

# **The Impact of Co-Location of Securities Exchanges' and Traders' Computer Servers on Market Liquidity**

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# Research Question

- Does the introduction of co-location by a futures exchange impact liquidity?

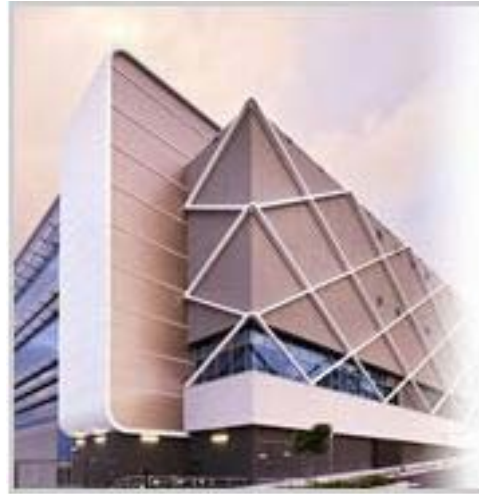
# Motivation

- HFT & Algorithmic Trading
- Growth & Controversy – parasitic traders
- “New” exchange arrangements to capture market share
- A “clean” natural experiment -> ASX allows *ALL* futures traders to co-locate their servers on February 20, 2012

# The Impact of Co-Location on Liquidity

- Hendershott, Jones and Menkveld, JoF [2011] argue exchanges encourage algorithmic trading by
  - providing potential “algorithmic traders [with] useful information and metrics to be fed into algorithms ... at low cost ...
  - [or by permitting] algorithmic traders to co-locate their servers in the market’s data center.”
- We investigate the latter.

# Institutional Details—Co-Location



The Australian Liquidity Centre

- According to exchange personnel:
  - Day one:
    - 5 futures brokers co-located
    - 20% of message traffic submitted through co-located servers.
  - By September 2012
    - > 50% of message traffic submitted through co-located servers

# Institutional Detail

- Co-location facility (ALQ)
  - provides cabinet space for futures brokers/clients which surround exchange server
  - 65 metre fibre optic cable connects each cabinet to ASX Trade24.
  - AOEI (Automated Order Entry Interface) (manages 12 messages per second)

# Institutional Detail (Cont'd)

- Co-location
  - reduces latency from 5 to 6 milliseconds to about 2 milliseconds.

- Cost to broker (per month)

Cabinet	\$5,000
Power supply	<u>\$2,500</u>
AOEI or gateway	\$2,500
Total	\$10,000

# Hypotheses

*Hypothesis 1: The introduction of colocation is associated with an increase in message traffic, ceteris paribus.*

*Hypothesis 2: The introduction of colocation is associated with a decrease in bid-ask spreads, ceteris paribus.*

*Hypothesis 3: The introduction of colocation is associated with an increase in market depth, ceteris paribus.*



# Data

- Intraday trade and quote data sourced from Thomson Reuters.
- Contracts:
  - 10 year government bonds
  - 10 year government bonds
  - 90-day Bank Accepted Bills
  - Share Price Index futures
- Nearest to expiration excluding 10 days before expiry
- Period August 20, 2011 to August 20, 2012

# Algorithmic Trading Proxy

- Hendershott et al (2011) proxy
- message traffic backed out of order book changes

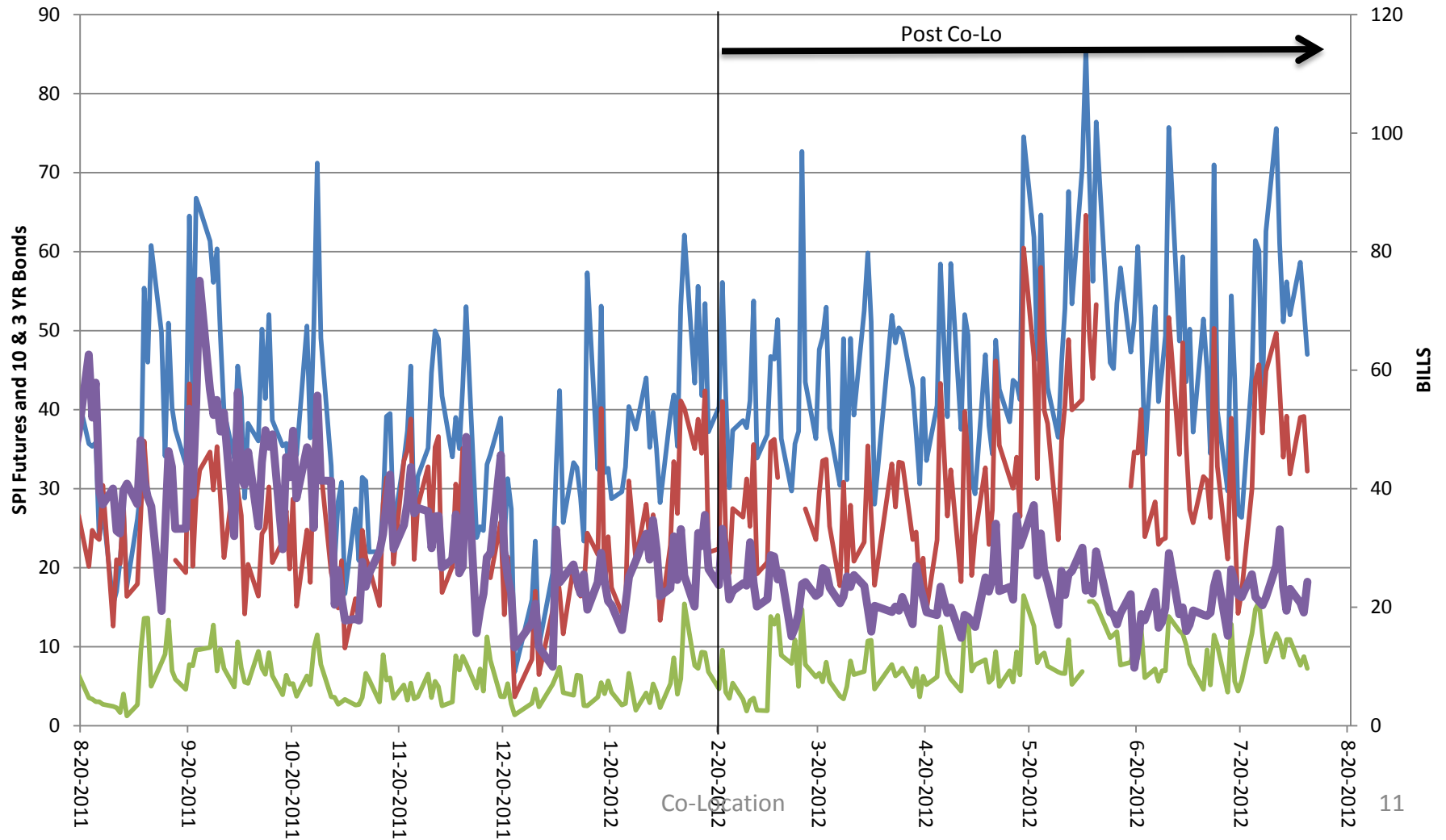
$$Algo\ Trade_{it} = \frac{-Volume_{it}/100}{Message\ Traffic_{it}}$$

$$Order\ to\ Ratio_{it} = \frac{Message\ Traffic_{it}}{Total\ Transactions_{it}}$$

# Pre & Post Co-Location

## Messages Per Minute

10YR 3YR BILL SPI (scaled by 10)



# Impact of Colo on Message Traffic & Liquidity, ceteris paribus

$$AT_{it} = \alpha_{it} + \beta_i Colo_{it} + \varphi_i CRC_{it} + \delta_i Open\ Interest_{t,i} + \gamma_i Volatility_{t,i} + \varepsilon_{it}$$

- where AT includes: Message Traffic, Order-to-Trade and Algo Trade
- For SPI only  
CRC = 1 if  $t$  is after January 1, 2012 else 0

$$Liquidity_i = \alpha_i + \delta_i Open\ Interest_{t,i} + \gamma_i Volatility_{t,i} + \beta_i Colo_{it} + \varepsilon_{t,i}$$

- where Liquidity includes: Bid-Ask Spread, Trades at Minimum Tick and Depth

# Results (Impact of colo on HFT):

Variable	10 Year Government Bonds	3 Year Government Bonds	Bank Accepted Bills	Share Price Index
Messages				
$D_t^{Colo}$	11.200*1	9.4988*	3.4110*	-29.7039*
$D_t^{CRC}$				-70.6745*
Open Interest	-0.000012	0.000022*	0.000003	0.000173
Volatility	26217.50*	15508.63*	7695.48*	9152.81*
Order to Trade Ratio				
$D_t^{Colo}$	-0.5690	0.5308*	2.0514*	-0.5941
$D_t^{CRC}$				-3.1206*
Open Interest	-0.000002	-0.000001	-0.000001	0.000009
Volatility	-1625.73	-445.54*	-1367.11*	-203.54*
Algo Trade (Volume)				
$D_t^{Colo}$	0.0000	-0.0014	0.0142*	-0.0003*
$D_t^{CRC}$				-0.0003*
Open Interest	0.000000	0.000000	0.000000*	0.000000
Volatility	-1.66*	-11.16*	-2.64	-0.02*

# Impact of Co-Location on Liquidity

Variable	10 Year Government Bonds	3 Year Government Bonds	Bank Accepted Bills	Share Price Index
Bid-Ask Spread (ticks)				
$D_t^{Colo}$	-0.000024*	-0.000014*	0.000004	-0.02361*1
Open Interest	-0.000000	-0.000000	-0.000000*	-0.000000
Volatility	0.02825	0.04503*	0.21071*	0.05195
Bid-Ask Spread (percent)				
$D_t^{Colo}$	-0.000062*	-0.000082*	-0.000068*	-0.000643*
Open Interest	-0.000000	-0.000000	-0.000000	-0.000000
Volatility	0.02661	0.04285*	0.19656*	0.03753*
Trades at Minimum Tick (percent)				
$D_t^{Colo}$	0.504262*	0.127501*	0.011729	2.242069*
Open Interest	0.000001	0.000001*	0.000003	0.000003
Volatility	-252.02	-248.63*	-1469.67*	-7.28
Depth				
$D_t^{Colo}$	88.30*	1078.61*	278.89*	12.31*
Open Interest	0.000271*	0.001277	0.004000*	0.000031*
Volatility	-105043.791*	-607274.799*	-600907.774*	-243.522*

# Conclusions

- Liquidity in ASX futures contracts has increased since co-location was introduced on February 20, 2012.
- The order to trade ratio, message traffic, depth, and trading volume increased while the percentage spread decreased for all three interest rate futures contracts following co-location.