Co-Location, High Frequency Trading and Exchange Profitability

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Information and Market Proximity

- Traders have long competed to obtain earlier access to potentially market moving information and closer proximity to the market to act upon that information more quickly than other market participants.
- Co-location is simply a modern example.

Information and Market Proximity

- The sale of co-location services by exchanges has helped shorten the relevant time frame for access to information by traders and increased their ability to act upon it through high frequency and other forms of algorithmic trading.

The Introduction of Co-Location

- Frino, Mollica and Webb [2014] examine the impact of the introduction of co-location on the ASX derivatives market and find greater liquidity without an increase in volatility.
- They also report that we report latency was reduced by 2 milliseconds.
- Frino, A., Mollica, V. and Webb, R. I. (2014), “The Impact of Co-Location of Securities Exchanges' and Traders' Computer Servers on Market Liquidity”, Journal of Futures Markets, Vol. 34, pp. 20–33.

The Impact of High Frequency Trading

- The impact of high frequency trading (HFT) on financial market prices is controversial.
- How does increased competition among HFT firms affects financial markets?

High Frequency Trading in Korea

- Lee [2015] reports evidence that high frequency trading in the Korean futures market does not "provide liquidity …[or improve] market quality …[and] is detrimental to the price discovery process."
- Lee, E. J. (2015), High Frequency Trading in the Korean Index Futures Market. *Journal of Futures Markets*, 35: 31–51.

High Frequency Trading Competition

- Many researchers argue that increased competition among HFT firms is beneficial because it:
  - improves market quality without increasing volatility (Baron, Brogaard and Kirilenko [2012])
  - enhances price discovery and price efficiency—(Brogaard, Hendershott and Riordan [2014] RFS)
  - reduces arbitrage opportunities in the FX market (Chaboud, Chiquoine, Hjalmarsson, and Vega 2014, Journal of Finance)

High Frequency Trading Competition

- Other researchers argue that increased competition among HFT firms is detrimental because it:
  - creates “execution risk” among HFT firms doing arbitrage (Kozhan and Tham 2014 Management Science)
  - does not reduce the amount of arbitrage profit opportunities although it may shorten their duration (Budish, Cramton and Shim 2015, QJE)

HFT and the Quest for Speed

- Several researchers argue that competition among high frequency and other latency sensitive traders to be faster leads to *socially wasteful* investments in technology because such investments do not produce a corresponding improvement in market quality.
- If true, this has important public policy implications.

HFT and the Quest for Speed

- For instance, Foucault, Moinas and Biais [2011] advance a theoretical model of fast and slow traders. Although investing in faster technology can improve social welfare by helping firms deal with market fragmentation their model suggests:
- "… fast trading technology also provide advance access to value relevant information, which creates adverse selection, lowering welfare. Thus, fast trading generates a negative externality. Because financial institutions do not internalize this negative externality, equilibrium investment in fast trading technologies is in general excessive."

Market Structure and Information

- What constitutes information in markets now?
- Maureen O'Hara [2015] argues that orders are the "basic unit of market information" in markets dominated by algorithmic trading.
- As a result, what is considered relevant information changes as well. Indeed, O'Hara [2015] argues: "… in the high frequency world, it is not clear that information-based trading necessarily relates to fundamental [economic] information."

Algorithmic Trading and Futures Markets

- O'Hara [2015]: "Futures markets are not fragmented, but the average trade in Treasury Bond Futures is now below 13 contracts and in WTI Crude Oil Future it is only 1.2 contracts. These small trade sizes reflect the influence of HFTs: because "silicon traders" can spot (and exploit) human traders by their tendency to trade in round numbers, all trading is converging to ever smaller sizes and it is being hidden whenever possible."

Market Structure and Liquidity

- Periodic market illiquidity arises, in part, because market makers seek to protect themselves from informed traders. This helps to change what new information is as well.
- O'Hara [2015] argues: "This has led to concerns that HFT market making can induce market instability in the guise of periodic illiquidity."

High Frequency Arbitrage

- Budish et al [2015] report evidence of significant “obvious mechanical arbitrage” profit opportunities at the millisecond level available to high frequency traders who are faster than other high frequency traders. This competition to be faster leads to investments in technology.
- Budish et al [2015] argue that there are billions of dollars of high frequency arbitrage profit opportunities available.

High Frequency Arbitrage

- Specifically, Budish et al [2015] argue:
- “We compute that the total prize at stake in the ES-SPY race averages $75 million per year. And, of course, ES-SPY is just a single pair of financial instruments—there are hundreds if not thousands of other pairs of highly correlated instruments, and, in fragmented equity markets, arbitrage trades that are even simpler, since the same stock trades on multiple venues. Although we hesitate to put a precise estimate on the total size of the prize in the speed race, common sense extrapolation from our ES-SPY estimates suggests that the sums are substantial.”

High Frequency Arbitrage

- Budish et al [2015] argue that the duration of arbitrage profit opportunities has gotten shorter but the absolute amount of profits have remained essentially constant.
- This assertion conflicts with practitioner estimates. Tabb [2014] estimates that profits among equity HFT firms in the U.S.A. have declined sharply from $7.2 billion to $1.3 billion.

Trading Opportunities

- Whenever one evaluates a seemingly persistent profitable trading opportunity one needs to ask the question, “Why does this trading opportunity exist?”
- For example, does the opportunity exist because the government is trying to maintain an unrealistic exchange rate?
- In this case, the relevant question is are exchanges pricing their co-locations services too low?

Access to Real-Time Information

- Access to real-time information is a necessary condition to conduct low-latency trading.
- If Budish et al [2015] are correct that there are billions of dollars of *purely technical arbitrage profit opportunities* on exchanges then it would suggest exchanges are NOT pricing their co-location services correctly.
- Alternatively, if exchanges are pricing their co-location services correctly, there may not be billions of dollars of *arbitrage* opportunities.

Prices as Property

- Thanks to a 1905 U.S. Supreme Court ruling, American exchanges own the price quotations they generate. This enables exchanges to exact royalties from the sale of such information. This is akin to owning a property right in a perishable commodity (fresh price quotations) that is most valuable for only a limited period of time.
- Board of Trade of the City of Chicago v. Christie Grain & Stock Co., 198 U.S. 236. (1905).

Prices as Property

- The sale of market data can account for a substantial amount of total exchange revenues. Webb [2003] reports that the sale of market data amounted to $43 million or over 20% of total CME revenue in 1999. The "… figures for the Chicago Board of Trade were even higher … [as it] collected almost $54 million … [or over] 29.22% of 1999 exchange revenue
- Webb, R. I. (2003), Transitory real-time property rights and exchange intellectual property. *Journal of Futures Markets*, Vol. 23, pp. 891–913.

CME Group

- The 2015 CME Group annual report states:
- “Revenues from our market data and information services represented 12% and 11% of our total revenues during the years ended December 31, 2015 and 2014, respectively.”
- The reduction was attributed to, among other reasons, to a “decrease in the average number of market data devices due to the continued economic uncertainty…”

CME Group—Colocation Revenue

- The CME Group reported in their 2015 annual report (Form 10-K):
- "We also offer co-location services at our data center facility, … for all products traded on the CME Globex electronic trading platform. The service provides the lowest latency connection for our customers. The offering is made available to all customers on equal terms. We derived 2% of our revenues from our co-location business in 2013 through 2015."

CME Group—Co-Location Revenues

- The CME Group reported total revenues of:
  - 2013—$2.936 billion
  - 2014---$3.112 billion
  - 2015---$3.326 billion
- Given the 2% estimate from the CME Group annual report, this implies that revenue from co-location fees has grown from $58.7 million in 2013 to $66.5 million in 2015.
- Are there really “billions” of dollars of *arbitrage* profit opportunities each year?

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- Thanks for your kind attention.