What do we know about high-frequency trading?

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October 2012

Muhammad ibn Musa al-Khwarizmi

- c. 780 – c. 850
- Persian Islamic scholar in the House of Wisdom in Baghdad
- Wrote *On Calculation with Hindu Numerals*
- Translated into Latin 400 years later as *Algoritmi de Numero Indorum*

Fast forward: a new bazaar for stocks

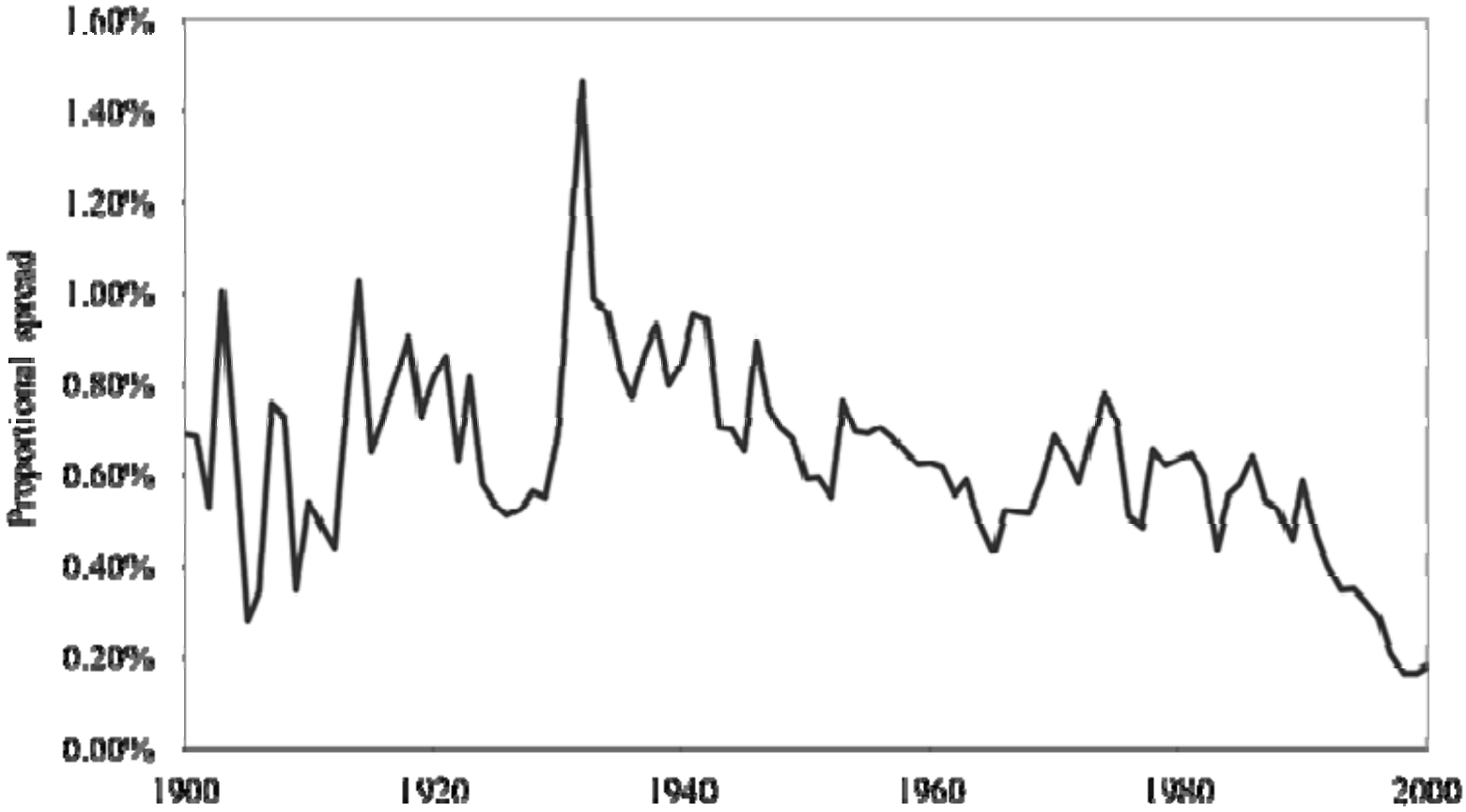
20th century

21st century

→ Automation driven by cost considerations →

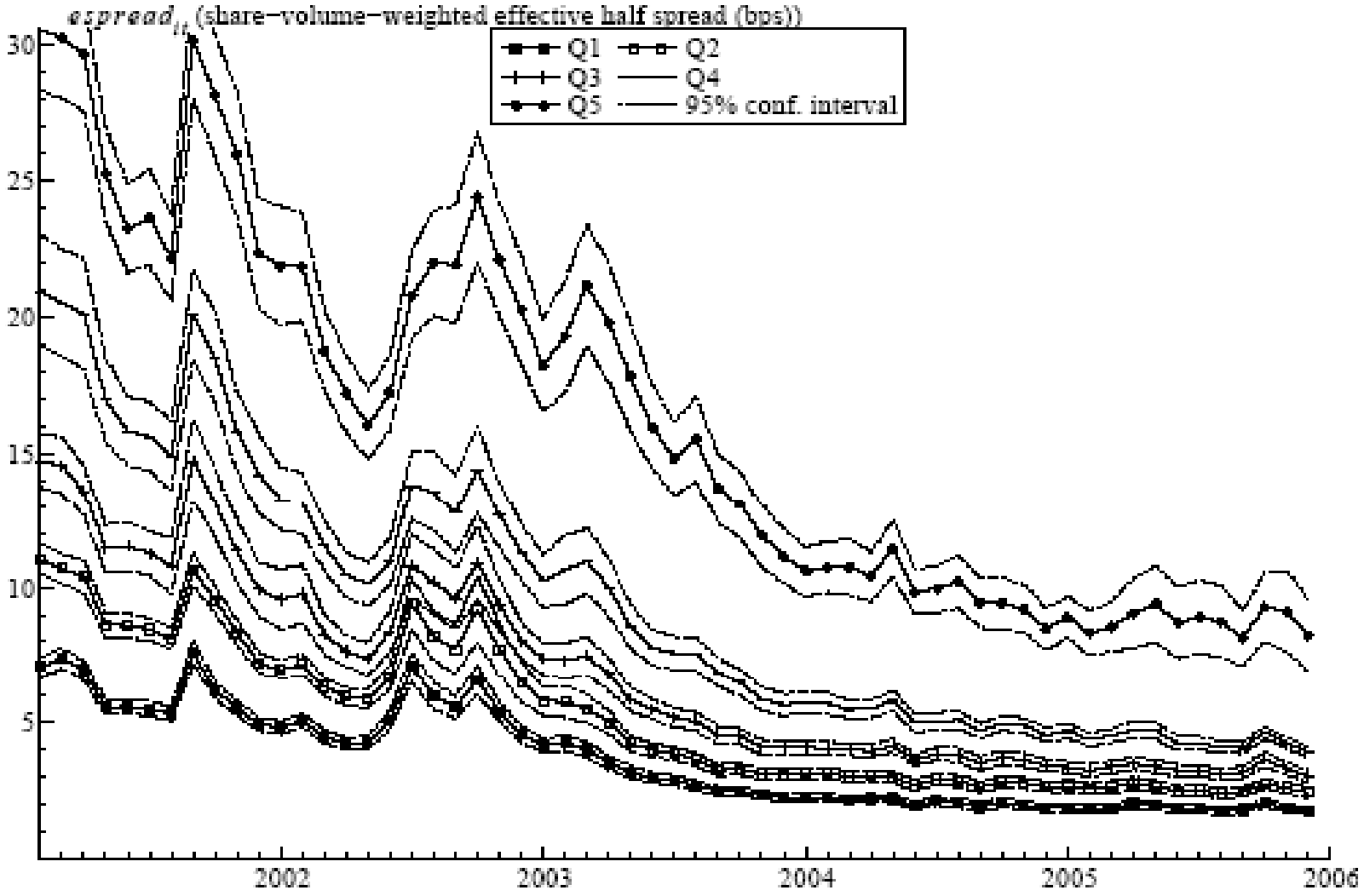
Liquidity improvement begins around 1990…

Figure 1. Bid-ask spreads on Dow Jones stocks
(all DJ stocks 1900-1928, DJIA stocks 1929-present)



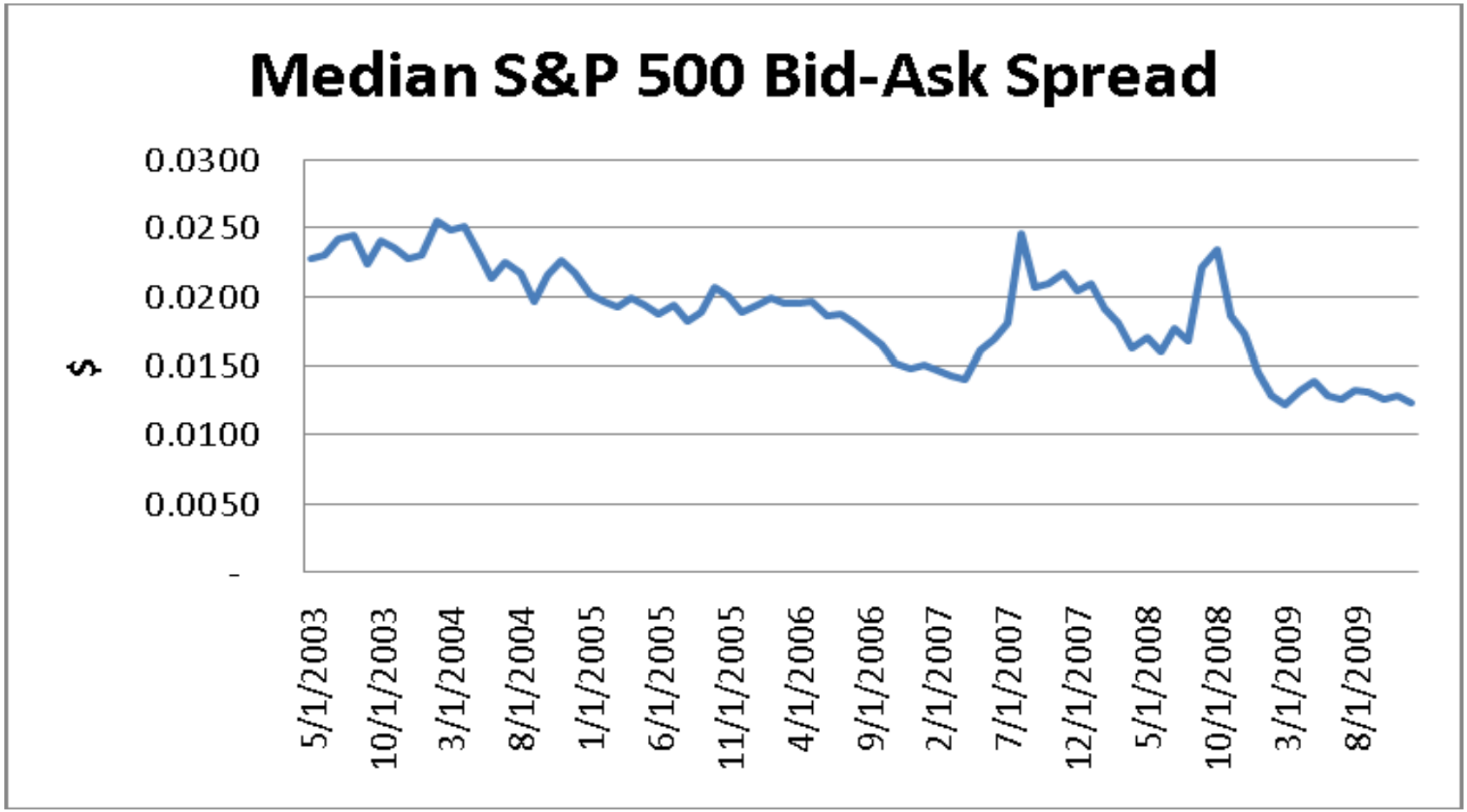
Source: Jones (2002)

Spreads continue to narrow



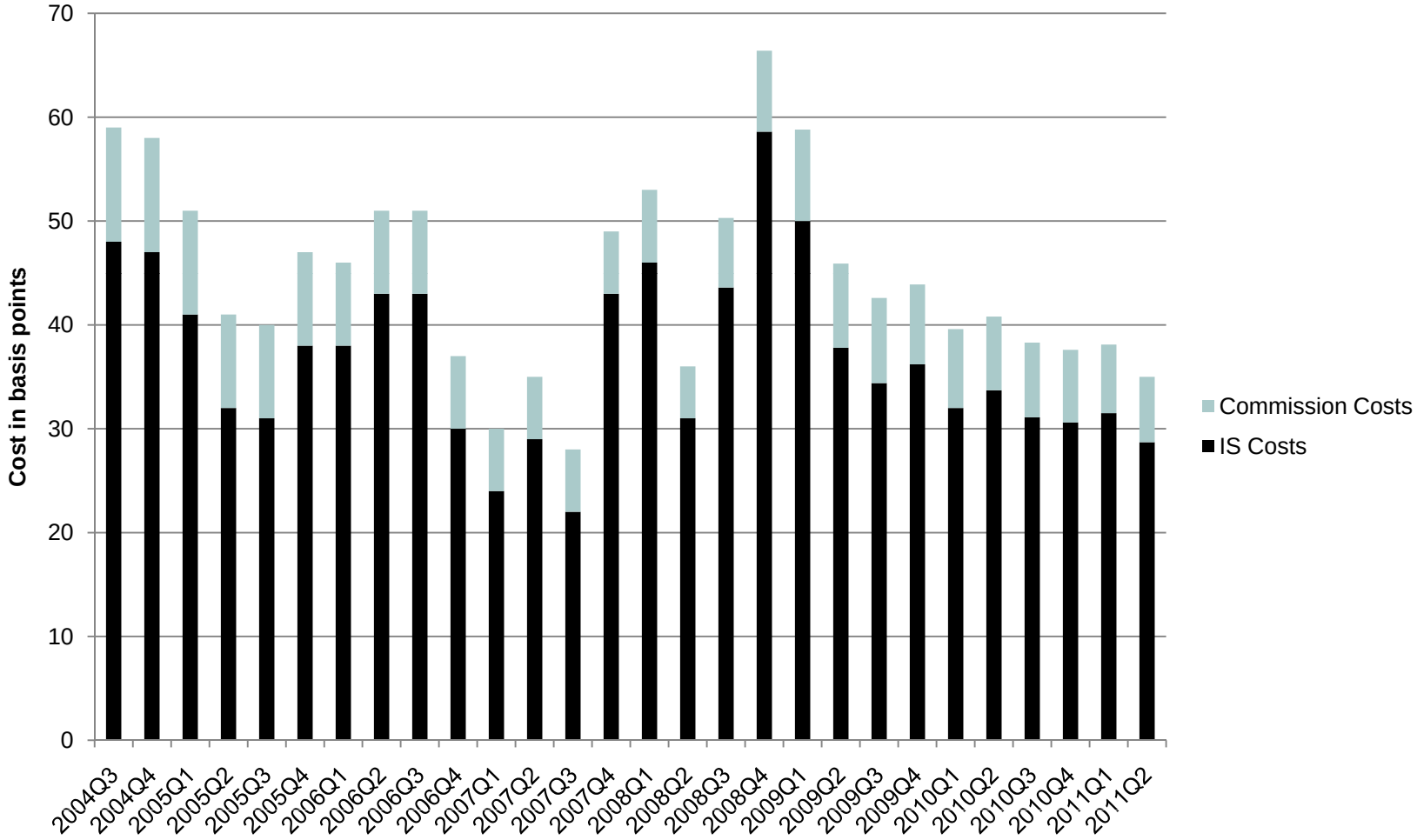
Source: Hendershott, Jones, and Menkveld (2010)

The narrowing trend resumes post-crisis



Source: Angel, Harris, and Spatt (2010)

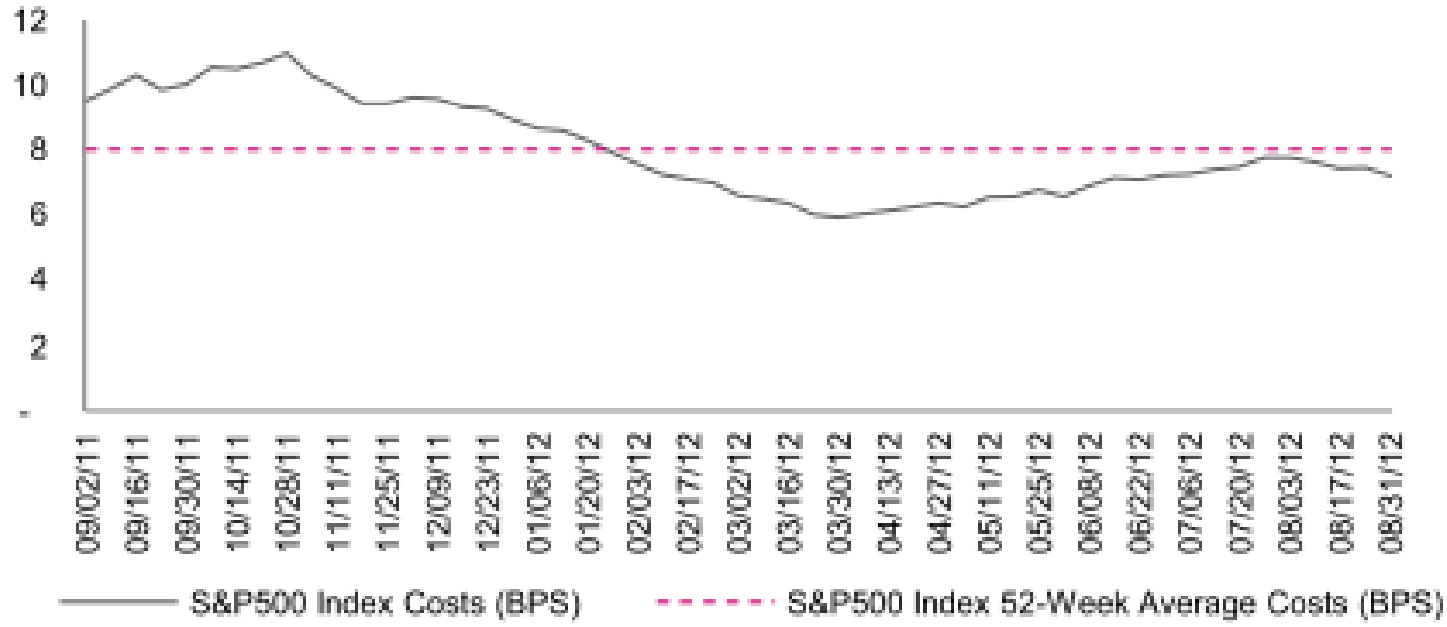
Institutional trading costs in US large-caps have also declined recently



Source: spliced ITG research reports

And splicing in one more year…

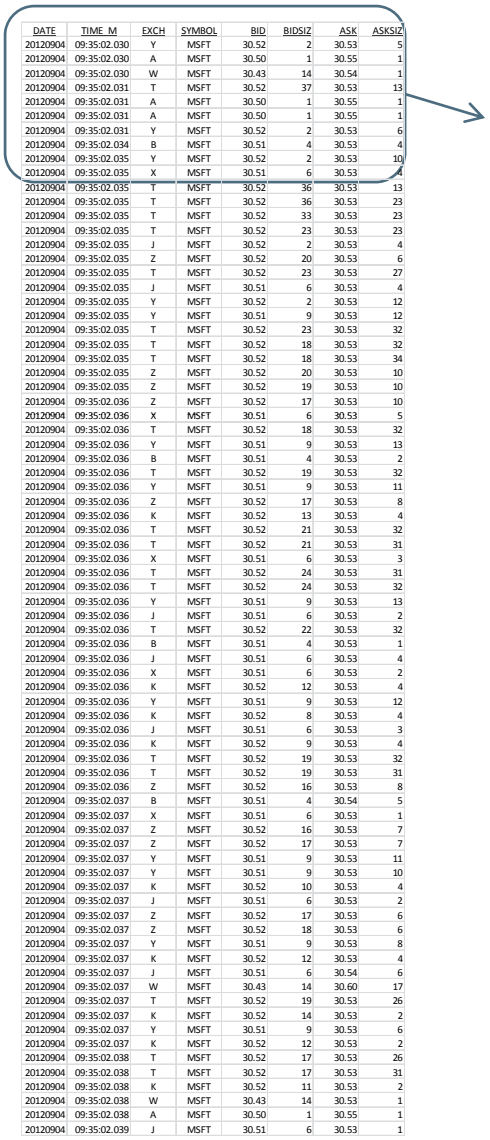
Average Trading Costs (BPS) for a $1B Portfolio of S&P 500 Constituents



Source: ITG

…all during the rise of the machines

0.01 seconds of activity in Microsoft



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20120904	09:35:02.035	Z	MSFT	30.52	20	30.53	6
20120904	09:35:02.035	T	MSFT	30.52	23	30.53	27

This is fairly typical of active names:
77 quote updates in 0.01 seconds!

High-frequency traders (HFTs)

- Proprietary trading at a rapid rate
- Focus on low latency
- Typically short (intraday) holding periods

Three broad categories of trading strategies:

- Market-making (formally or informally)
- High-frequency relative-value trading
  - Index arbitrage (futures vs. ETFs vs. single stocks)
  - Pairs trading (home market vs. ADRs, GM vs. Ford)
- Directional trading on public signals
  - Order flow
  - Newswire releases

The economics behind HFT

Potential benefits

- Increased competition in market-making
- Cost reduction via technology

Some potential costs

- Front-running persistent order flow could discourage others from participating
- Faster-take-all could lead to an unproductive arms race
- Additional temporary volatility (no evidence, though)
- Greater complexity imposes costs on others
- Greater complexity makes it easier for bad actors to hide

Some HFT theory models

- Biais, Foucault, and Moinas (2011)
- Jovanovic and Menkveld (2011)
- Martinez and Rosu (2011)
- Foucault, Hombert, and Rosu (2012)
- Pagnotta and Philippon (2011)
- Cartea and Penalva (2011)
- Brolley and Malinova (2012)

Oldies but goodies

- Glosten and Milgrom (1985): spreads due to
  - Order processing costs
  - Adverse selection

  Can view HFT, policy through this lens

- Grossman and Stiglitz (1980)
  - Returns compensate for investment in acquiring information
- J. Hirshleifer (1971)

Is it due to the computers?

Correlation is not causality!

Needed: good instruments

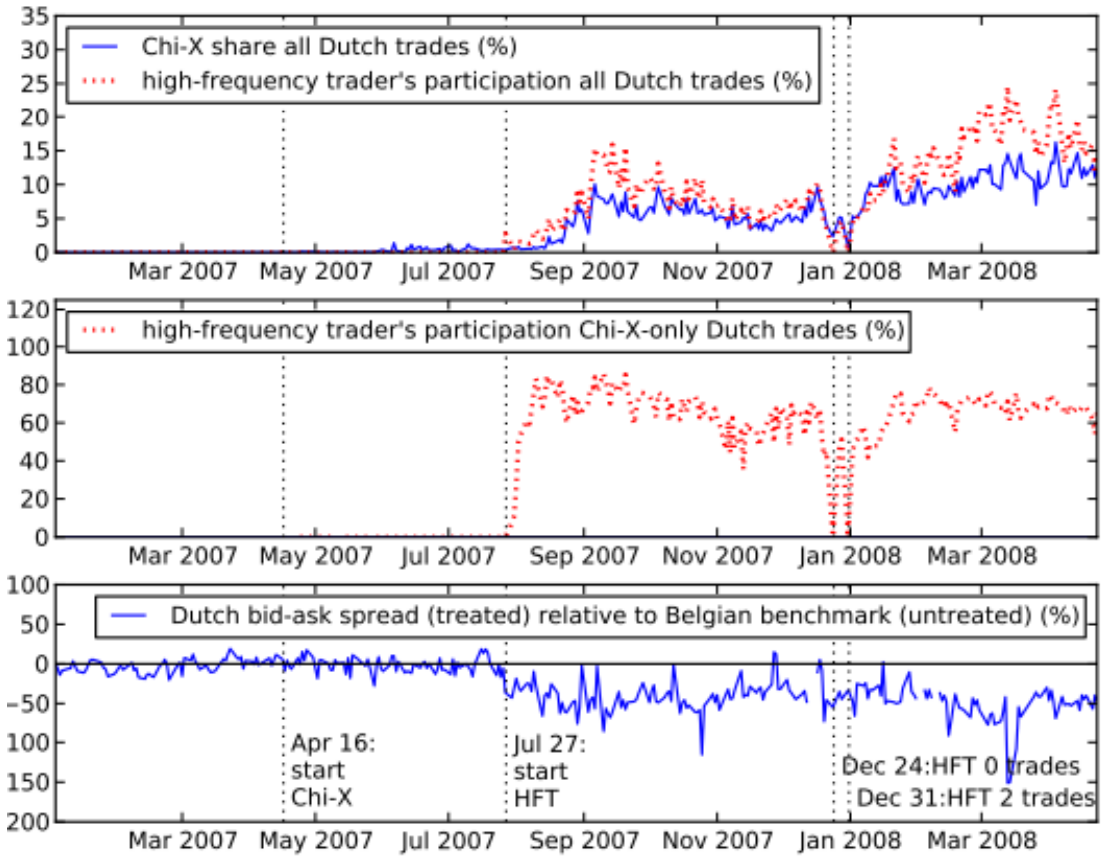
Ex.: market structure changes that enable HFT.

- Hendershott-Jones-Menkveld (2010 JF) "Does algorithmic trading improve liquidity?"
  - 2003 introduction of autoquoting on the NYSE increased message traffic, narrowed spreads
  - Answer to the question: yes (at least then and there)

- Riordan-Storkenmaier (JFM 2012)
  - Study the April 2007 Deutsche Boerse systems upgrade
  - Reduced latencies from 50ms to 10ms
  - Improves liquidity, but liquidity supplier competition decreases

Menkveld (2011 WP)

- Examines entry by a HFT market-maker on Chi-X, a relatively new competitor to Euronext.
- Paper shows detailed metrics on the trading of that HFT.
- The HFT competes by offering narrower bid-ask spreads

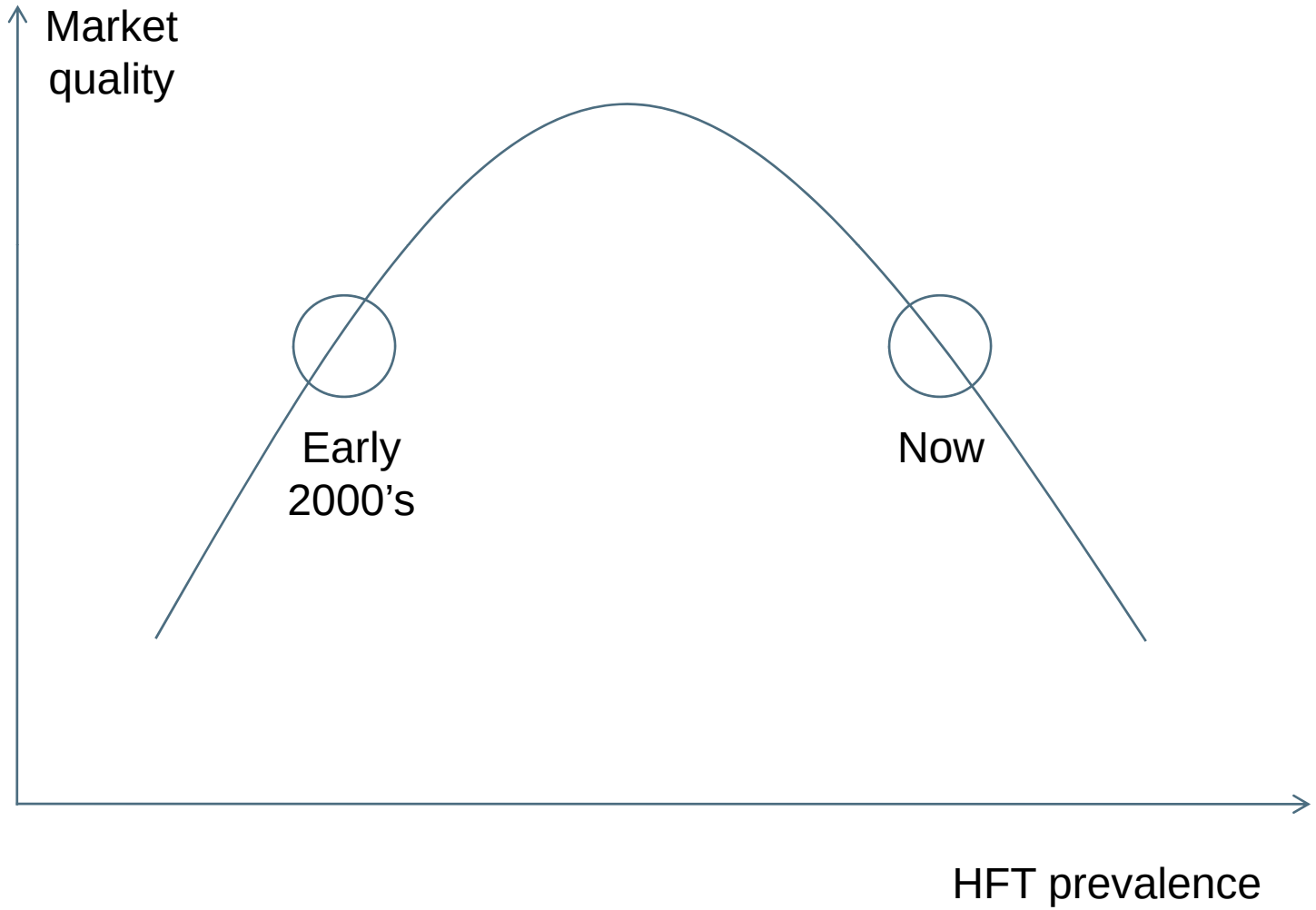


Other important HFT papers

- Brogaard series (2012 WP)
  - 2008-2010 Nasdaq and BATS data
  - Exchanges identify all trades from about 25 HFT firms
  - HFTs supply and demand liquidity about equally
  - Gross trading profit (per $ traded) is less than 1 basis point
  - This aggregates to perhaps $3 billion per year
  - HFT was restricted during 2008 shorting ban; this causes liquidity to worsen

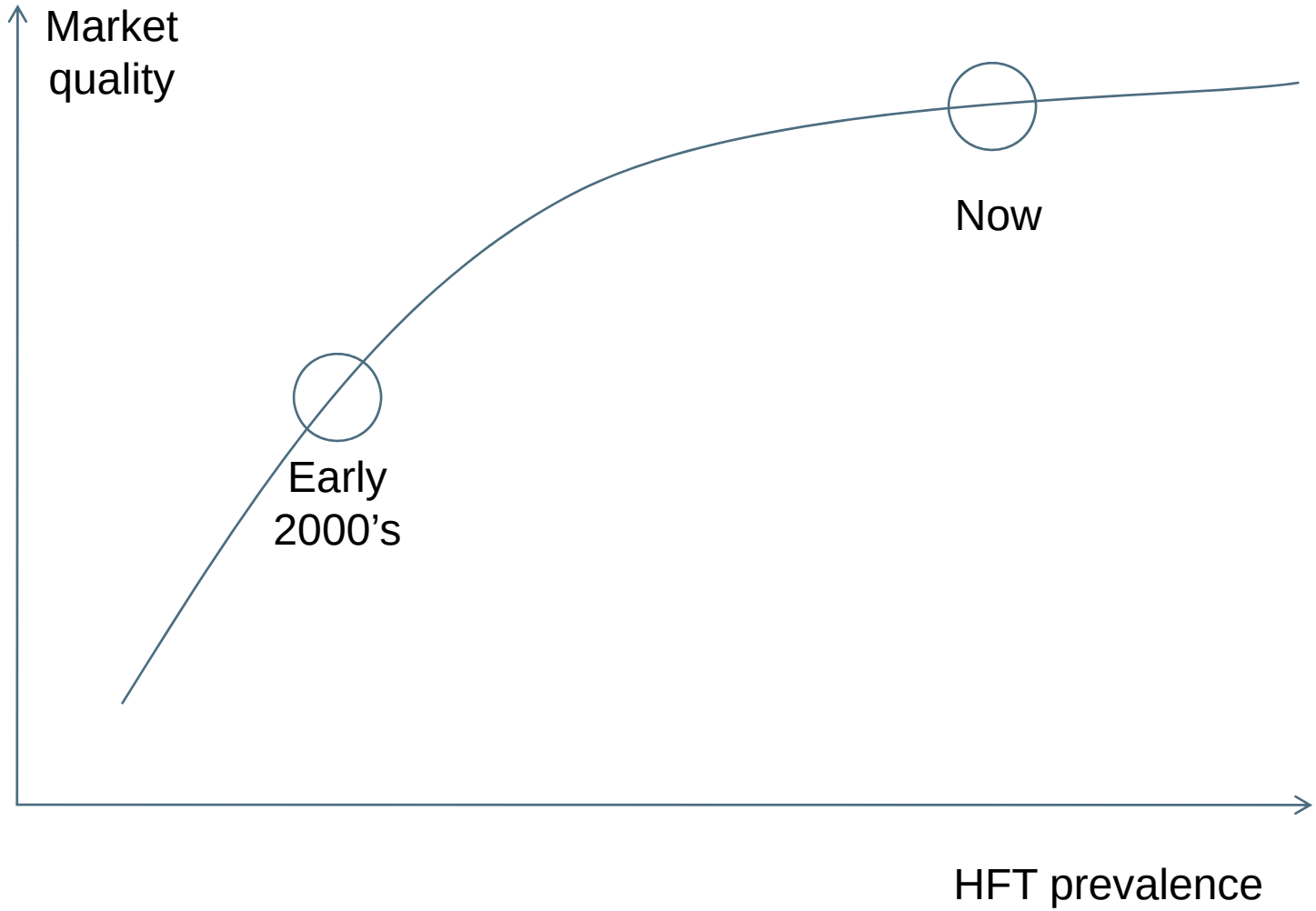
Where are we now?

- It's possible we are now simply past the optimum



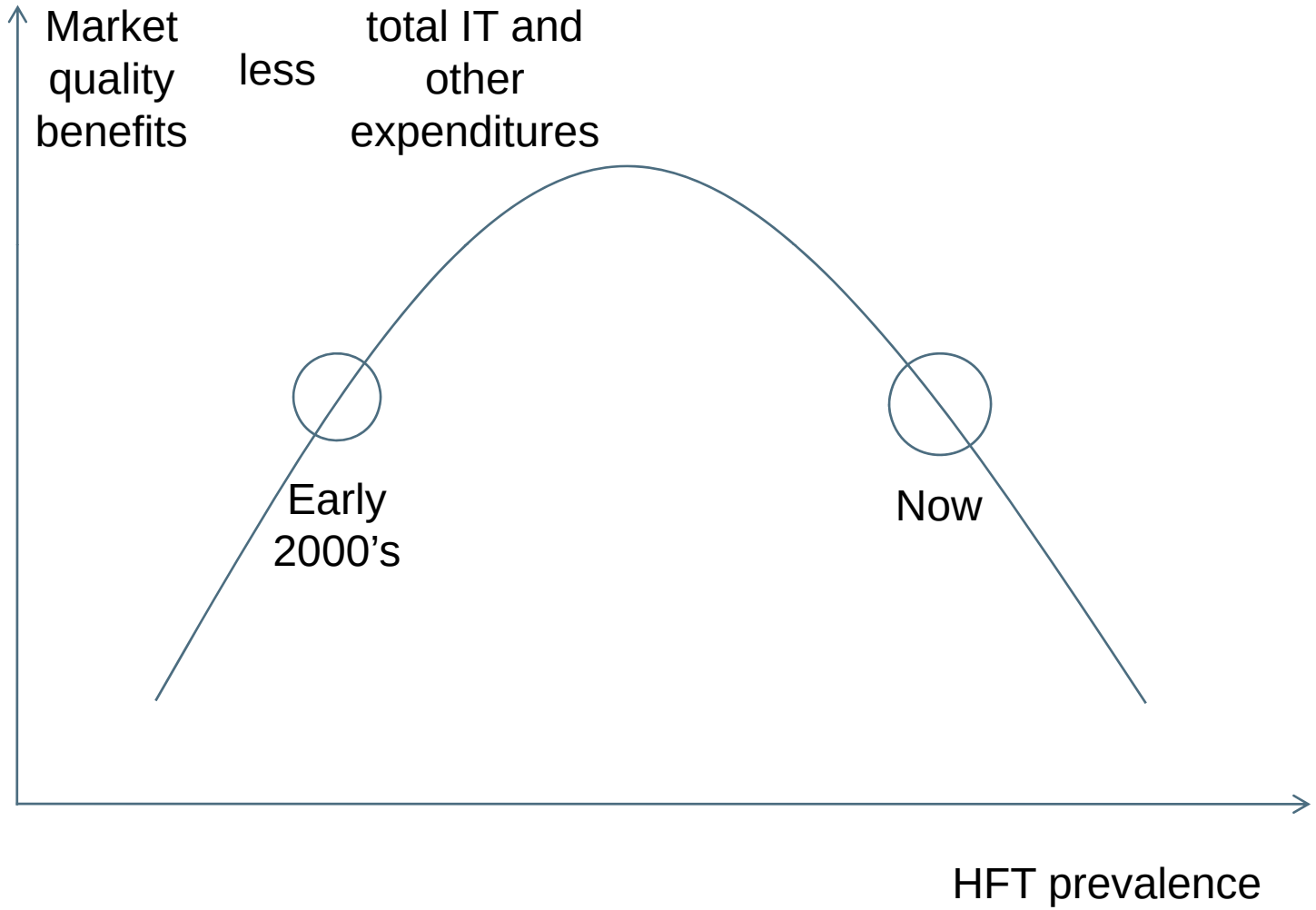
Where are we now?

- More likely we've reaped most of the benefits already…



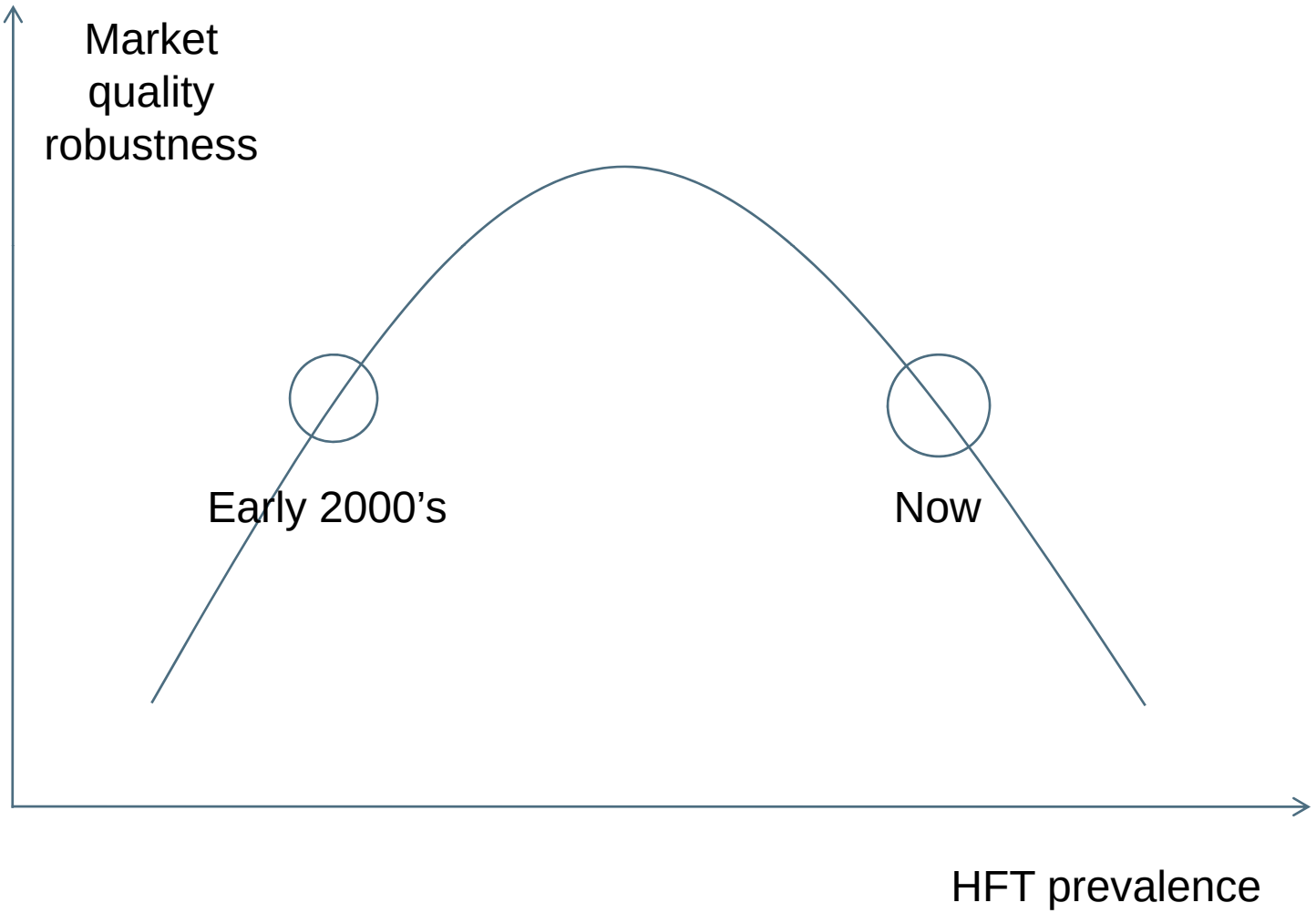
Where are we now?

- …but we could be seeing an unproductive arms race

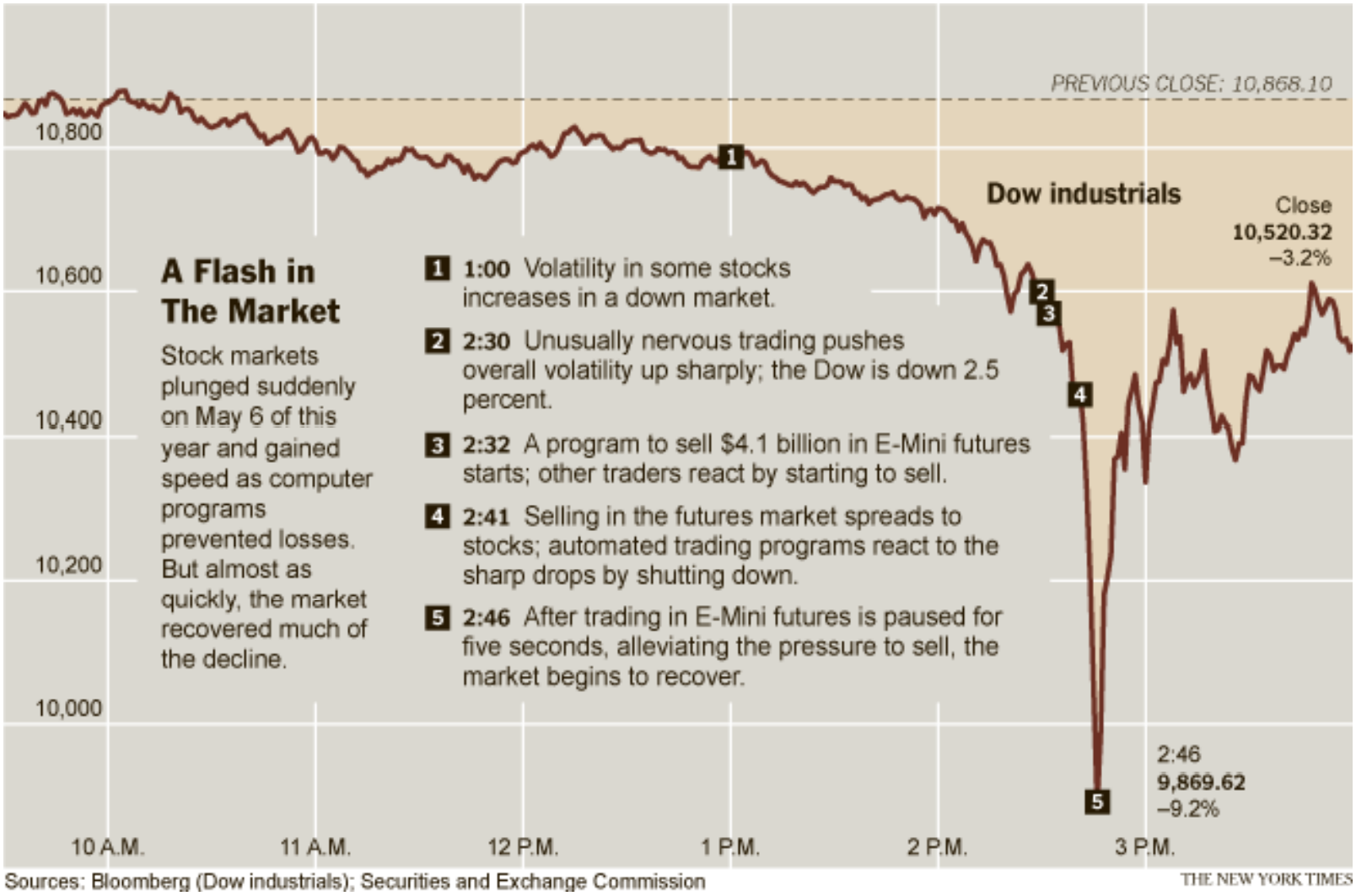


Where are we now?

- …or we might have more fragility now



Average effects. v. left tails: could the robots make things worse in a crisis?



New York Times headline

STOCK PRICES DIVE
IN SHARPEST LOSS
SINCE 1929 BREAK

$20,800,000,000 of Values
Erased—1,212 Issues
Drop, Only 74 Rise

May 29, 1962

IBM (prior close, $398.50) fell from $375 to $365 on four downticks in two minutes, and fell to $360 moments later, before bottoming at $355. That was a 5.3% drop in 19 minutes.

Kirilenko et al. (2011 WP) on the 2010 Flash Crash

Use audit trail data to classify S&P500 futures (e-mini) traders:

- High-frequency traders (HFTs)
- Fundamental Sellers
- Fundamental Buyers

- On 2010 May 6, 16 HFTs traded over 1,455,000 contracts, almost 1/3 of total trading volume.

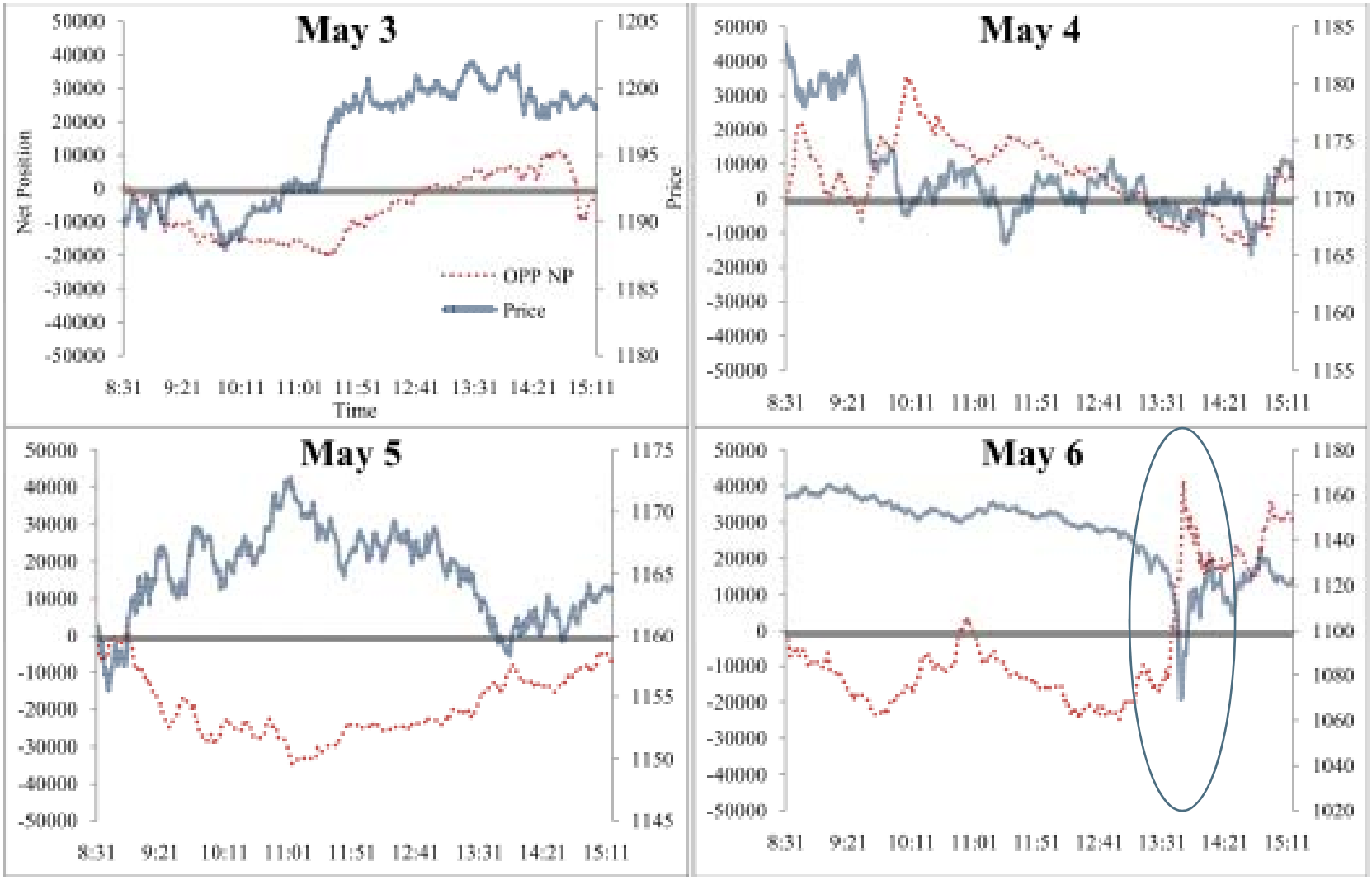
During the Flash Crash:

- HFTs initially bought, providing liquidity as prices fell
- HFTs **overwhelmed** after a few minutes, sold as decline continued

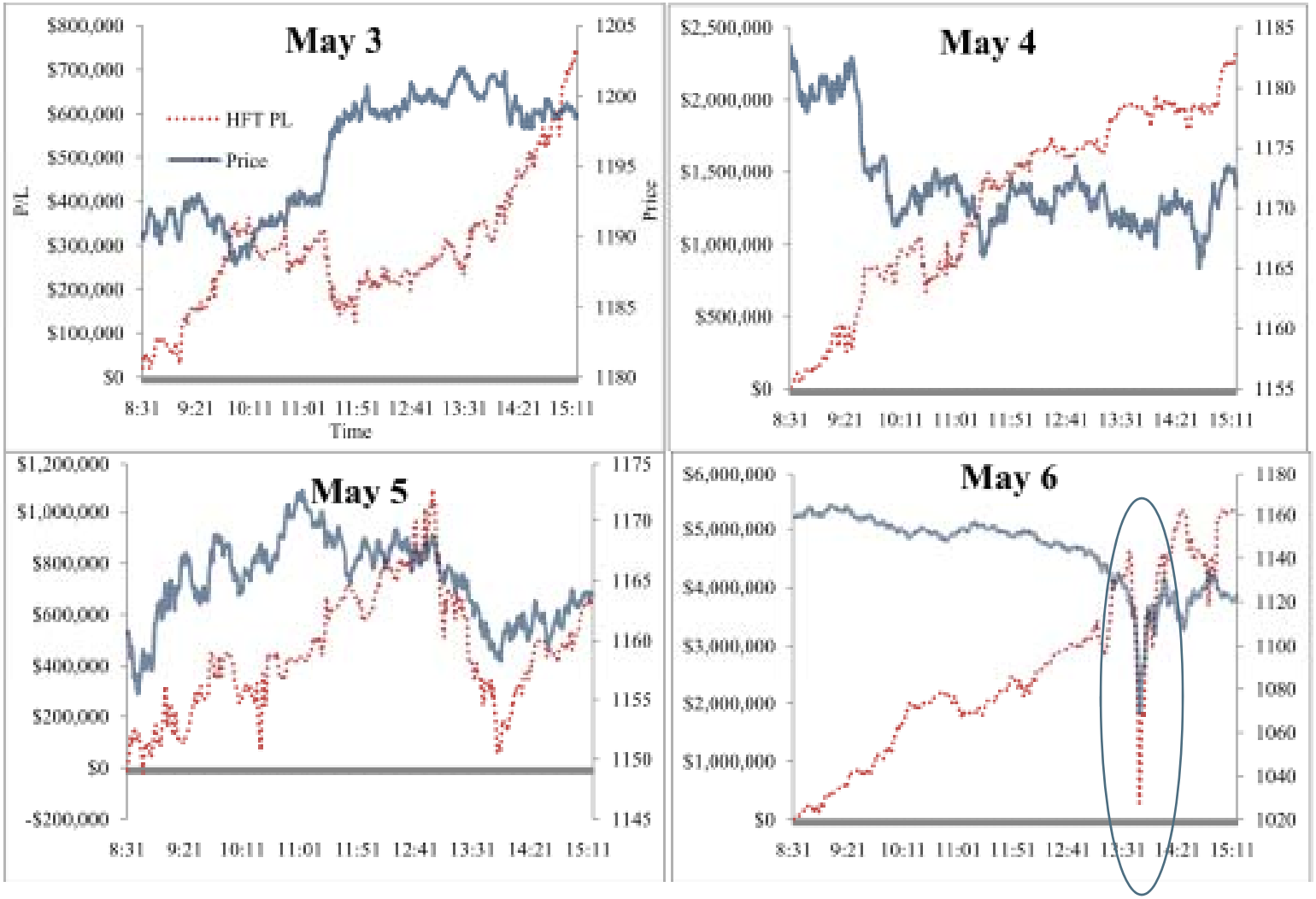
- Eventually, Fundamental Buyers were attracted by the rapidly falling prices to step in and buy.

  "Because net holdings of the HFTs were so small relative to the selling pressure from the Fundamental Sellers on May 6, HFTs could have neither caused nor prevented the fall in prices..."

Net futures positions of HFTs

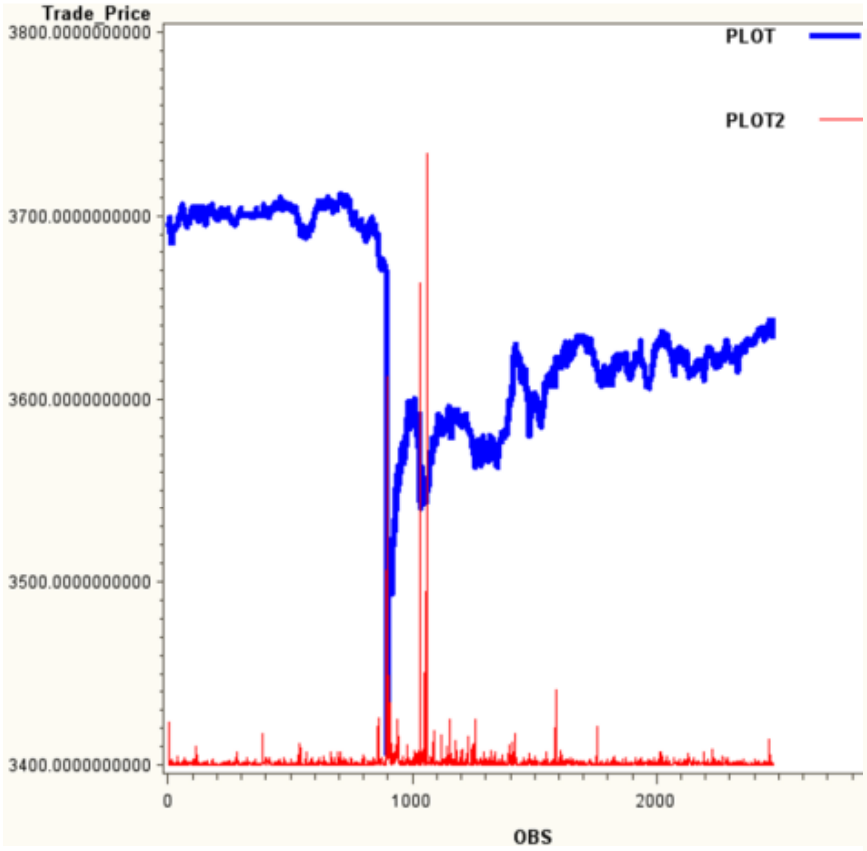


Net trading profits to HFTs



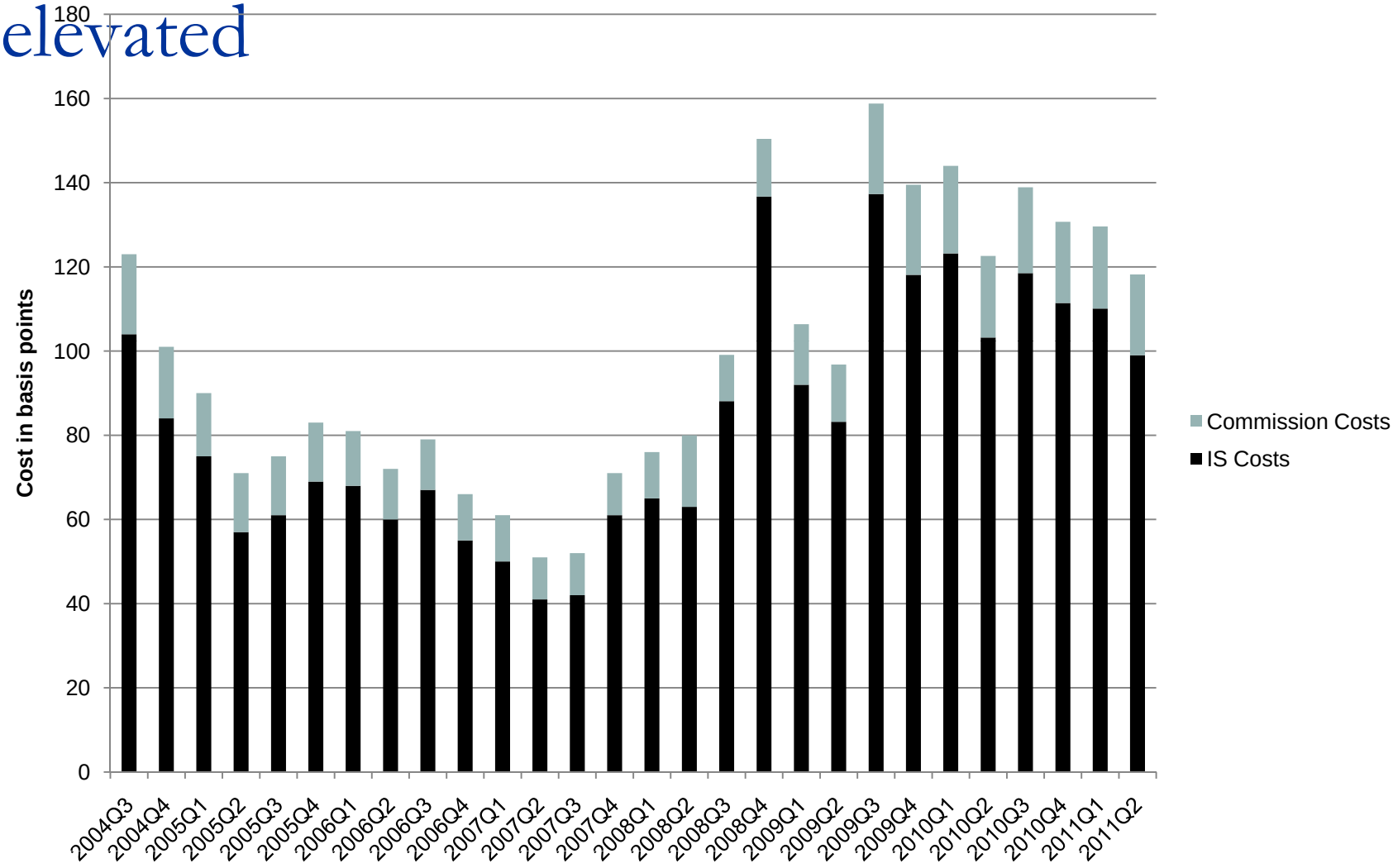
Flash crashes are not that unusual

Cocoa: March 1st 2011



Wheat: April 26th, 2010

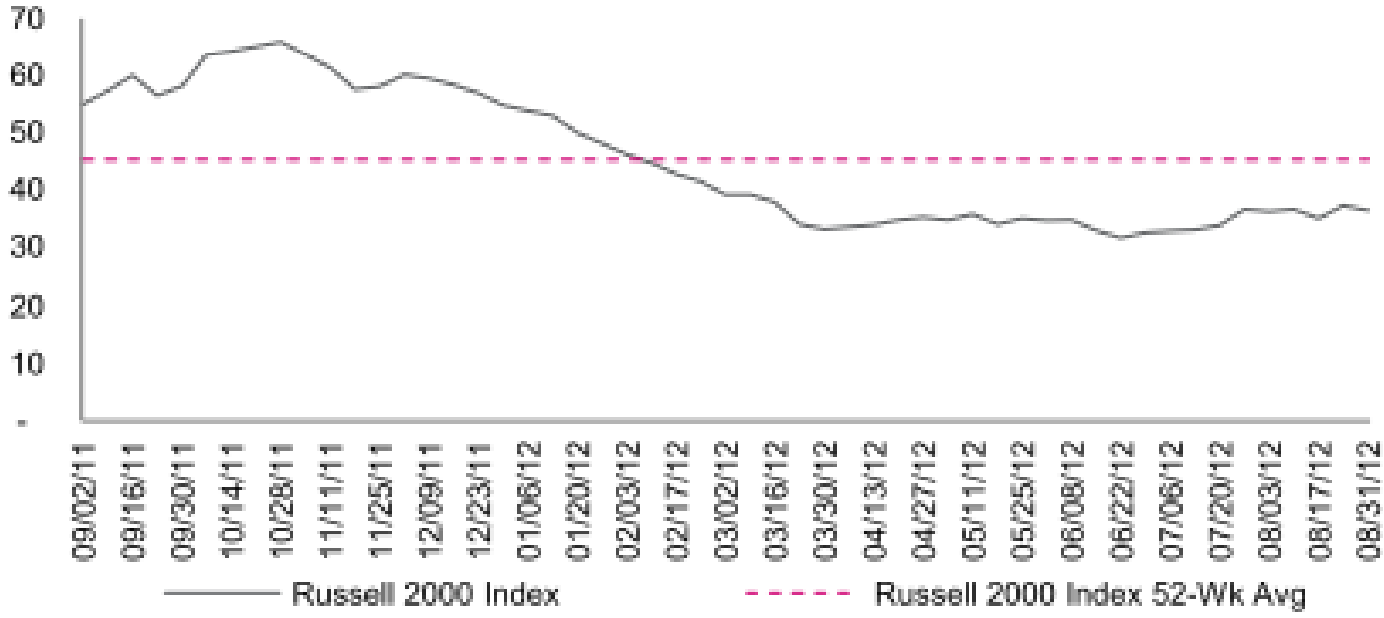
The other concern: small-cap costs remain elevated



Source: spliced ITG research reports

With some recent improvement…

Average Trading Costs (BPS) for a $1B Portfolio of Russell 2000 Constituents



Source: ITG

On the regulatory front…

- Short-lived disasters
  - Occasional fat-finger trading halts in individual stocks
  - Facebook glitch
  - Knight's runaway algo

  don't contribute much to "average" market quality but might be important to investors (and legislators)
- SEC and other regulators are well behind the curve
- Specific initiatives on the table:
  - Short trading halts after large price moves
  - Affirmative obligations for market-makers
  - Centralized order book audit trails
  - Minimum order exposure times or other speed bumps
  - Transaction or message taxes

Overall conclusions

- Equity market liquidity is clearly better than it was 10 years ago.
- All the evidence suggests that technological innovation and competition have contributed to this improvement.
- Diminishing marginal social returns?
- Little benefit to small-cap stocks. (Other illiquid assets?)
- Concerns about whether market liquidity is fragile.
- Recommend small tweaks, robust enforcement of existing rules.