NBA 5420: Investment and Portfolio Management
Class 8: Financial Markets & High-Frequency Trading

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March 23, 2016

Trading

- We've talked a lot about how to form your portfolios and what the "correct" prices of securities should be…

- But how does the market arrive at a price?

- And how do you actually buy or sell a security?

Trading

- Exchanges
  - Stocks, futures, options (and a few types of bonds)
  - NYSE, NASDAQ, dark pools, etc.

- Broker-dealer networks (OTC)
  - Bonds, swaps
  - Block trades of stocks

- Internalization
  - Your broker matches your buy order with another incoming sell order without sending it to the exchange

Two types of orders

1. **A limit order** (or quote) stands on the exchange
   - For example:
     - "bid" = an offer to buy 100 shares at price $464
     - "ask" = an offer to sell 150 shares at price $470
   - Doesn't immediate generate a trade
     - Stands on the order book until executed or canceled

2. **A market order** results in an immediate trade
   - Executes against a resting limit order on the order book
     - For example, buy 150 shares at price $470 (hitting the "ask" listed above)

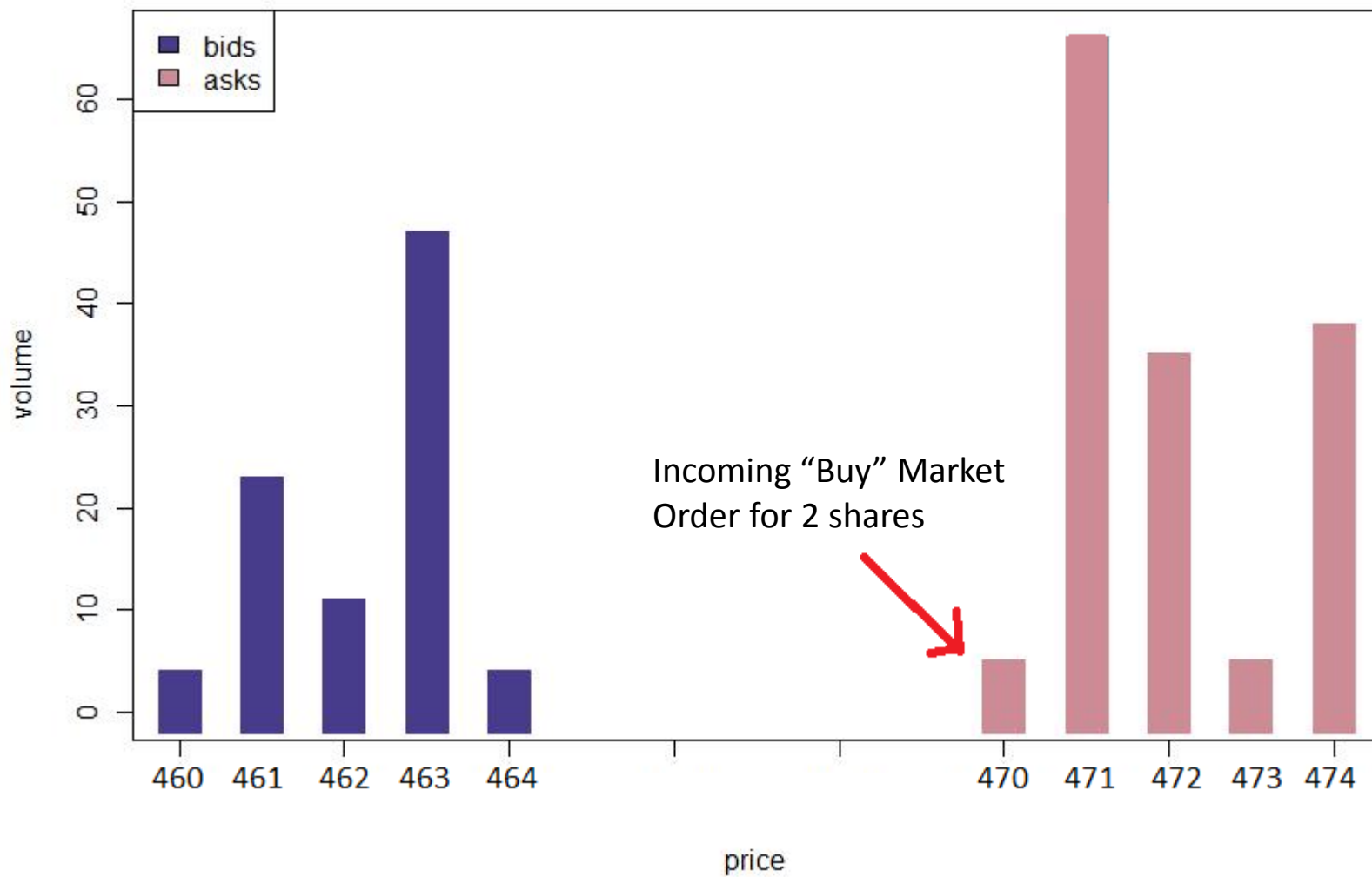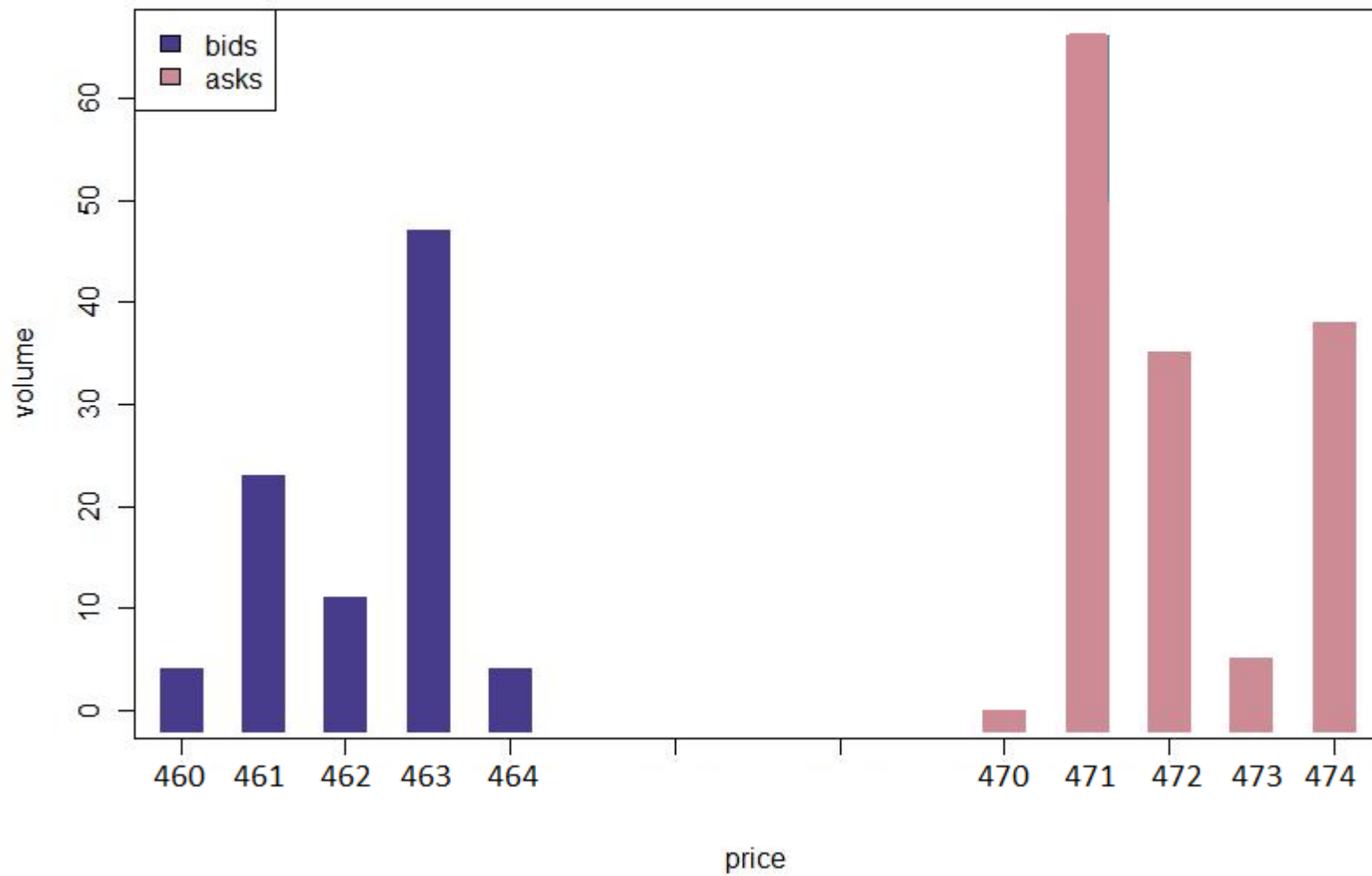**Every trade consists of a market order hitting a limit order**
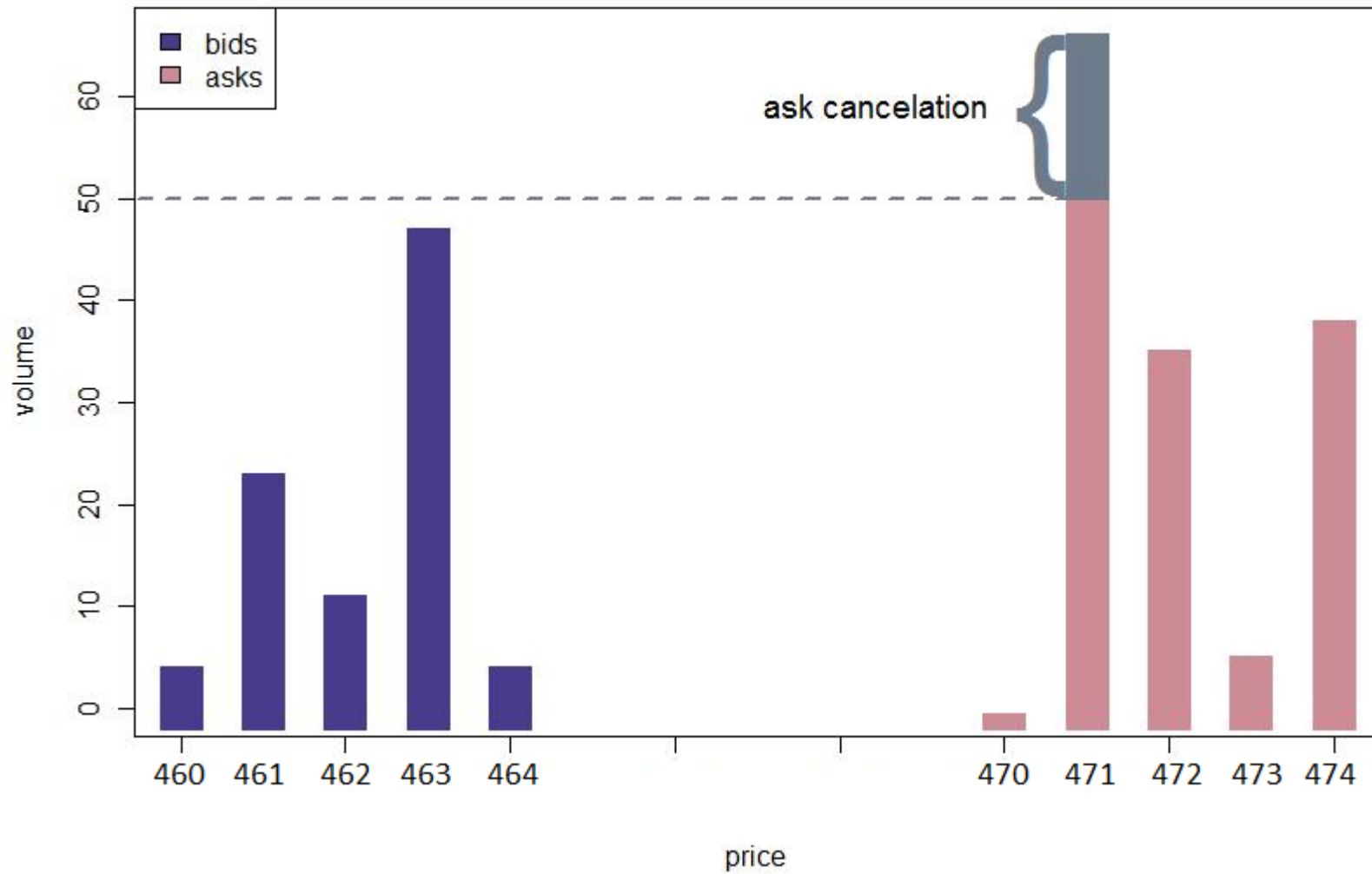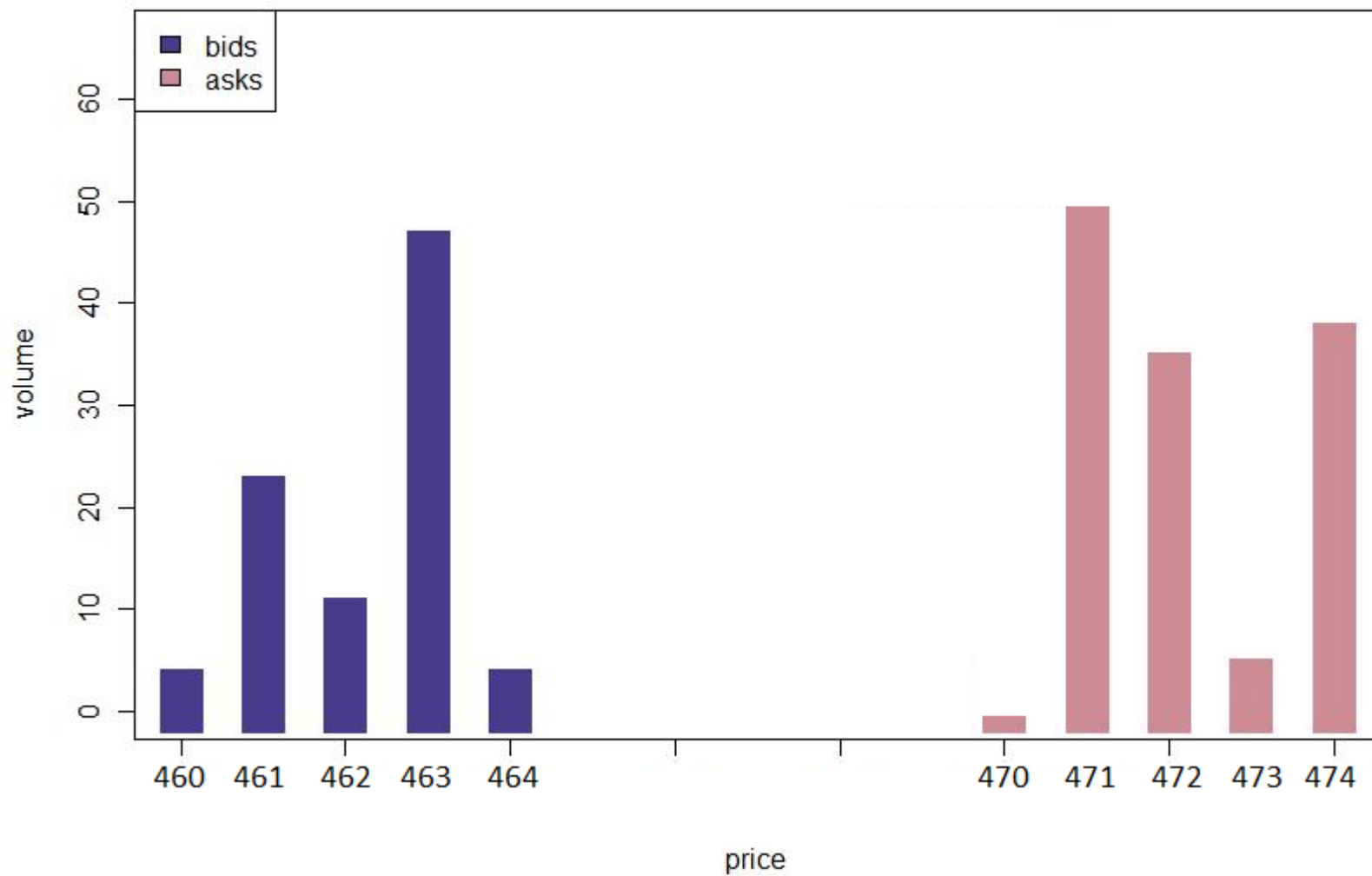
Limit Order Book

Limit Order Book

Incoming "Buy" Market Order for 2 shares
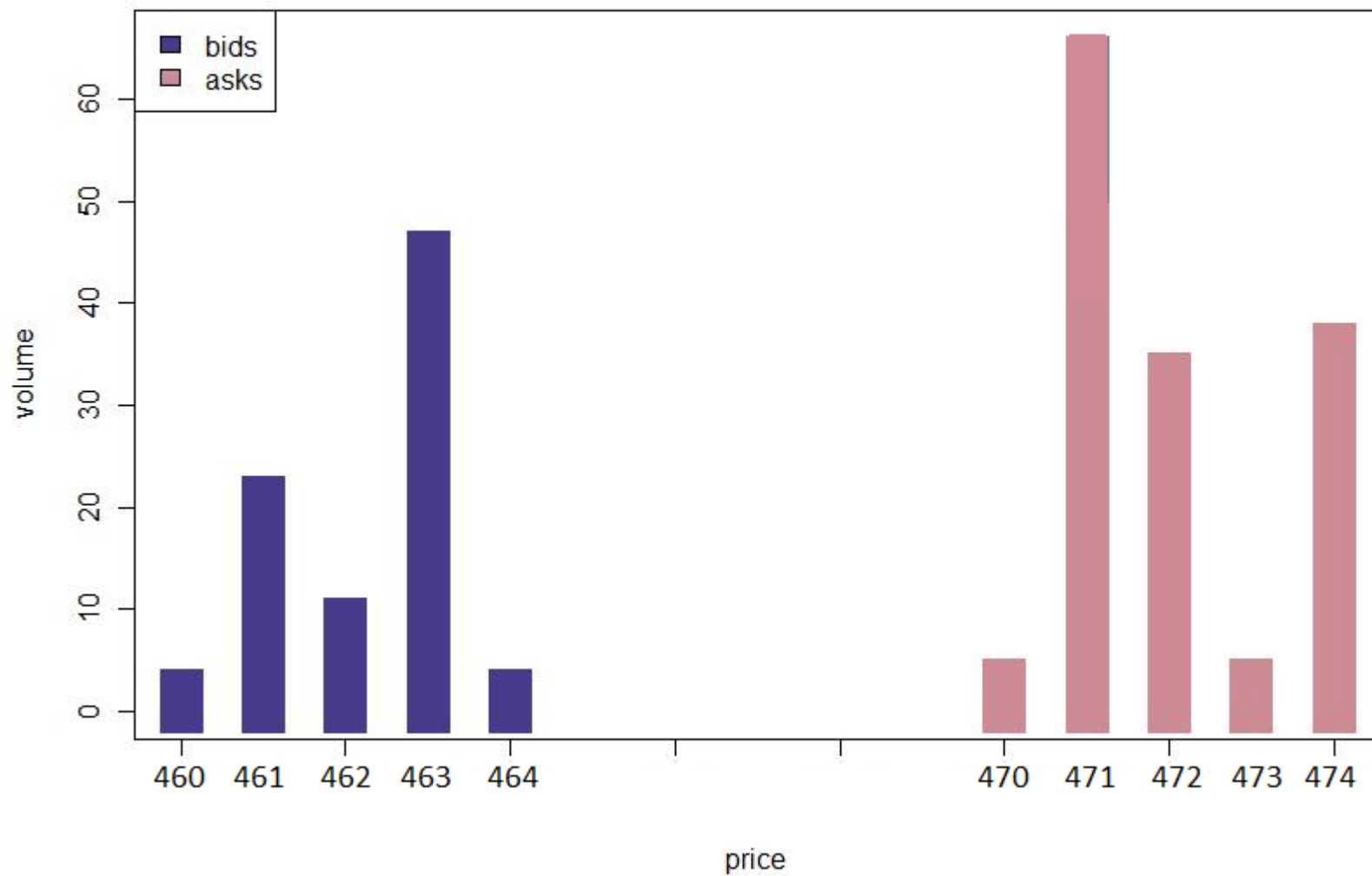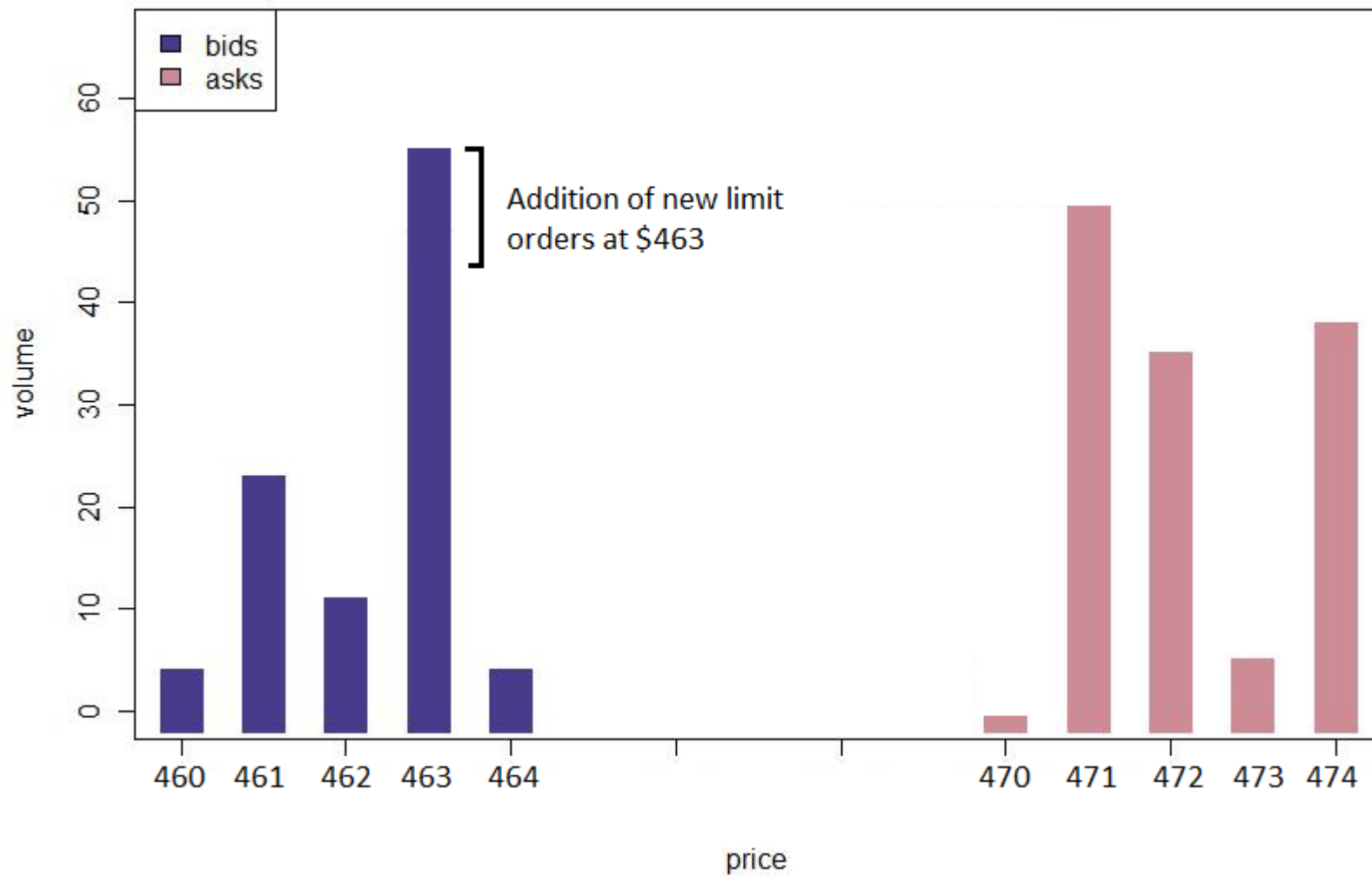
Limit Order Book

Limit Order Book

Limit Order Book

A "deeper" order book
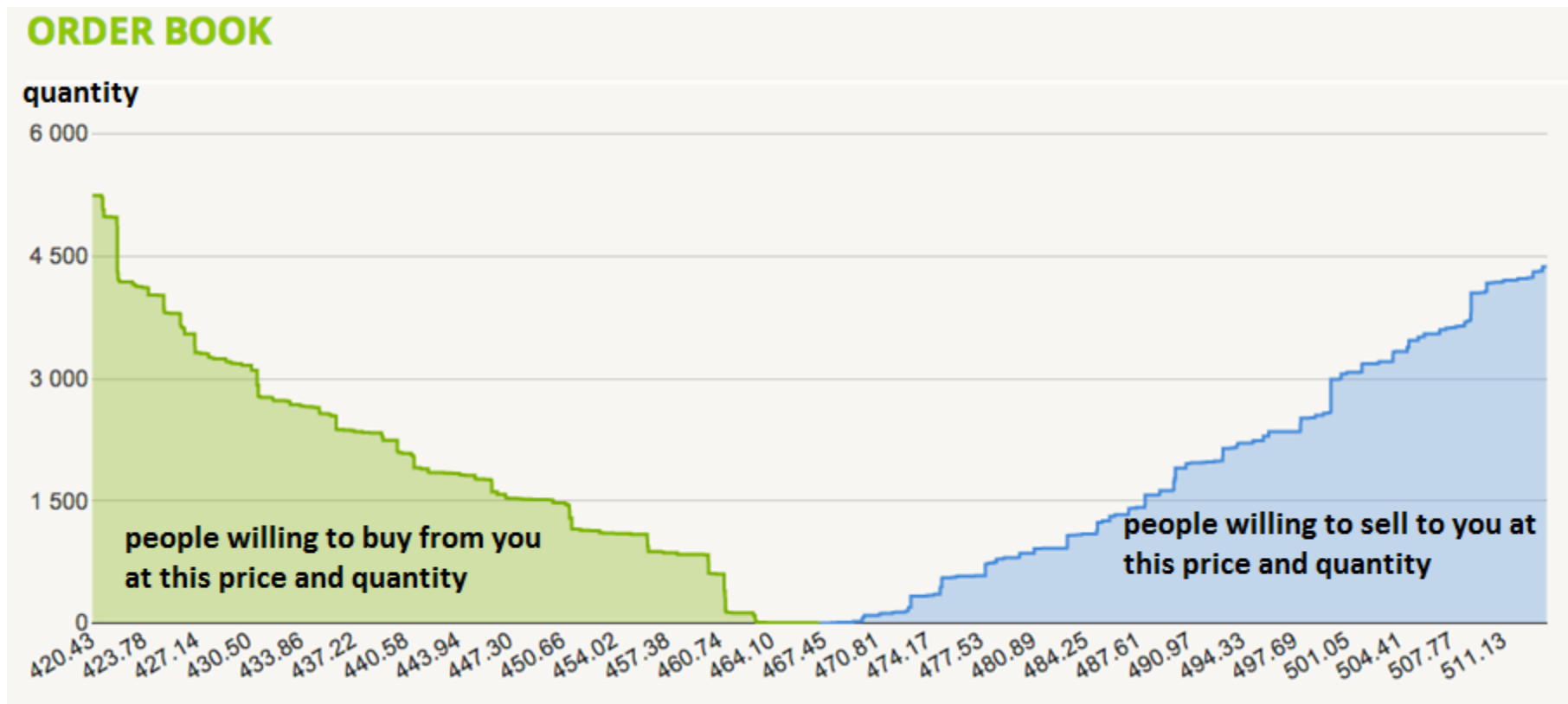
Bid-ask Spread

- Bid-ask Spread = difference between the bid and the ask prices
  - Can fluctuate over time
  - Determined by the market makers and other investors who use limit orders

- Determines the profits of market makers
  - Market makers have to charge a higher bid-ask when they face more risk (e.g., inventory risk, adverse selection risk)

- A measure of liquidity
  - A narrower bid-ask spread is better for investors, means lower trading costs

- For executing large market order, the "depth" of the order book may be more important

Bid-ask spread

Alphabet Inc. (GOOG) - NasdaqGS ⭐ Watchlist

740.75 ↓ 1.34 (0.18%) 3:59PM EDT

After Hours : **741.90** ↑ 1.15 (0.16%) 6:51PM EDT

Prev Close:	742.09	Day's Range:	737.46 - 745.00	
Open:	737.65	52wk Range:	515.18 - 789.87	
Bid:	739.18 x 100	Volume:	1,269,749	
Ask:	741.90 x 100	Avg Vol (3m):	2,476,600	
1y Target Est:	930.08	Market Cap:	509.87B	
Beta:	1.032	P/E (ttm):	31.40	
Next Earnings Date:	N/A	EPS (ttm):	23.59	
		Div & Yield:	N/A (N/A)	

Alphabet Inc.
GOOG   Mar 22, 3:59pm EDT

© Yahoo!

10am   12pm   2pm   4pm

------- Previous Close

1d 5d 1m 3m 6m 1y 2y 5y max
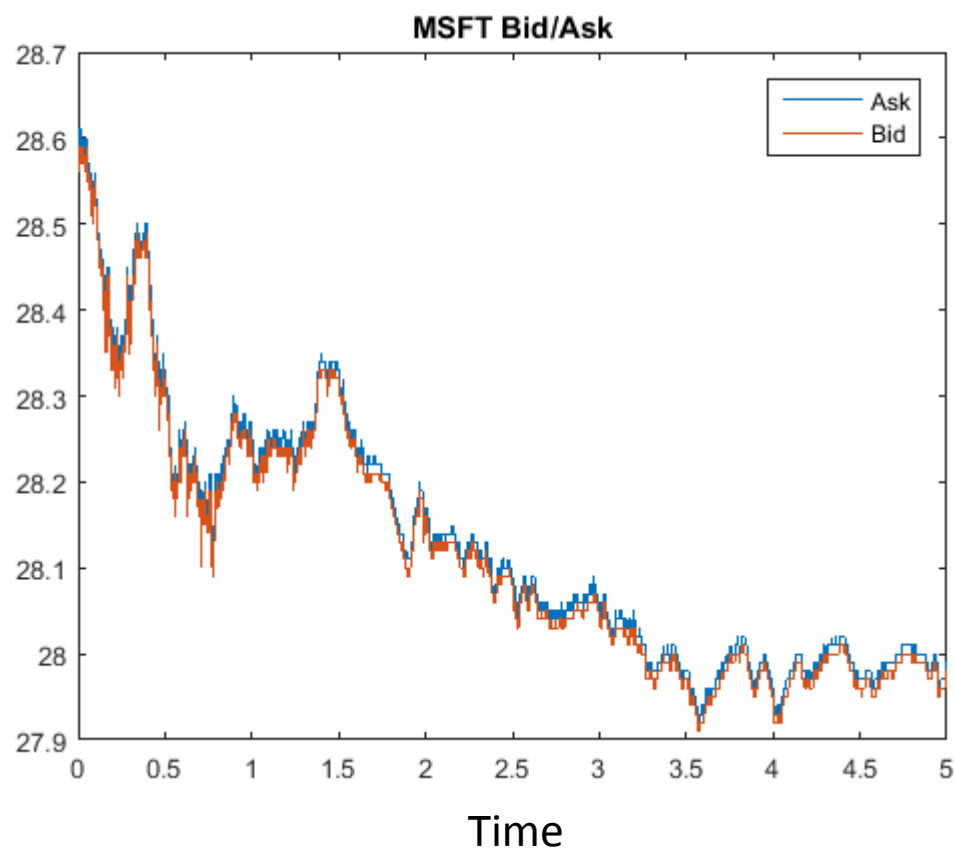
Bid-ask spread

Market makers

- Traders who specialize in continuously providing bids and asks ("provide liquidity")
  - Make it so that other investors can trade on demand

- They earn bid-ask spread
  - Compensation for various risks:
    - Inventory risk
    - Adverse selection

- There used to be designated market makers (e.g., "NYSE specialists") who had special obligations to provide liquidity
  - But now anyone can effectively be a market maker by posting limit orders

Market makers

Market maker posts the best bid and ask:

Best Bid | Best Ask
$81 | $84
(10 shares) | (10 shares)

1. Investor buys 5 shares at $84   Market maker inventory = -5 shares

2. Another investor sells 10 shares at $81   Market maker inventory = +5 shares

3. Another investor buys 5 shares at $84   Market maker inventory = 0 shares

Market maker final profit = 10 shares * bid-ask-spread
= 10*$3 = **$30**

Market makers

- Match buy and sell orders intertemporally. For example:
  - A lot of sell orders come in at 10:30 AM
  - A lot of buys orders come in at 10:35 AM

- Market Markers help smooth "order flow imbalances"
  - Stand ready with quotes to buy or sell at any given time
    - e.g., announce willingness to buy at $464 ("bid") & sell at $470 ("ask")

- Then profit from the "order flow imbalance"
  - Buy from the sellers at 10:30 AM
  - Then, turn around and sell those contracts at 10:35 AM
  - Hopefully, end the day with zero inventory
    - And earn $470 - $476 = $4 per share ("the bid-ask spread") as profit
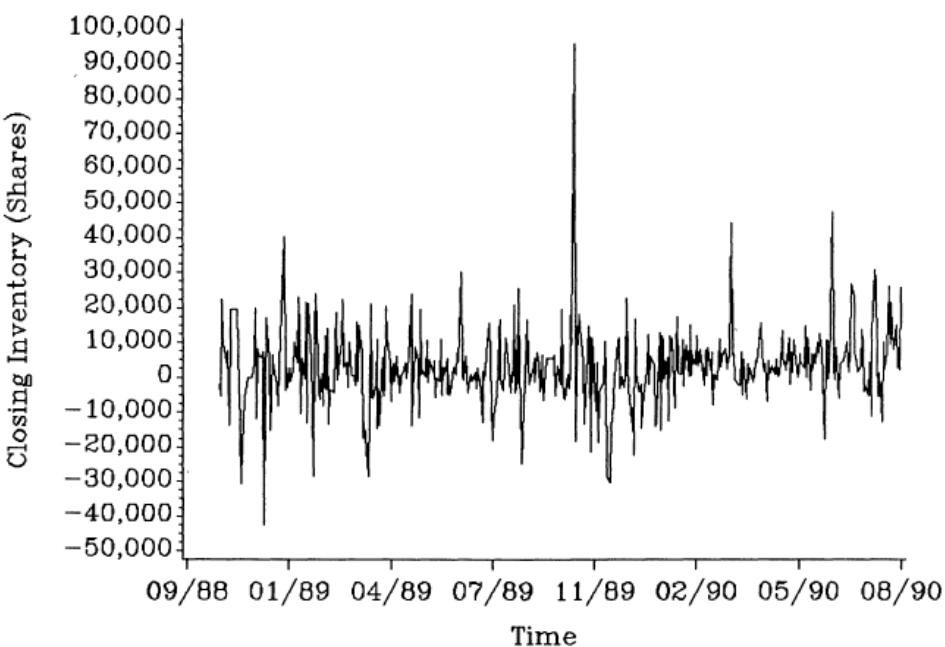
Market makers' inventories

Figure 1. Daily closing specialist inventory in shares for "stock A." Source: NYSE Specialist Performance Evaluation Trade Summary file.
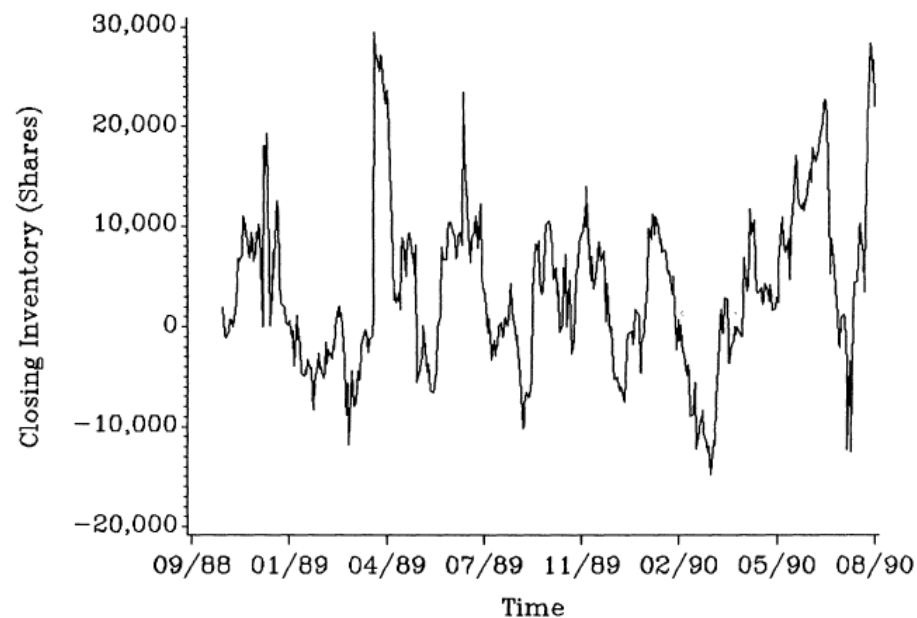
Figure 3. Daily closing specialist inventory in shares for "stock C." Source: NYSE Specialist Performance Evaluation Trade Summary file.

Figures from Hasbrouck & Sofianos (1993)

Price impact

- Effect that a market participant has when placing a buy / sell
  - The extent to which the buying or selling moves the price against the buyer or seller

- Market orders cause the price to move because:
  1. A single large market order will "eat through" the order book
  2. Other traders will trade market orders in the same direction
  3. Market makers cancel their limit orders and revise them at more expensive prices

Price impact

- Why price impact may arise:
  1. Market makers don't want to hold too much inventory
  2. Market orders may signal informed trading
  3. Market makers don't want to have limit orders that will be hit by informed trading ("adverse selection")

Exchanges

- What we want exchanges to do?
  - Low transaction costs
  - Liquidity
    - The ability to buy/sell large amounts on demand without moving the price
    - Liquid markets have deep order books and low price impact
 - Price discovery

1950s

1980s

Today

Stock trading is "fragmented"

- Small number of venues historically
  - NYSE, NASDAQ, AMEX

- 30+ stock trading venues today
  - New exchanges, alternative trading venues, dark pools, etc.
  - For example: NYSE Arca, ISE, BATS, Turquoise, IEX, etc.

- National Best Bid and Offer (NBBO) is a SEC regulation that requires brokers to execute customer trades at the best available bid and ask across exchanges

NYSE-listed Market Shares
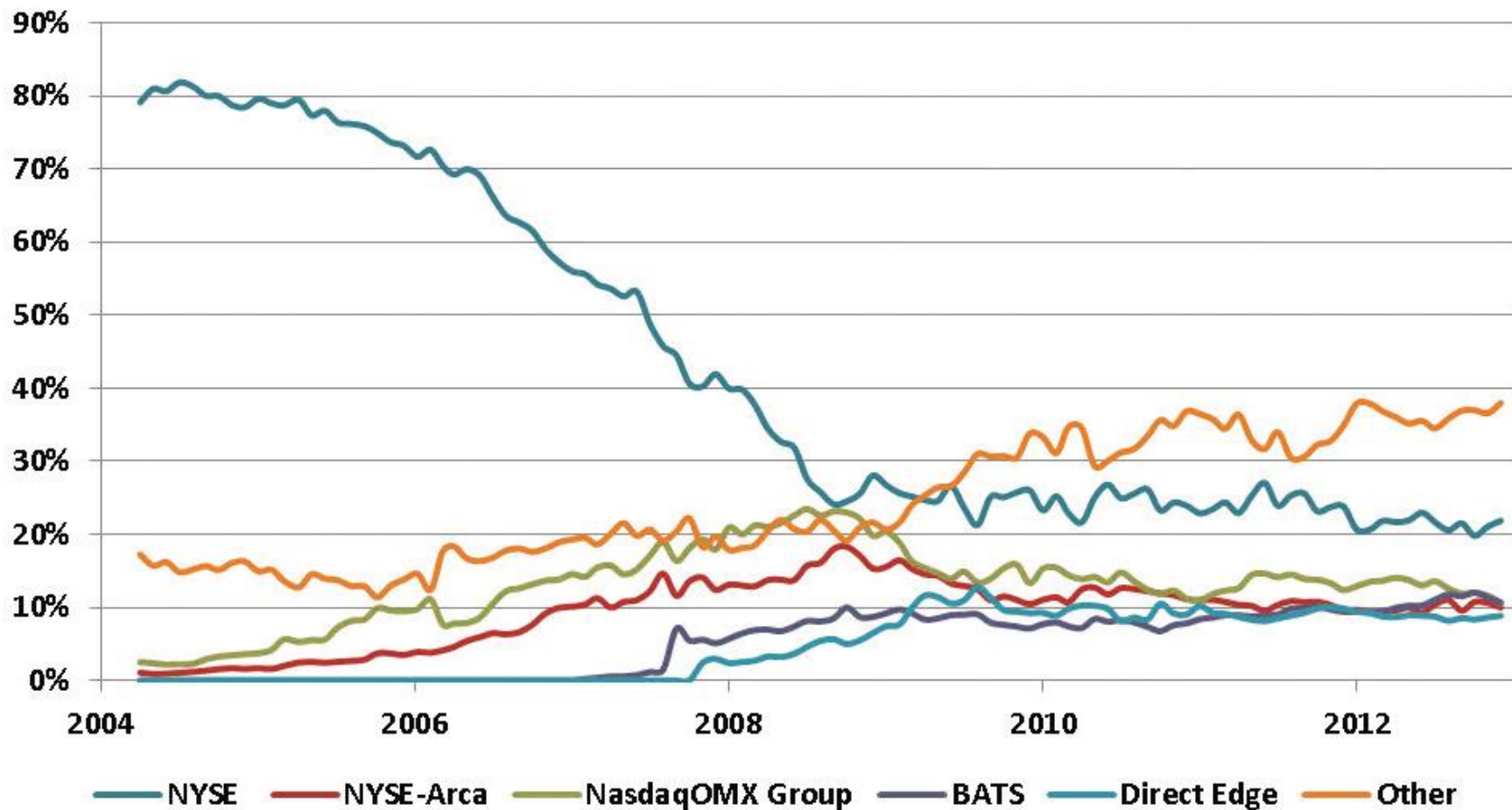
Who are HFTs?

- High-Frequency Traders (HFTs) use proprietary trading strategies carried out by computers to move in and out of positions in seconds or fractions of a second.

- While there is no single definition of HFT, key attributes are:
  - Highly sophisticated algorithms
  - High trading volumes at low-latencies
  - Co-location
  - Very short-term investment horizons
  - High cancellation rates of limit orders

- Recently, HFT account for 40-70% of all US equity trading volume
  - HFTs mostly trade in large-cap stocks (high volume & liquidity stocks)
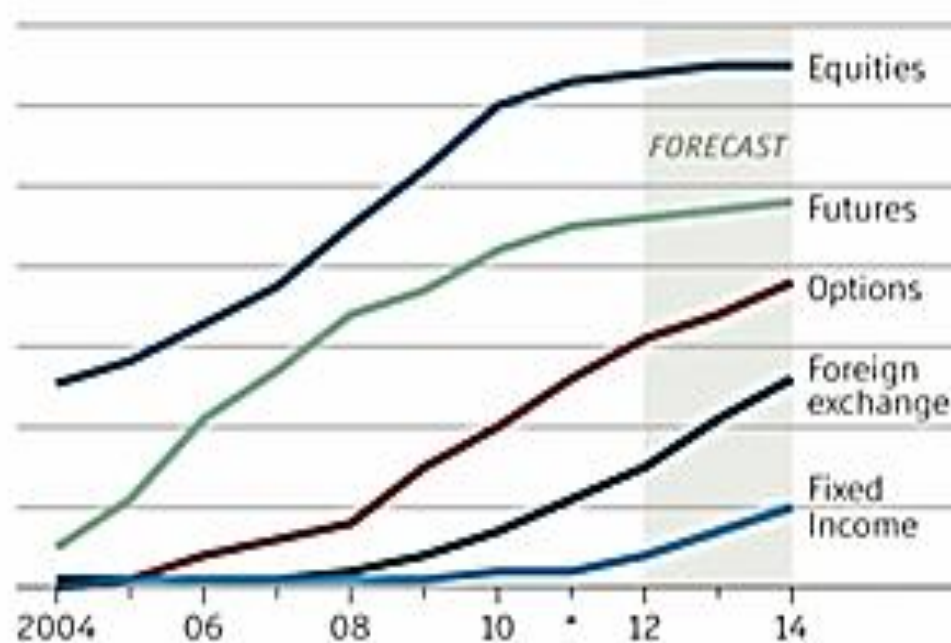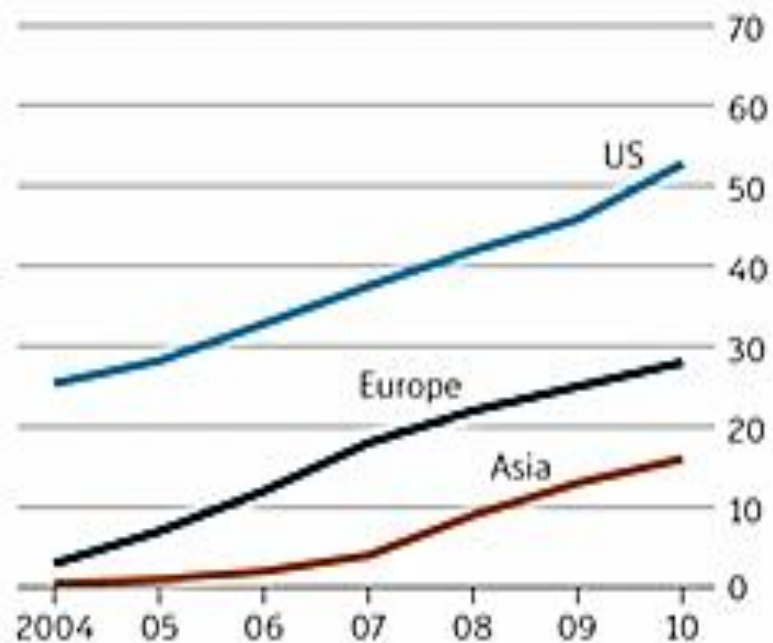
Who are the HFTs?
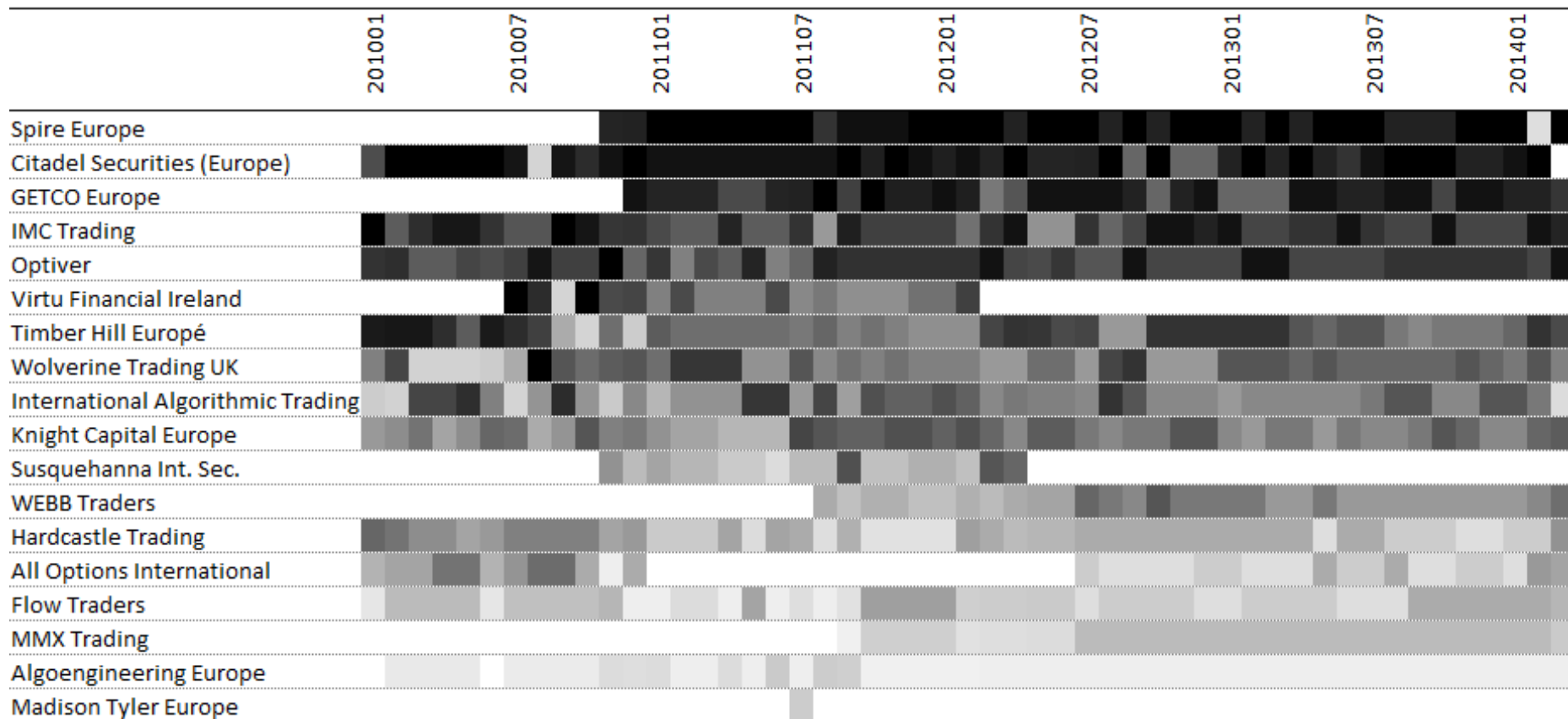
Algorithmic trading, % of total trading

Rise of the machines

Algorithmic trading, % of total trading

Source: Aite Group

*Estimate

What are HFT strategies?

- Market making
  - Post bid and asks, profit from the bid-ask spread
  - Must be able to quickly cancel & revise limit orders in response to news and informed trading

- Cross-market arbitrage
  - e.g., the E-mini S&P 500 futures and the SPY ETF

- Trading on signals (order flow or news)
  - Direct news data feeds
  - Analyze whether news is "good" or "bad" in sub-millisecond level

Some other facts about HFTs

- HFTs aim to capture sometimes a fraction of a cent in profit on every trade
  - HFT firms make up the low margins with incredibly high volumes of trades, frequently numbering in the millions

- HFT firms do not require significant amounts of capital
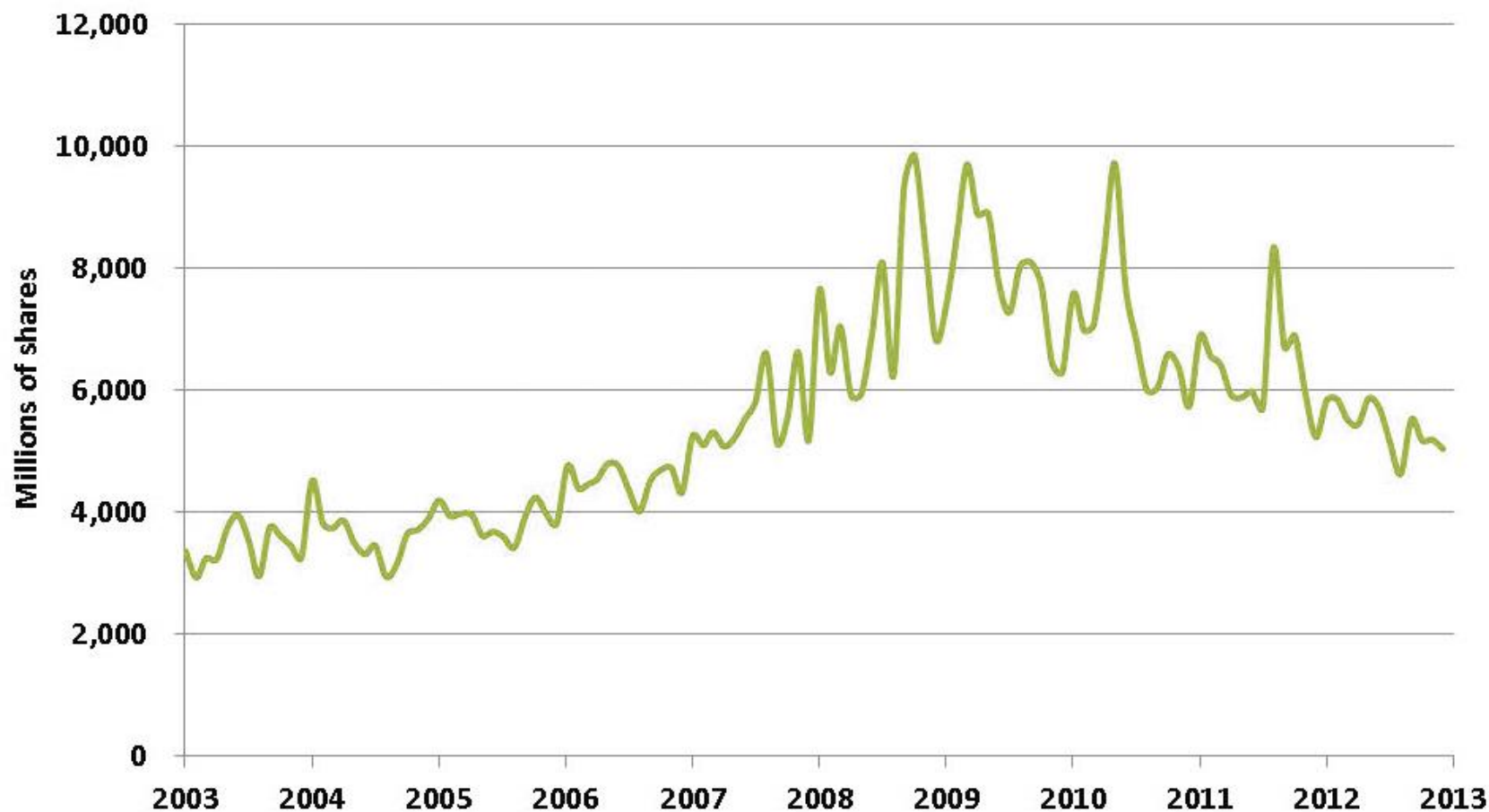 - Because they don't accumulate positions or hold portfolios over night

NYSE Annual Share Turnover

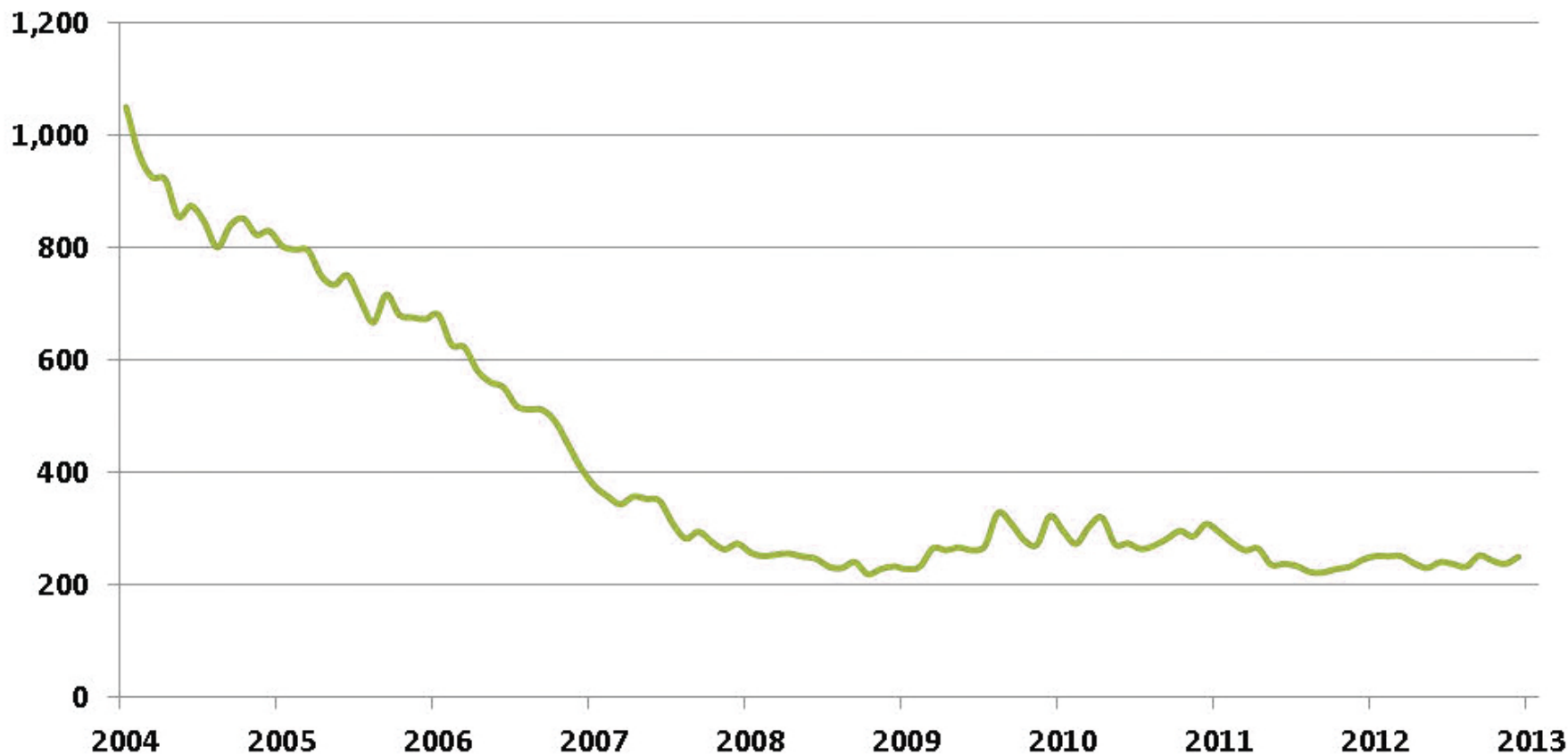Turnover = Annual Trading Volume / Mkt Cap

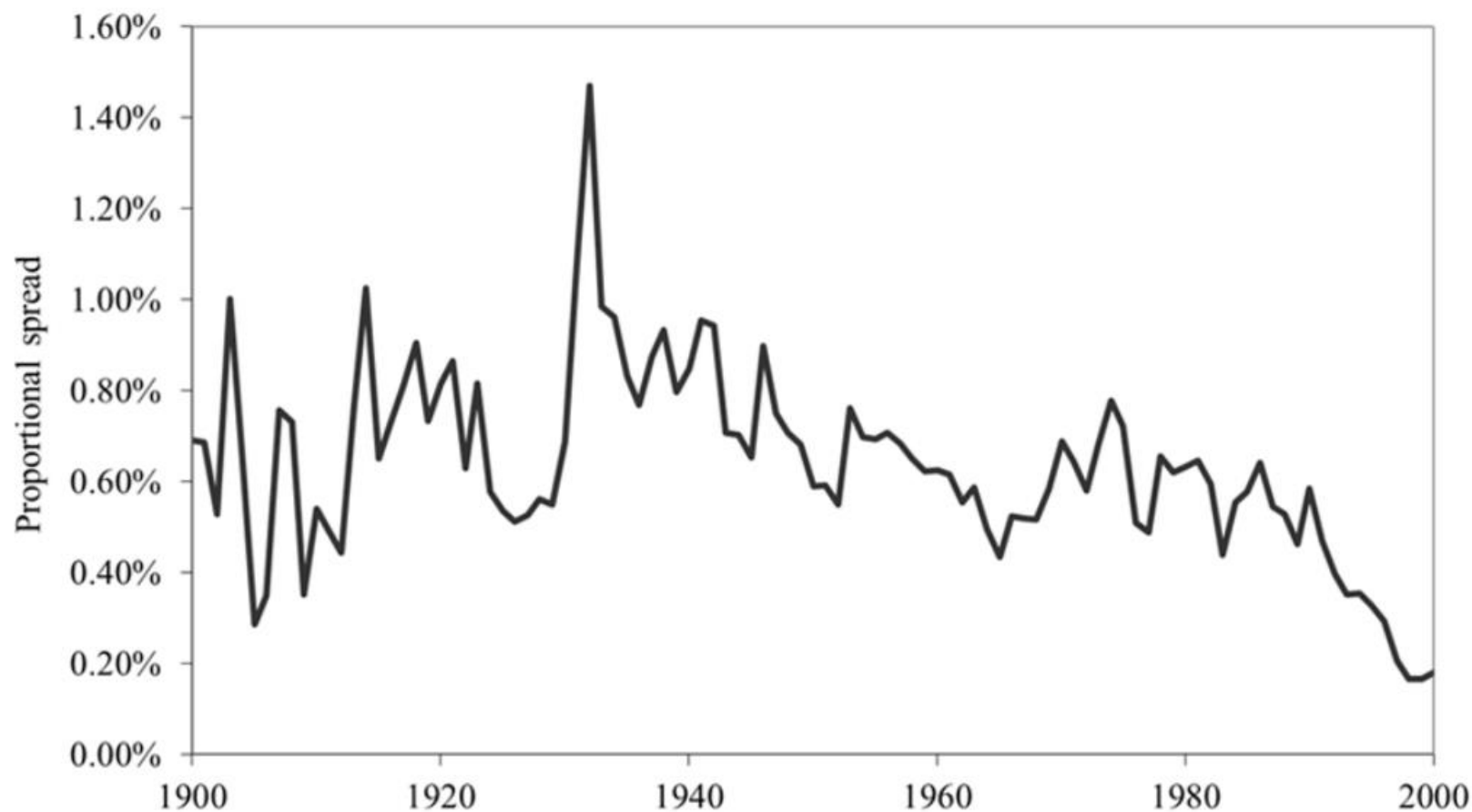Average Daily U.S. Equity Trading Volumes

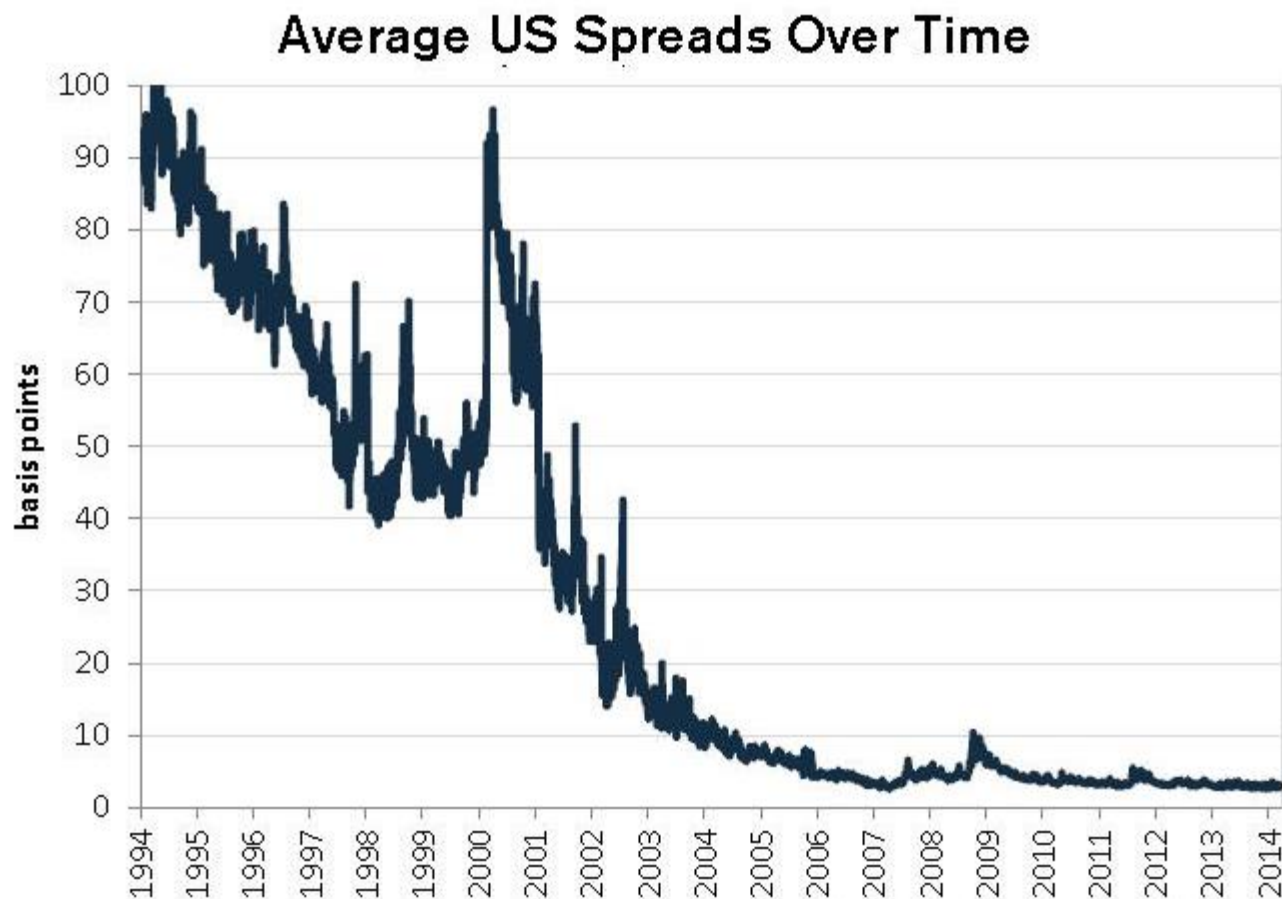NYSE-listed Consolidated Average Shares per Trade

Effective bid-ask spreads

Effective bid-ask spreads

Average US Spreads Over Time

Displayed Market Depth (Bid+Ask)
Median Stock
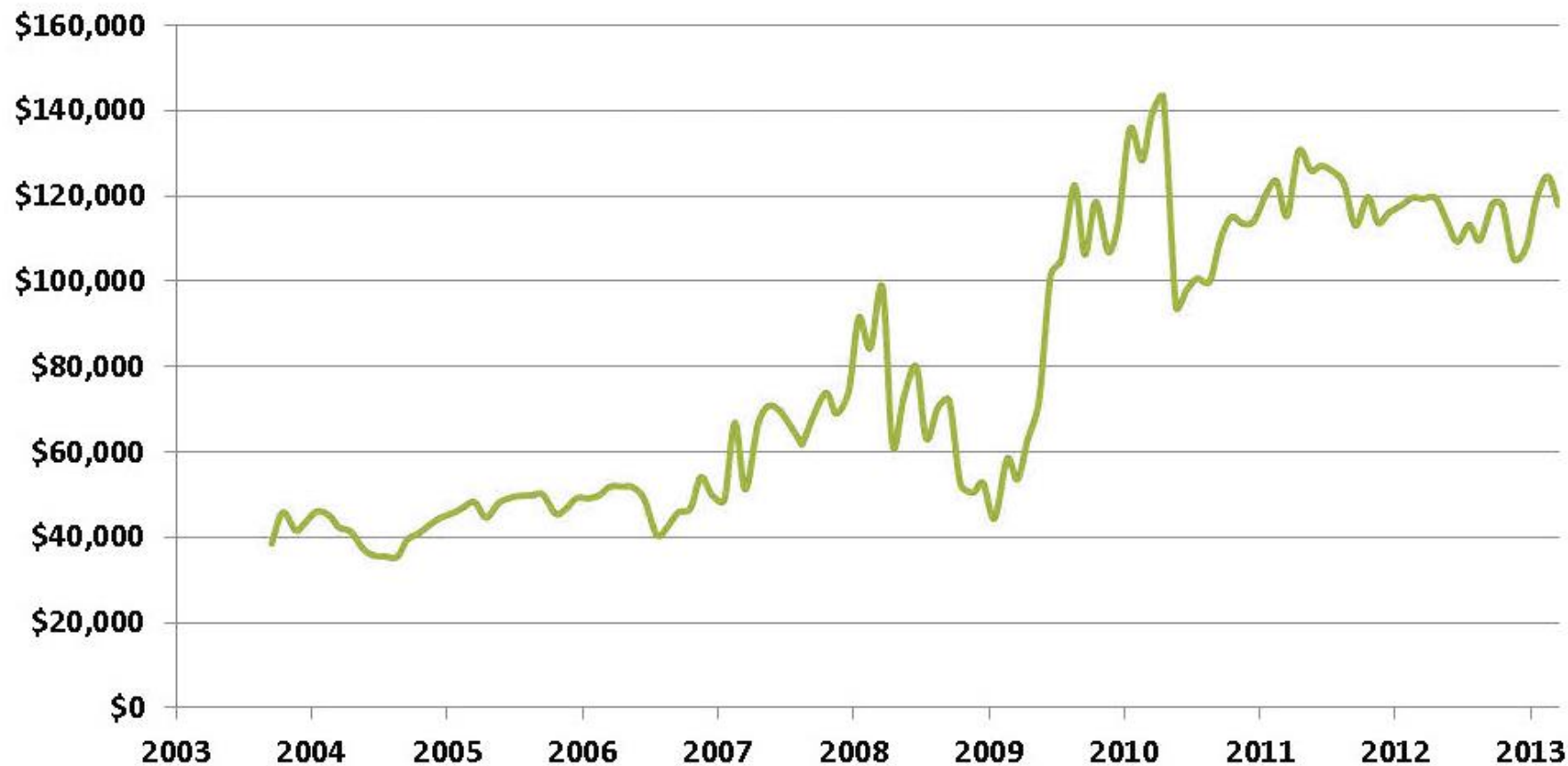
Quote-to-Trade Ratio
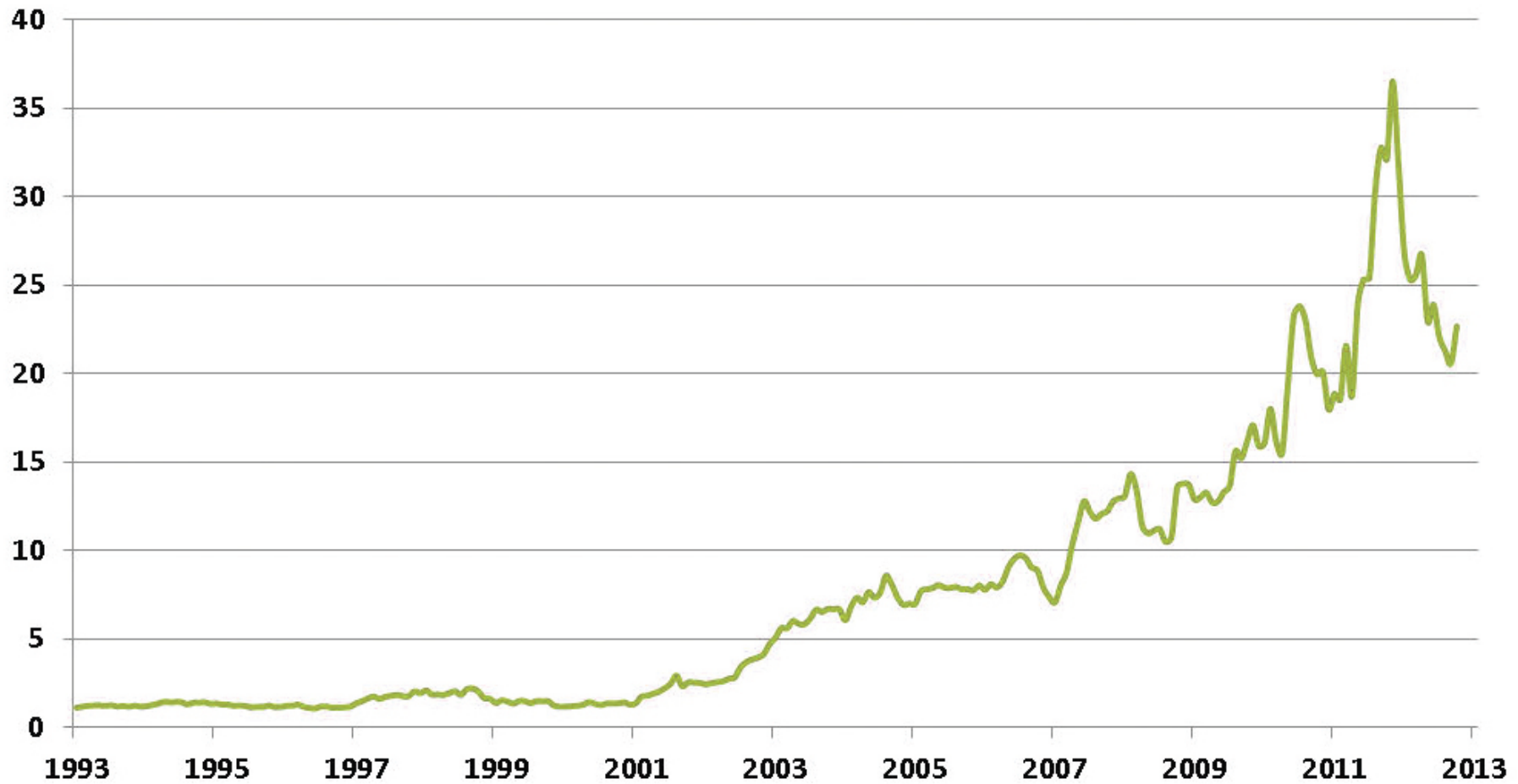
Quotes per Minute per Security

How fast are they?

Are HFTs good or bad?

- Who cares about microsecond price discovery?
  - I'm unconvinced that this helps long-term investors and improves corporate capital allocation

- The main benefit seems to be improved liquidity and decreased trading costs for both retail and institutional investors
  - Malinova, Park, Riordan (2013)

Malinova, Park, Riordan (2013)
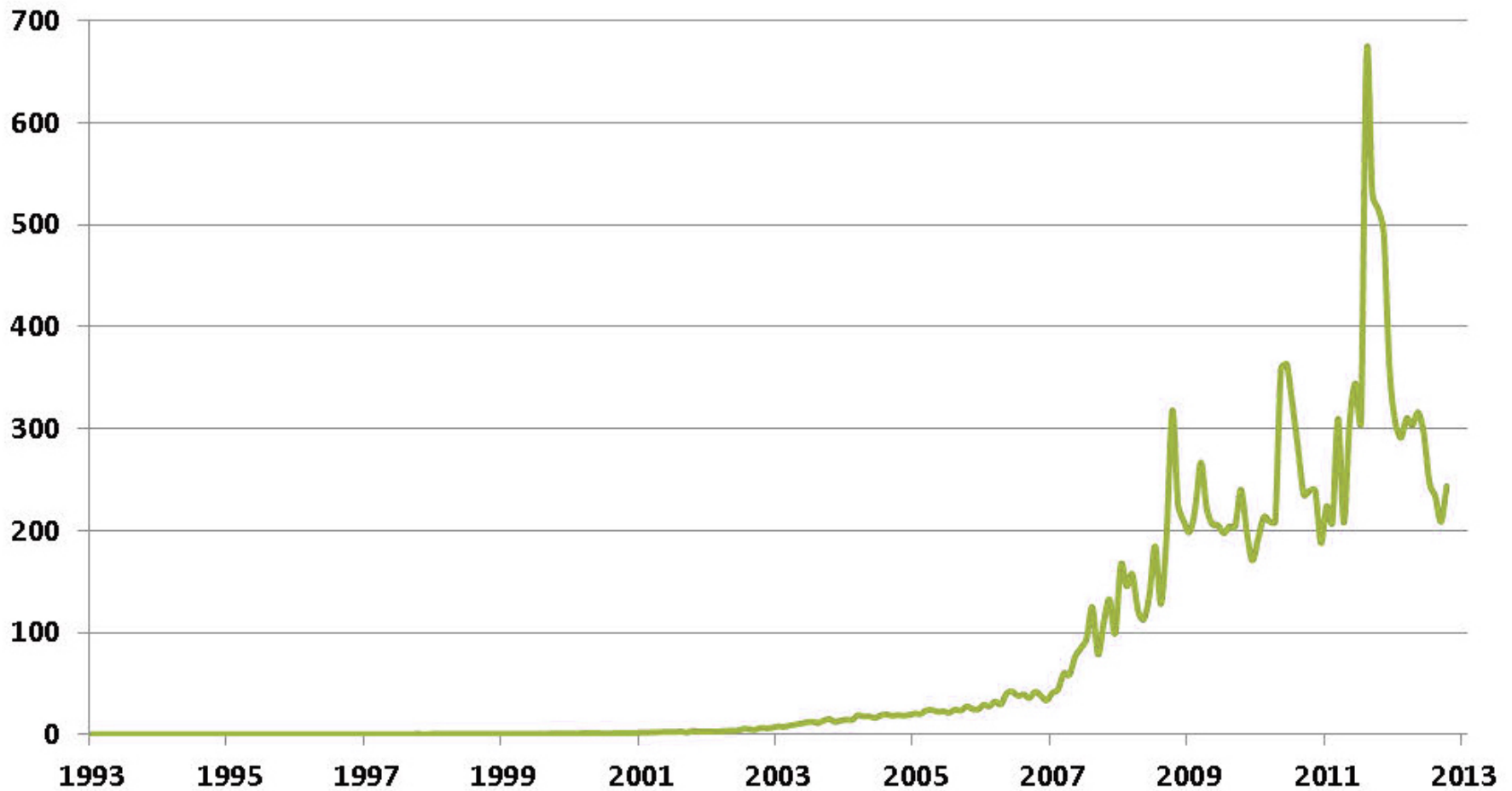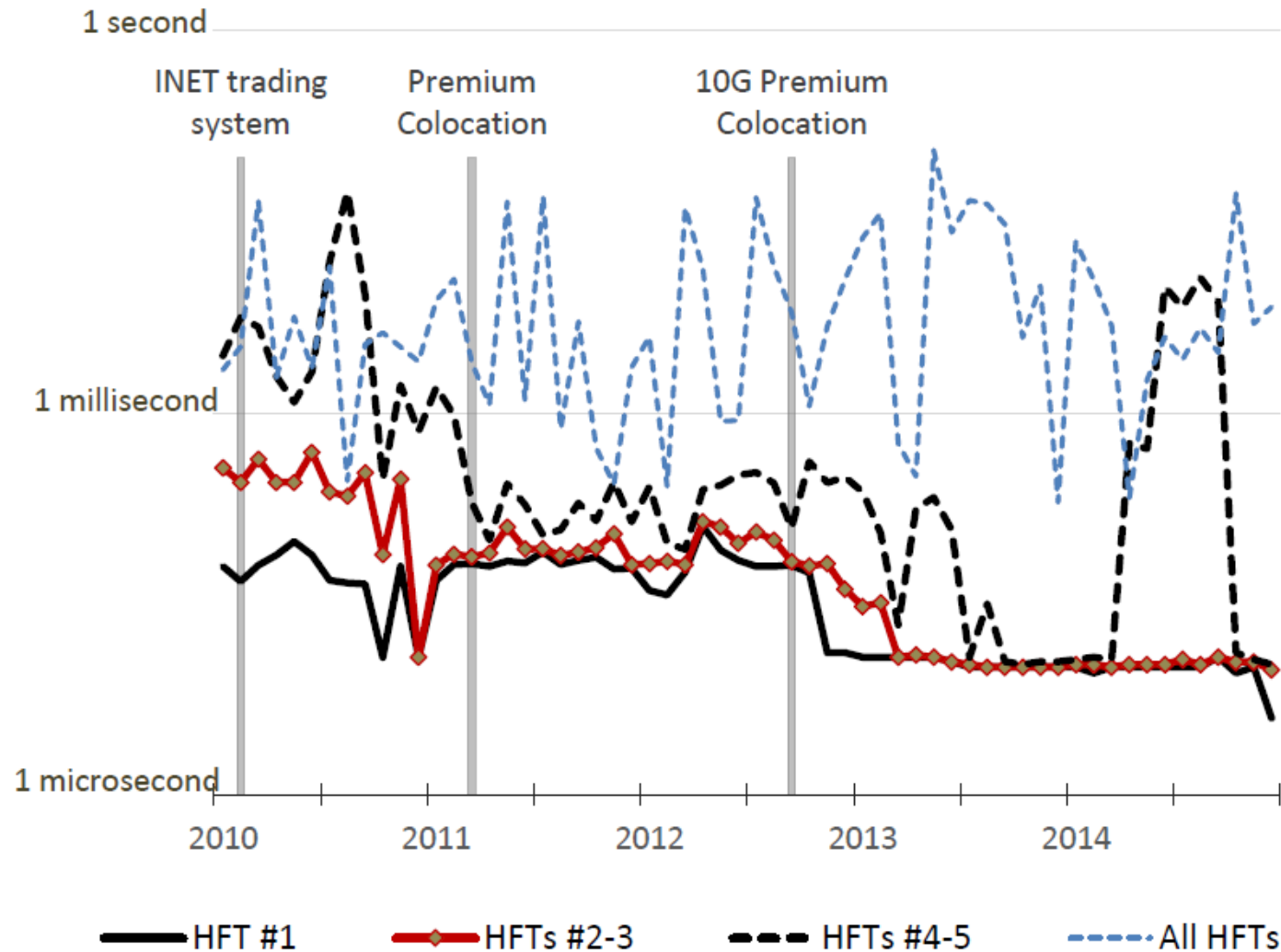
- Studies trading on Canadian equities markets in 2012
  - Uses special regulatory data to look at trading of HFTs, retail traders, and institutional traders

- Analyzes an 'experiment' that temporarily removes HFTs
  - A transaction tax that only affects HFTs
    - i.e. traders that have an enormous number of order messages
  - The transaction tax on HFTs leads to 30% reduction in order messages

- Malinova, Park, & Riordan (2013) find that:
  - Market bid-ask spreads rise by 9%
  - Effective bid-ask spreads increase for institutional investors but not retail investors
  - Both groups incur higher adverse selection. In particular,
    - Retail traders' intraday returns (especially from limit orders) declined
    - Institutional traders' returns from market order increased

Malinova, Park, Riordan (2013)
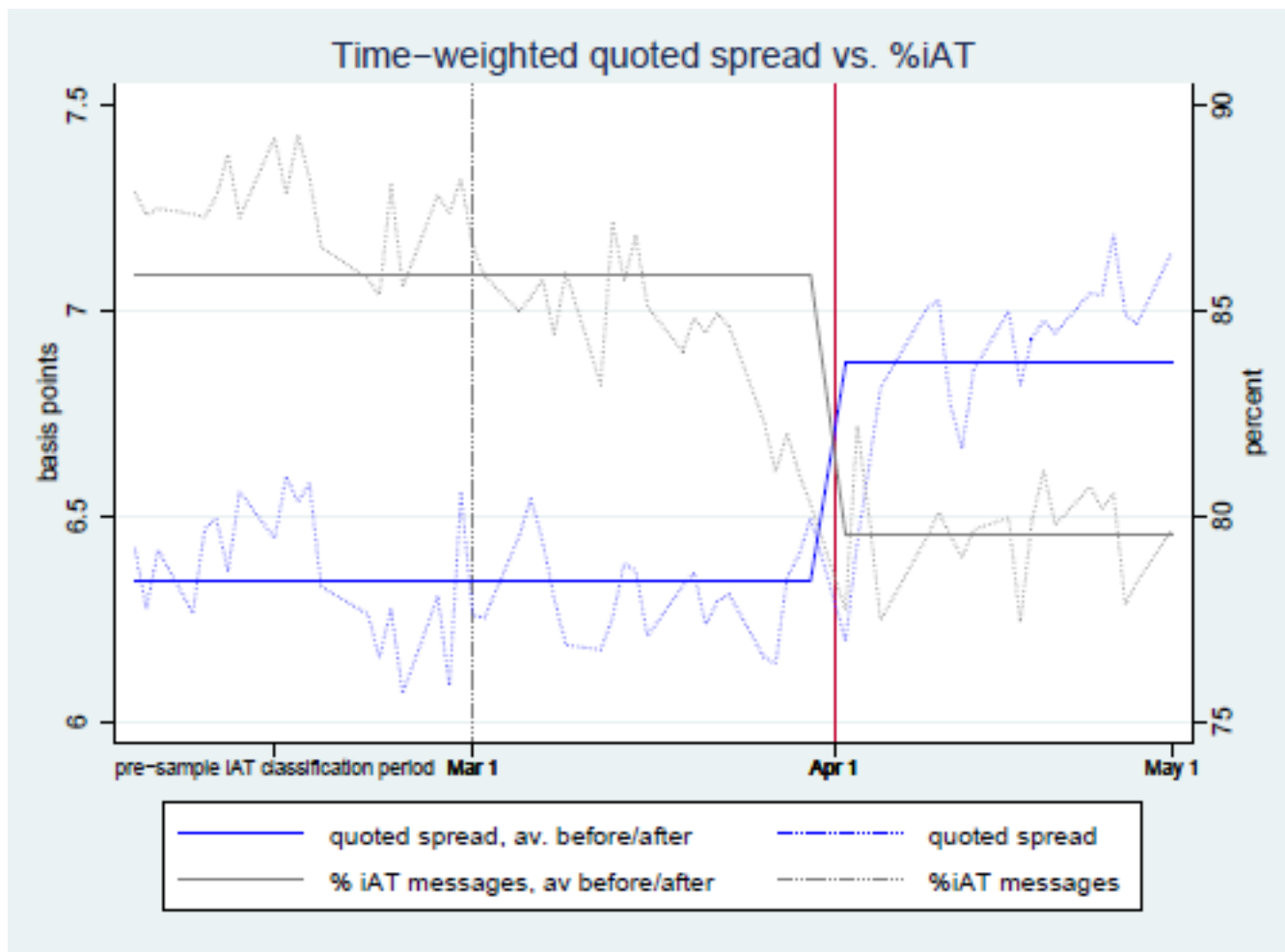
Time-weighted quoted spread vs. %iAT

Wealth Fund Cautions Against Costs Exacted by High-Speed Trading

By NATHANIEL POPPER   OCTOBER 20, 2013 7:27 PM   🗨 10 Comments

Oyvind G. Schanke, the top trader at Norway's sovereign wealth fund, which holds $110 billion in United States' stocks. Kyrre Lien for The New York Times

"Despite being one of the largest single investors in the world, Norway's sovereign wealth fund rarely makes waves.

"Now, though, the $750 billion fund is preparing to raise its voice on a sensitive topic: the increasing computerization of the stock markets and the costs it has imposed on big long-term investors.

"'The U.S. market has gone through a lot of changes and has become quite complicated and this complexity of the market creates a lot of challenges for a large investor like us'

"For the large investors trading millions of shares, like the Norwegian fund, the spread is only a small part of the cost of trading. The much more significant cost comes when other traders spot a big investor coming and then push the price down or up, knowing the investor will have many more shares to buy or sell.

"Mr. Schanke said that fragmentation of the markets had made that practice easier for high-speed traders, and that the cost of the so-called market impact was 5 to 10 times any other costs, he said."

One Way to Unrig Stock Trading

By JONATHAN MACEY and DAVID SWENSEN   DEC. 24, 2015

AMERICA'S equity markets are broken. Individuals and institutions make transactions in rigged markets favoring short-term players. The root cause of the problem is that stocks trade on numerous venues, including 11 traditional exchanges and dozens of so-called dark pools that allow buyers and sellers to work out of the public eye. This market fragmentation allows high-frequency traders and exchanges to profit at the expense of long-term investors.

Individual investors, trading through brokers like Charles Schwab, E-Trade and TD Ameritrade, suffer first as the brokers profit by hundreds of millions of dollars from selling their retail orders to high-frequency traders and again as those traders take advantage of the orders they bought.

Market depth, critically important to investors who trade large blocks of securities, also suffers in the world of high-frequency traders. Startling evidence for the lack of robustness in today's market comes from a 2013 Securities and Exchange Commission report that found order cancellation rates as high as 95 to 97 percent, a result of high-frequency traders' playing their cat and mouse game. Market depth is an illusion that fades in the face of real buying and selling.

Other potential problems

- Flash crashes
    - Have become more common recently

- Adverse selection based on speed
    - Fast traders can react to new information and 'pick off' the limit orders of slower market makers
    - Knowing this, market makers provide less liquidity in the first place

- Arms race for speed
    - The race to be the fastest can lead to wasteful investment
        - NYC-Chicago optic cable for $300 million to reduce communications time from 16 to 13 microseconds
        - Microwave transmission has further reduced transmission time to 8.5 microseconds

- Hidden liquidity; spoofing
    - HFT market makers can quickly cancel orders before you can execute against it
        - Giving the illusion of liquidity
        - Manipulating institutional traders' attempting to trade
        - Or taking away liquidity when it's most needed (like during a flash crash)

The May 2010 Flash Crash

U.S. Markets on May 6, 2010
Percent Change, Time Shown in EST