/sell orders & volumes) are not disclosed to buyers
- Trade executions are not released until one business day later
- Pros: Dark pools promote competition and reduce trading costs. Large institutional investors are safer from front-running – they are more likely sell their full block of shares at a better price because they avoid leaking their intentions to the market
- Cons: The secrecy around dark pools
- HFT firms can “ping” dark pools with no intention of buying to find large hidden orders – they can then “front-run” the true buyer/seller, resulting in a worse price
The Crash of 2:45
A glimpse of the chaos high-frequency trading can wreak

36 Minutes of Havoc

- On May 6th 2010, at around 2:32 PM, all major US stock indexes collapsed seemingly without reason, leading to colossal losses that rebounded within minutes
  - Dow Jones dropped nearly 1,000 points, the biggest intraday decline in its history up to that point
  - All 3 major large-cap US indexes dipped at least 7.50% at their worst points, making an already negative trading day cataclysmic

The Cause? Abuse From High-Frequency Trading

- Various theories were floated initially, from a fat finger trade, technical glitches, or market volatility brought on by movements in the USD/JPY markets
  - Eventually, in April 2015, charges were brought against London-based trader Navinder Singh Sarao
  - Sarao stands accused of using an illegal trading strategy called “spoofing”, leading on HFT funds in the market that caused the turmoil
  - Spoofing leads the market in a certain way by creating artificial demand in buy or sell orders that have no intention of ever being filled
Leveraging Twitter
Market reactions to Tweets by influencers

The Trump Effect

- The Trump Administration represents a real risk – or opportunity – to companies that draw his ire
  - Trump’s Twitter account has had major impacts on markets as they react to the President’s sentiment
  - Equities, forex markets, and credit markets have all seen major moves at one point or another based on the President’s musings

Lockheed Martin Case Study – December 2016

- On 22 December, 2016, the President-Elect posted a scathing criticism of the price of the F-35 project, and stated his interest in pursuing rival Boeing’s F-18 options instead
  - LMT shares nosedived on the news, however volume did not remain inflated after the initial shock
  - BA shares also dropped significantly, though recovered more quickly than LMT, showing that even positive news can rattle markets

Based on the tremendous cost and cost overruns of the Lockheed Martin F-35, I have asked Boeing to price-out a comparable F-18 Super Hornet!
2:26 PM - 22 Dec 2016
The Rising Power of Social Media Influencers

Market reactions to Tweets by influencers

Lost Love – Kylie Jenner and Snapchat

- SNAP’s stock price has taken a beating since listing, but it has greater risk from its userbase than other TMT companies
  - Given their public and celebrity status, Snapchat’s key users can have an overblown effect on the company’s performance
  - Snapchat relies on influencers and celebrities such as DJ Khaled and Kylie Jenner to keep their userbase engaged and growing

Snapchat Case Study – February 2018

- On 21 February, 2018, Jenner tweeted that she was upset about the recent Snapchat update, and rarely used the app anymore
  - Although she clarified later that day that she was exaggerating and still loved the application, share prices dropped quickly
  - Trading volume remained muted
  - The effect of Jenner’s tweet is difficult to isolate as the shares would be under pressure again due to ER sell ratings
The Evolution of Regulation
Like any other disruptive technology, regulators have been slow but methodical on HFT

Regulatory Timeline

2010
- IMF proposes issuance of financial transaction taxes on HFT

August 2012
- France levies 0.2% tax on share trades of French companies with >€1bn market cap to limit speculative trading

2011
- European Commission proposes continent-wide FTT on equities and derivatives (failed to gather support)

March 2013
- Italy institutes a similar FTT on equities and derivatives

2014
- Canada introduces NI 23-103, requiring automated traders to be familiar with the risks associated with their systems

2013
- Germany launches the “German HFT Act”, requiring HFT firms to register and pay fees based on their Order-to-Trade Ratios (OTR)
**Major Milestones**

**The Rise of High Frequency Trading**

- **January 1983**
  - Bloomberg, the first computerized system to provide real-time price feed officially kicks off

- **Mid-1990s**
  - Electronic Communication Networks (ECN) gain prominence

- **October 1987**
  - Algorithmic trading largely blamed for the 1987 stock market crash

- **June 1980**
  - Privately dedicated networks were created to enable brokers to order remotely

- **April 1998**
  - SEC authorizes electronic exchanges and the use of computerized HFT

- **April 2001**
  - IBM releases a report revealing that algorithmic trading is capable of consistently outperforming humans
Major Milestones

The Rise of High Frequency Trading

2005-2009
HFT credited for the 134% rise in trading volumes

2000
HFT accounts for <10% of total equity orders

2010
HFT accounts for 56% of all equity trading activity across the US

May 2010
HFT firms blamed for causing the Flash Crash

March 2017
Professional HFT accounts for 80% of all Bitcoin trading

June 2012
Custom-made chip for HFT enables trade execution in a 0.000000074 seconds
Present Day Picture

High Frequency Trading has hit some recent speed bumps

Catalysts of Recent Declines

- Lower volatility
  - VIX has declined from 18 to 12 in recent years
- Cost increases
  - Market data fees have increased substantially
- Lower trade volumes
  - Trading volumes have declined 12.2% YoY
- Speed of public feeds

Industry Consolidation

- Firms selling to stronger rivals
  - Few large players able to dominate
- Recent shift to trading Crypto-currencies
  - High volatility within those markets creates opportunity
- Alternative Data
  - Consumer Records
  - Social Media

HFT Industry Rev. From US Equities ($bn)

HFT share of US equities daily volume
Your Thoughts?