

High-Frequency Trading (HFT) & Flash Crashes

Algorithmic Trading (“Algos”)

- ❑ Algorithmic trading refers to automated systems that
 - Directly monitor trade and quote feeds.
 - Generate orders without human intervention
- ❑ Used by many types of traders.
 - A mutual fund might use algos to achieve VWAP or split and work orders over time.
 - A momentum trader might have an algo that detects trends and follows them (as in the F1 case)
 - Hedging trades can be automated (as in the H3 case).
- ❑ These algos don't rely on pure speed: don't need to be the first-mover.
- ❑ Automation substitutes for human in “low touch” trades.
- ❑ Available through brokers like ITG, Pragma, Interactive Brokers, and so on.

High Frequency Trading/Traders (HFTs)

- ❑ Proprietary traders who seek to profit from short-term trading activities.
 - Virtu Financial; Jump Trading; Hudson River Trading; Tower Research Capital; Citadel
- ❑ Strategies depend on moving faster than anyone else.
 - Being the first to hit a bid or lift an offer in response to some news event.
- ❑ Reliant on extreme technology to achieve speed.
- ❑ Typical strategy involves a mix of active and passive trading.

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HFT Technology

- ❑ Colocation
 - Placing computers in the same room as the Exchange's computers, so that all communication is at bus speeds (rather than network speeds)
- ❑ Advanced computer technology (such as fast solid-state disks, fast logic circuits)
- ❑ Fast communication links between cities
 - Microwave towers (see www.exaltcomm.com)
 - Fast transoceanic fiber-optic cables

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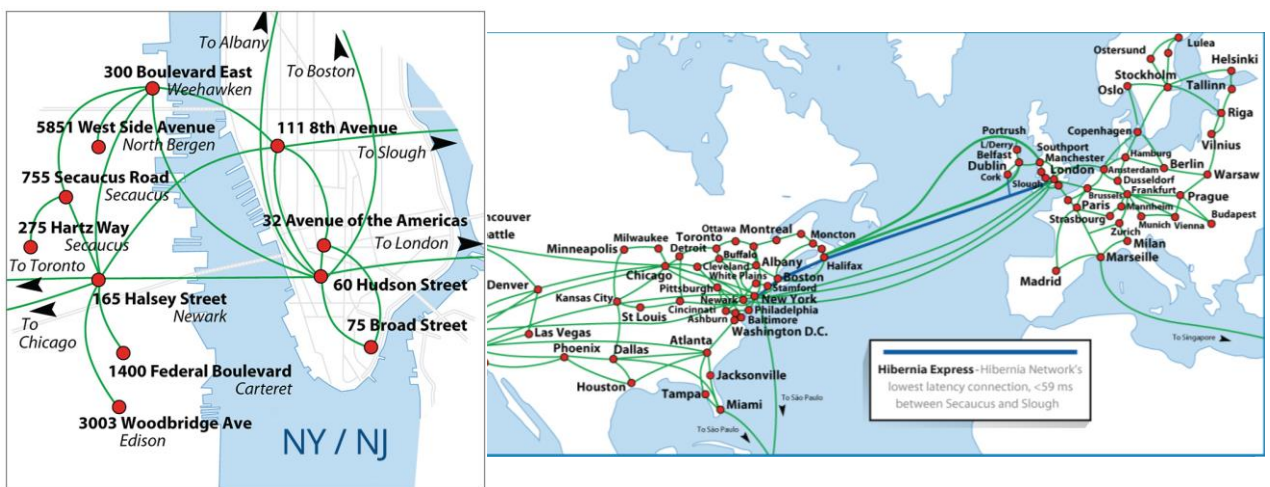
Microwave vs. fiberoptics (exaltcomm.com)



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Hibernia Networks



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One major HFT strategy: market-making
(posting on ModernMarketsInitiative.org, an HFT industry trade group.)

- ❑ ... [M]arket makers have always competed by having the most up-to-date public information regarding supply and demand for a security ...
- ❑ In the past, NYSE specialists would [observe] selling or buying pressure on exchange floors. NYSE specialists also had exclusive access to information regarding orders and a monopoly on market making.
- ❑ HFT market makers now use high-speed public data feeds to remain informed ...
- ❑ [They] use algorithms to assess the supply and demand for that security.
- ❑ [They] use their high-speed programs to constantly update their quotes. As a result, [They] are able to reduce the likelihood that they will buy or sell a stock at stale prices and thus manage their financial risk more effectively.
- ❑ An active debate exists regarding the liquidity enhancements provided by HFT market makers. Some argue that HFT market makers increase liquidity during normal times, only to pull it during times of stress, thus exacerbating market disruptions. However, others have more recently shown that HFT market makers in aggregate are net suppliers of liquidity during market disruptions, thus improving market stability.

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Point/counterpoint

- ❑ HFT is nothing new. Posting on Modernmarketsinitiative.org (an HFT trade group):
 - High frequency trading strategies are consistent with trading strategies that have always existed in securities markets. Through high-speed access to data, algorithms that can assess the significance of the data, and the ability to constantly update prices accordingly, high frequency traders have improved upon these traditional trading strategies.
- ❑ HFT is unfair. Posting on brokenmarkets.com (also see ThemisTrading.com):
 - The real truth about the stock market is that a small consortium of players is making billions by skimming and scalping unaware investors -- and, in so doing, they've transformed our markets from the world's envy into a fragmented mess rife with conflicts of interest.
 - In *Broken Markets*, authors Sal Arnuk and Joe Saluzzi shed light on the dark realities of the stock market. What was an imperfect, yet elegant, oligopoly of a few stock exchanges has become a broken vase of fragmentation held together loosely by high frequency trading.

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Flash crashes (or, more politely, “market disruptions”)

- ❑ A flash-crash is a sudden drop in security prices, usually associated with algorithmic trading.
- ❑ Major flash-crashes include
 - May 6, 2010 (US stocks)
 - October 15, 2014 (US Treasury bonds)
 - August 24, 2014 (US stocks)

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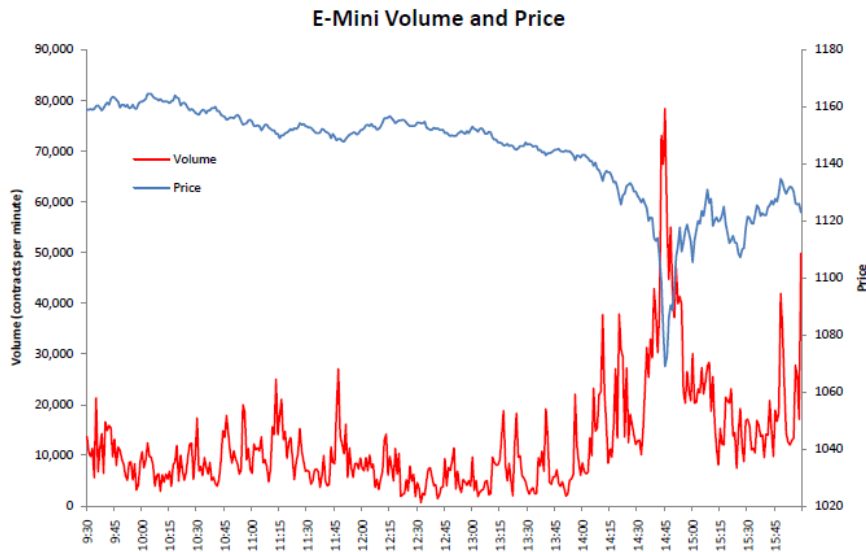
The flash crash of May 6, 2010

- ❑ US stock indexes: sharp decline (5-6%) over a few minutes, followed by a quick rebound.
- ❑ The behavior of some individual stocks was even more extreme:
- ❑ “Over 20,000 trades across more than 300 securities were executed at prices more than 60% away from their values just moments before. Moreover, many of these trades were executed at prices of a penny or less, or as high as \$100,000, before prices of those securities returned to their “pre-crash” levels.”
- ❑ After the market close, the exchanges simply cancelled many trades.

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FIGURE 1.1: E-Mini Volume and Price



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The triggering event

- ❑ Prior to the crash, negative news regarding the European debt crisis (the Greek bond crisis).
- ❑ At 2:32 p.m., ... a large fundamental trader (a mutual fund complex) initiated a sell program to sell a total of 75,000 E-Mini contracts (valued at approximately \$4.1 billion) as a hedge to an existing equity position. *Similar to your static hedging exercise.*
- ❑ This large fundamental trader chose to execute this sell program via an automated execution algorithm ("Sell Algorithm") that was programmed to feed orders into the June 2010 E-Mini market to target an execution rate set to 9% of the trading volume calculated over the previous minute, but without regard to price or time.

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And in individual stocks:

- ❑ [A]utomated trading systems used by many liquidity providers temporarily paused in reaction to the sudden price declines...
- ❑ ...
- ❑ After their trading systems were automatically paused, individual market participants had to assess the risks associated with continuing their trading.
- ❑ ...
- ❑ [S]ome market makers and other liquidity providers widened their quote spreads, others reduced offered liquidity, and a significant number withdrew completely from the markets.

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- ❑ HFTs in the equity markets, who normally both provide and take liquidity as part of their strategies, traded proportionally more as volume increased, and overall were net sellers in the rapidly declining broad market along with most other participants. Some of these firms continued to trade as the broad indices began to recover and individual securities started to experience severe price dislocations, whereas others reduced or halted trading completely.
- ❑ Many over-the-counter (“OTC”) market makers who would otherwise internally execute as principal a significant fraction of the buy and sell orders they receive from retail customers (i.e., “internalizers”) began routing most, if not all, of these orders directly to the public exchanges where they competed with other orders for immediately available, but dwindling, liquidity.

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Aftermath

- ❑ The events of May 6, 2010 led to the adoption of limit-up/limit down trading pauses.

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Flash crash in US Treasuries, October 15, 2014 (from the joint SEC/FRB/Treasury/CFTC report)

- ❑ On October 15, 2014, the market for U.S. Treasury securities, futures, and other closely related financial markets experienced an unusually high level of volatility and a very rapid round-trip in prices.
- ❑ The yield on the benchmark 10-year Treasury security ... experienced a 37-basis-point trading range, only to close 6 basis points below its opening level.
- ❑ Intraday changes of greater magnitude have been seen on only three occasions since 1998 and, unlike October 15, all were driven by significant policy announcements. Moreover, in the narrow window between 9:33 and 9:45 a.m. ET, yields exhibited a significant round-trip without a clear cause, with the 10-year Treasury yield experiencing a 16-basis-point drop and then rebound.
- ❑ For such significant volatility and a large round-trip in prices to occur in so short a time with no obvious catalyst is unprecedented in the recent history of the Treasury market.

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Flash crash, US equities, August 24, 2015 (Forbes)

They say a picture is worth a thousand words. I think this one speaks volumes. In red we have the SPDR S&P 500 ETF (SPY). In blue, we have the Guggenheim S&P 500 Equal Weight ETF (RSP). We can see that SPY and RSP are, normally, fairly highly correlated. And we would expect this, since they invest in the same basket of stocks, just weighted differently. Yet for nearly an hour during the morning on August 24, SPY and RSP diverged in performance by thousands of basis points.



- ❑ At the open, SPY was down about 7%; the RSP opened down 12%.
- ❑ SPY recovered quickly; RSP continued to plunge.

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Commentary from blackrock.com (a large sponsor of ETFs)

- ❑ A confluence of US equity market issues exposed structural flaws that impeded the flow of order and pricing information, halted trading, and delayed the open for various securities.
- ❑ Widespread selling pressure led to pre-market price declines in futures and a surge in market orders.
- ❑ Almost half of New York Stock Exchange (NYSE)-listed equities had not opened by 9:40am. Exchange rules limited preopen pricing information on those securities.
- ❑ Many stocks that opened on time began trading at abnormally low levels (e.g., down 20%).
- ❑ Trading in hundreds of securities was repeatedly halted by Limit-Up Limit-Down (LULD) rules, including 773 Limit Up halts and 505 Limit Down halts.

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- ❑ The US equity ETP [Exchange Traded Product] arbitrage mechanism was temporarily impaired due to disruptions stemming from the above issues.
- ❑ ~20% of US-listed ETPs were halted from trading at some point during the day.
- ❑ ETPs depend on market makers to arbitrage price discrepancies between share price and underlying portfolio value.
- ❑ Arbitrage ceased temporarily on many US ETPs amid the lack of price indications, widespread anomalous single stock pricing, uncertainty around hedging due to fear of “broken trades,” delayed opens and trading halts in many stocks.
- ❑ The result was price dislocations or disparate behavior between comparable ETPs, similar to the experience of individual stocks.
- ❑ Market and stop-loss orders that demand “liquidity at any price” added to selling pressure and proved especially risky on the morning of August 24.