

High Frequency Trading in Agricultural Futures Markets: What Low Frequency Traders Should Know

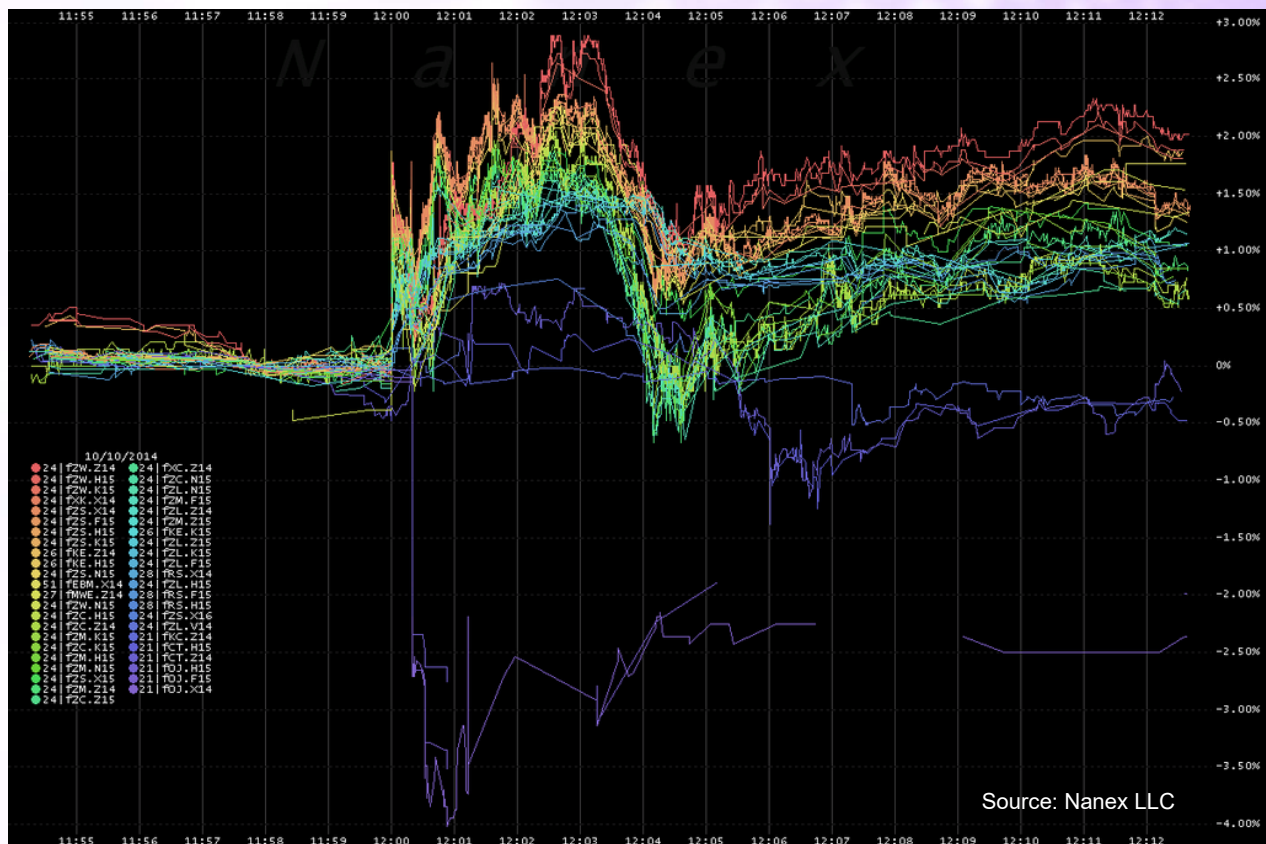
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Presentation to the Risk and Profit Conference

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Source: Nanex LLC



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High frequency trading: what is it?

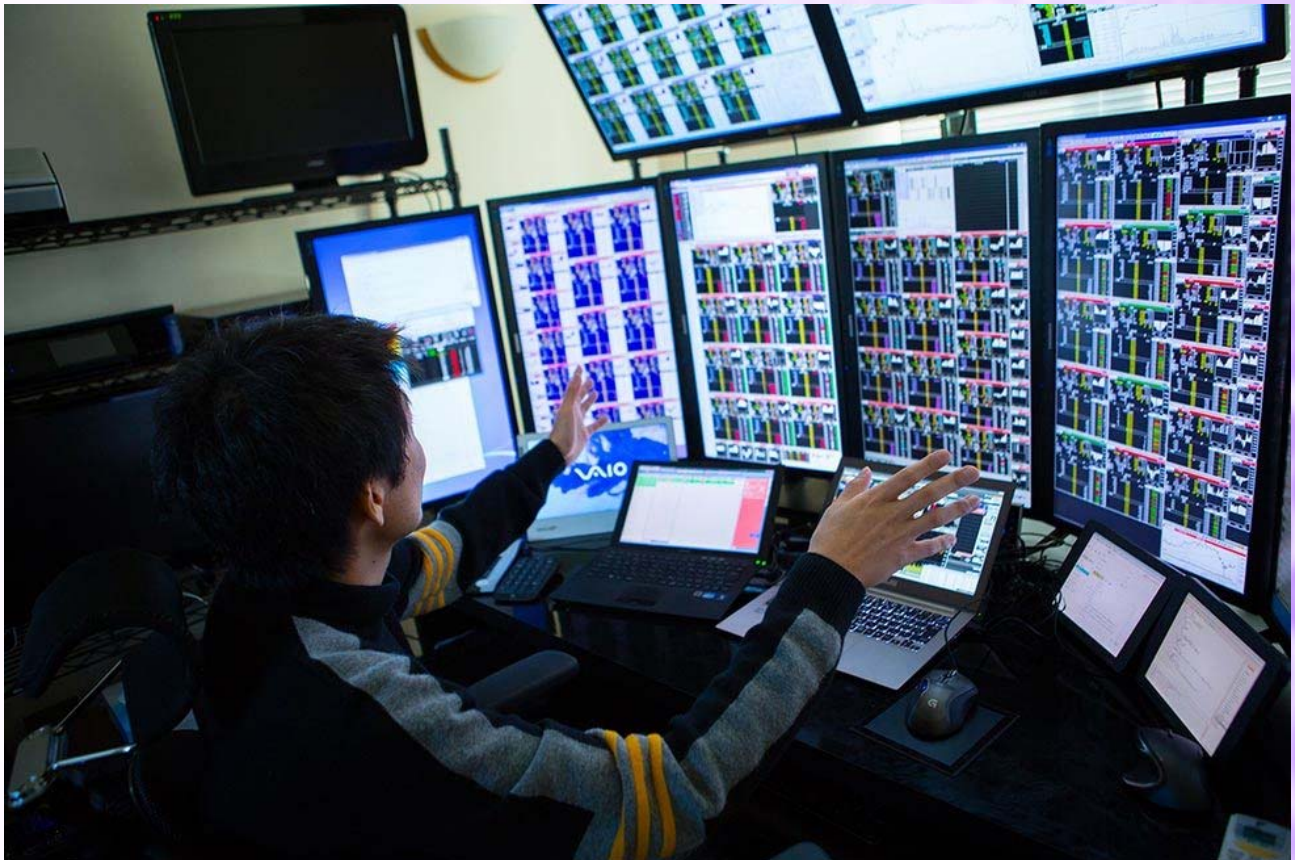
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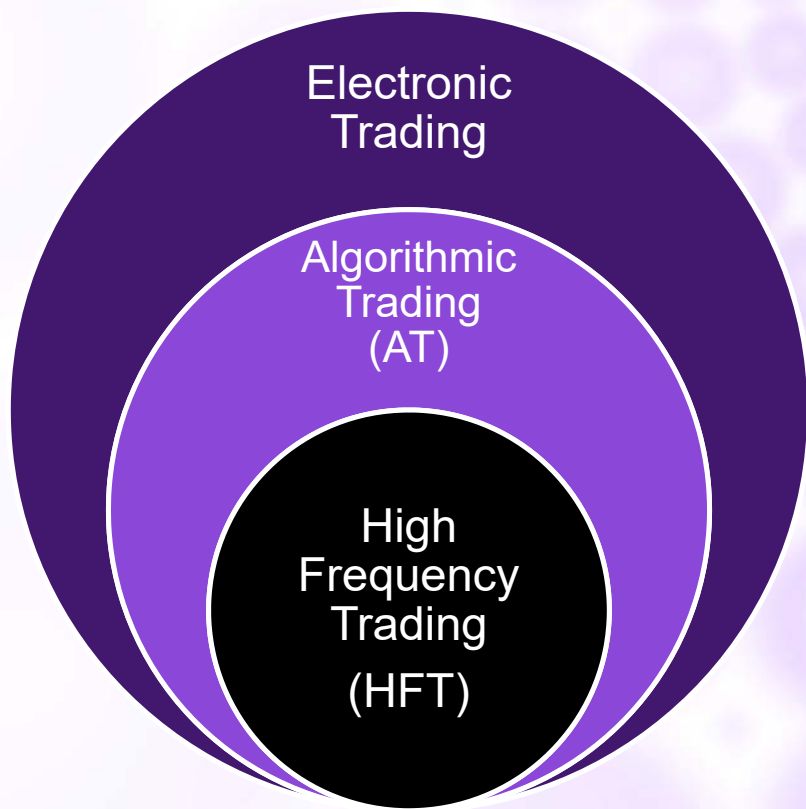
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Orders to buy and sell futures contracts are submitted and matched using an automated order matching system

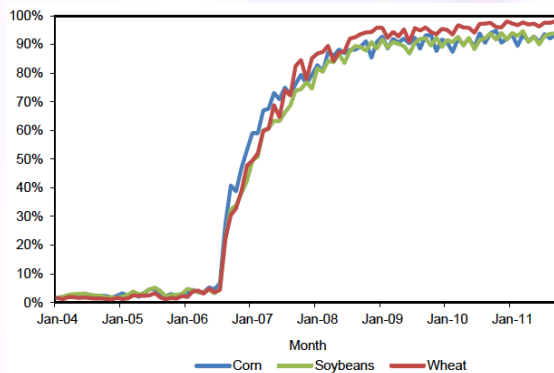
Decision making, order submission, and trade execution are automated - without human direction

Algorithmic trading system that uses high speed connections to submit high numbers of messages with minimal reaction time

How prevalent is high frequency trading in ag markets?

- HFT in agricultural futures markets made possible through introduction of electronic trading platforms beginning in 2004-2006.

Percentage of futures volume in select markets transacted on electronic platform, 2004-2011

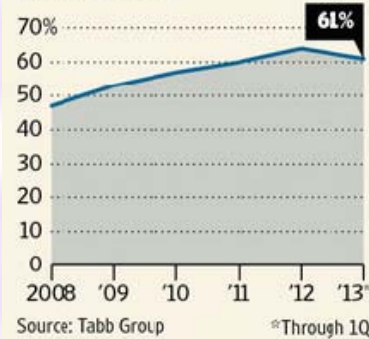


Source: Scott Irwin, "Structural Changes in Agricultural Futures Markets: What have we wrought?", 2013

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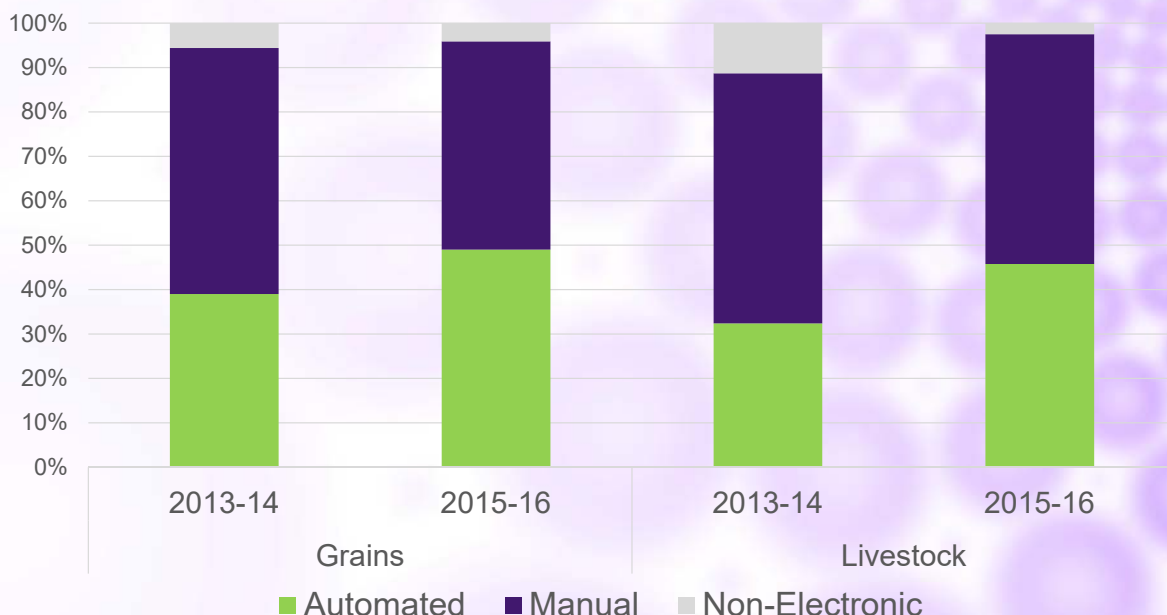
High-frequency trading as a percentage of U.S. futures-market volume



Source: Patterson, Strasburg, and Plevin, "High speed traders exploit loophole", *Wall Street Journal*, 5/1/2013

- HFT is not a particular trading strategy, it is a particular use of this electronic trading technology

How much automated trading occurs in ag markets?



Source: Haynes and Roberts (2015 and 2017) "Automated Trading in Futures Markets," CFTC White Paper.

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How likely are you to trade with an automated trader?

Market	Volume (millions of contracts)		Likelihood of Manual Trader matching with ATS (%)	
Year	2013-14	2015-16	2013-14	2015-16
Corn	128	168	55	62
Soybeans	93	115	54	65
Wheat	49	62	57	69

Source: Haynes and Roberts (2015 and 2017) "Automated Trading in Futures Markets," CFTC White Paper.

- Manual traders still involved in 75% of ag futures trades. Some FX and equity markets down to 25-35%.

HFT Trading Strategies

- Market making:
- Statistical arbitrage:
- Order anticipation/Momentum ignition/Spoofing



Why does Michael Lewis think markets are rigged?

- HFTs front-run other traders
- Exchanges give HFT unfair advantages
 - Co-location: Algorithms located close to exchange
 - Rebates, incentives, and “maker-taker” pricing
- HFTs submit orders they have no intention of executing: “spoofing”
- HFTs make prices more volatile

Stock markets and commodity futures markets are different

Stock markets

- Fragmented: 13 exchanges, numerous off-exchange trading venues



Commodity Futures Markets

- Consolidated: “vertical silo”, all orders to buy and sell executed against central limit order book.



Stock markets and commodity futures markets are different

Stock markets

- Complicated incentives to trade: “maker-taker pricing” means some exchanges will pay you to trade.
- Complex order types: between 50 and 100

Commodity Futures Markets

- Simpler incentives: Some in the form of lower trading costs for particular traders.
- Simple order types: e.g. CME has seven types of orders

Central limit order book: a snapshot

Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	10
	115.88	10
	115.87	
10	115.86	
30	115.85	
30	115.84	
50	115.83	

Standing "limit" orders to **buy** at given prices

Standing "limit" orders to **sell** at given prices

Central limit order book: a snapshot

Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	10
	115.88	10
	115.87	
10	115.86	
30	115.85	
30	115.84	
50	115.83	

"Best bid"

"Best offer"

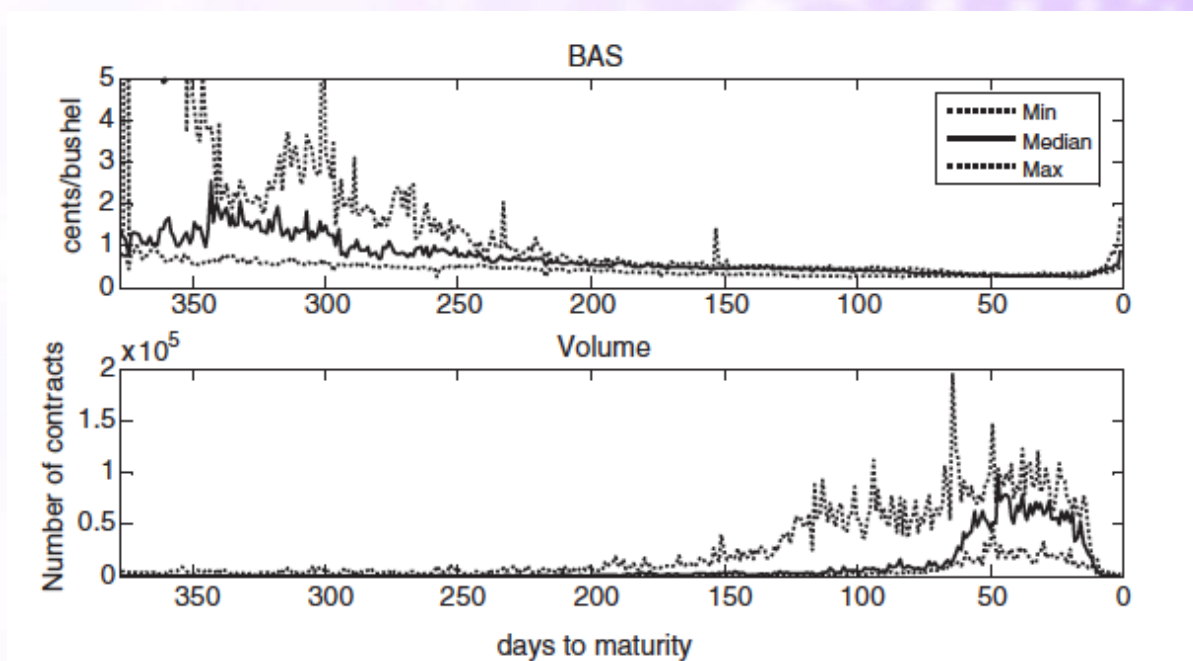
Central limit order book: a snapshot

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Characteristics of liquidity

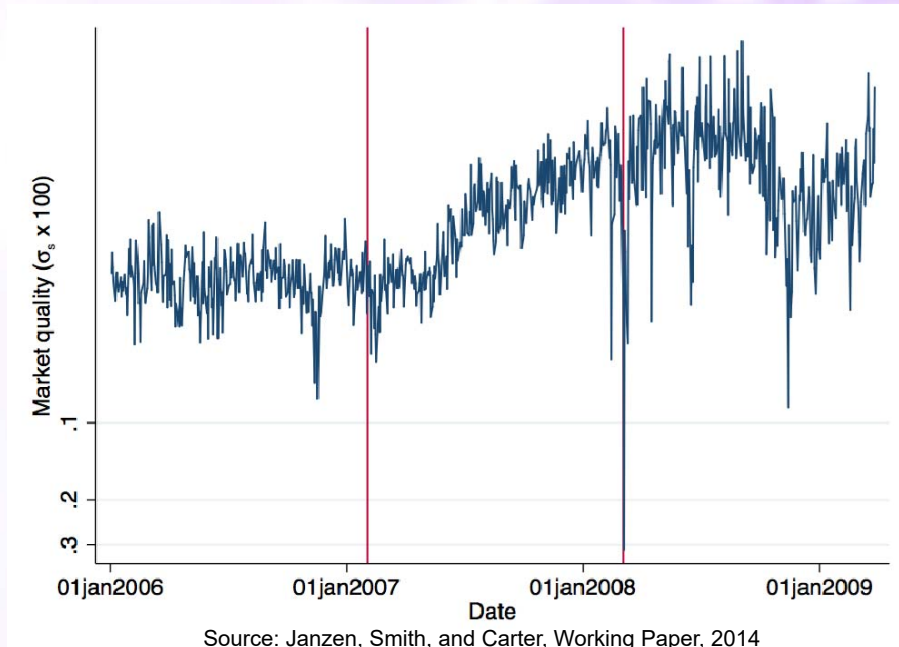
- **Immediacy:** Is someone willing to trade with me?
- **Breadth:** How much do I have to pay to trade?
- **Depth:** If many people want to buy or sell, can we all get filled near the best bid or ask?
- **Resiliency:** If prices move due to a large transaction, will they bounce back?

Measuring liquidity using bid-ask spreads: The electronic CBOT corn futures market in 2009



Source: Wang, Irwin, and Garcia, American Journal of Agricultural Economics, 2013

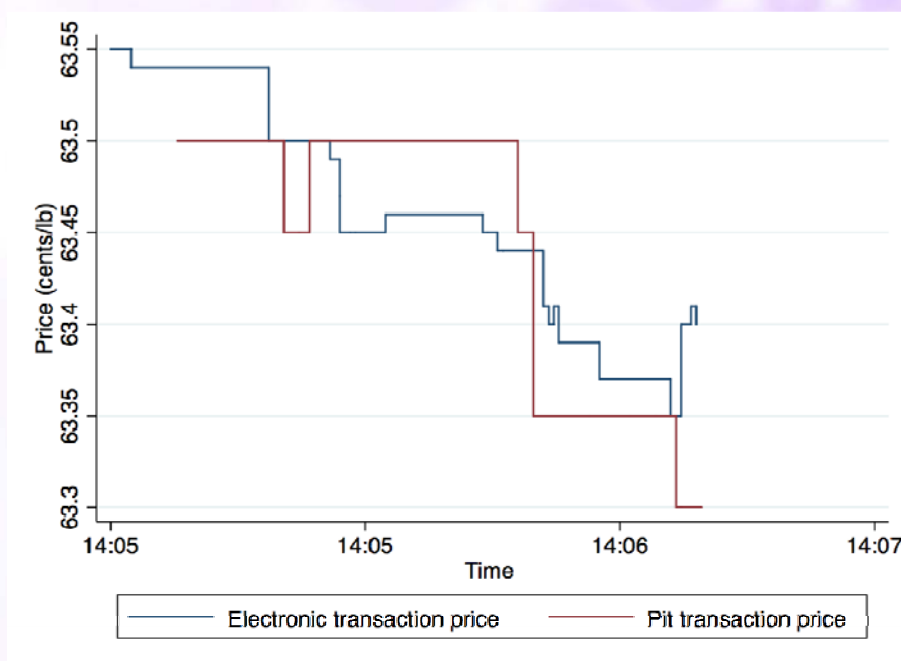
An alternate measure of “market quality”: The ICE cotton futures market before and after electronic trading



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Lowering trading costs through clustering in the cotton market



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Evaluating HFT

- Data corroborates major case for electronic trading and HFT: tighter bid-ask spreads
- Claims still to evaluate:
 - HFTs “spoof”: post offers to buy and sell that they have no intention of executing
 - HFTs make prices more volatile

HFT Trading Strategies

- Passive (Liquidity providing)
 - Market making
 - Statistical arbitrage
- Aggressive (Liquidity demanding)
 - Order anticipation
 - Momentum ignition/Spoofing

An example of aggressive HFT activity: The Coscia case



Source: Erin Hooley / Chicago Tribune

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Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	10
	115.88	10
	115.87	
10	115.86	
30	115.85	
30	115.84	
50	115.83	

Initial Market Condition

Elapsed time: 0 milliseconds

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Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	10
	115.88	10
	115.87	
27	115.86	
30	115.85	
30	115.84	
50	115.83	

Coscia enters small buy order

Elapsed time: 1 millisecond

Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	132
	115.88	10
	115.87	
27	115.86	
30	115.85	
30	115.84	
50	115.83	

Coscia "layers" multiple sell orders

Elapsed time: 23 milliseconds

Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	132
	115.88	95
	115.87	
27	115.86	
30	115.85	
30	115.84	
50	115.83	

Coscia "layers" multiple sell orders

Elapsed time: 122 milliseconds

Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	132
	115.88	95
	115.87	54
27	115.86	
30	115.85	
30	115.84	
50	115.83	

Momentum for price decrease or massive liability for Coscia?

Coscia "layers" multiple sell orders

Elapsed time: 231 milliseconds

Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	132
	115.88	95
	115.87	54
27	115.86	
30	115.85	
30	115.84	
50	115.83	

Someone else must hit bids at 115.86

Standing buy orders trade at 115.86

Elapsed time: 234 milliseconds

Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	132
	115.88	95
	115.87	54
	115.86	10
30	115.85	
30	115.84	
50	115.83	

More buy orders trade at 115.85

Elapsed time: 240-250 milliseconds

Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	132
	115.88	95
	115.87	54
	115.86	10
	115.85	
30	115.84	
50	115.83	

If these orders aren't cancelled, Coscia will be massively short, not long.

Coscia begins to cancel large sell orders

Elapsed time: 257 milliseconds

Reaction time after his buy order trades: 23 milliseconds

Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	10
	115.88	10
	115.87	10
	115.86	10
	115.85	
30	115.84	
50	115.83	

Coscia cancels large sell orders

Elapsed time: 265 milliseconds

Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	10
	115.88	27
	115.87	10
	115.86	10
	115.85	
30	115.84	
50	115.83	

} Sell order of same size as long position

Coscia needs to unwind his long position, enters sell order

Elapsed time: 294 milliseconds

Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	10
	115.88	27
	115.87	10
	115.86	10
	115.85	
30	115.84	
149	115.83	

Coscia enters large buy orders

Elapsed time: 316 milliseconds

Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	10
	115.88	27
	115.87	10
	115.86	10
	115.85	
118	115.84	
149	115.83	

Coscia enters additional buy orders

Elapsed time: 423 milliseconds

Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	10
	115.88	27
	115.87	
122	115.86	
10	115.85	
118	115.84	
149	115.83	

Again, Coscia attempts to generate price momentum

Best bid moves back to 115.88, how likely is this?

Coscia enters additional buy orders

Elapsed time: 550 milliseconds

Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	10
	115.88	27
20	115.87	
122	115.86	
10	115.85	
118	115.84	
149	115.83	

Coscia's standing sell order trades at 115.88

Elapsed time: 579 milliseconds

Profit realized: $115.88 - 115.86 = 0.02/\text{bbl} \times 1000\text{bbls} \times 17 \text{ contracts} = \340.00

Bid Size	Price	Ask Size
	115.91	20
	115.90	20
	115.89	
	115.88	
20	115.87	
10	115.86	
10	115.85	
30	115.84	
50	115.83	

Coscia withdraws large buy orders

Elapsed time: 593-609 milliseconds

Reaction time after trade: 14 milliseconds

Trader responses to HFT

- End of manual market making
- Automated “smart order routing” for large trades
- Block trades

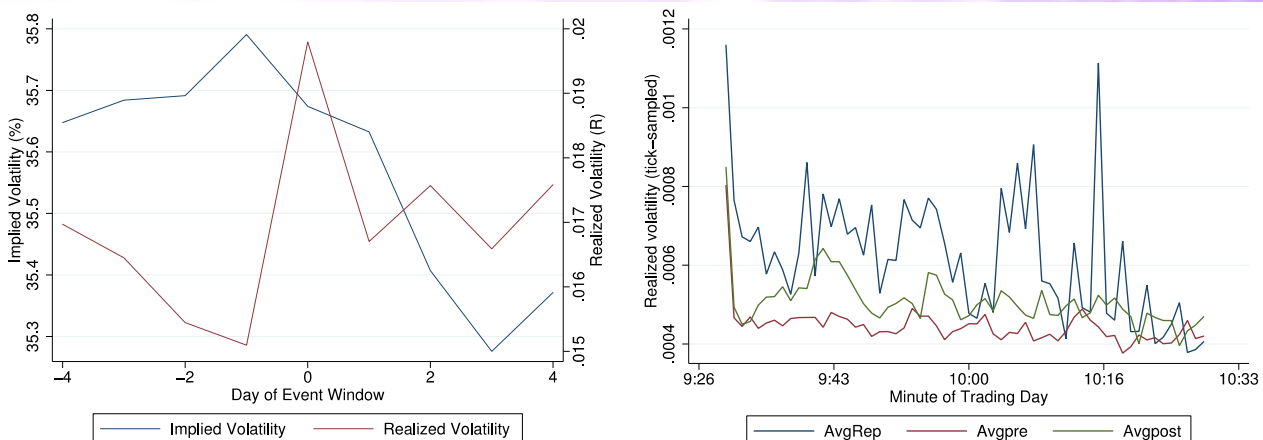
Regulatory response: CME Rule 575

- September 2014: Related to mandates from CFTC, CME bans “disruptive practices” in Rule 575
- **“All orders must be entered for the purpose of executing bona fide transactions.**
 - A. No person shall enter or cause to be entered an order with **the intent, at the time of order entry, to cancel the order** before execution or to modify the order to avoid execution;
 - B. No Person shall enter or cause to be entered an actionable or non-actionable message or messages with **intent to mislead** other market participants;
 - C. No Person shall enter or cause to be entered an actionable or non-actionable message or messages with **intent to overload, delay, or disrupt** the systems of the Exchange or other market participants; and
 - D. No person shall enter or cause to be entered an actionable or non-actionable message with **intent to disrupt**, or with reckless disregard for the adverse impact on, the orderly conduct of trading or the fair execution of transactions.”

Other responses: WASDE lock-up

- July 2018, USDA announced end of “lock-up” procedure for major report releases; news organizations no longer have early access to WASDE, Grain Stocks, and other reports
 - Some news organizations may have been able to send out report up to 2 seconds before USDA posted report
 - August 10 WASDE was first with no lockup; wheat prices fell 20 cents/bu

Prices are briefly volatile around USDA report releases



Source: Janzen and Bunek, Working Paper, 2018.

Summary: HFT in ag markets

- HFT is part of modern electronic futures markets. HFT is prevalent, but not dominant in major ag futures markets.
- Some features of futures markets curb negative impacts of HFTs.
- Markets are on average more liquid post-HFT.
- “Spoofing” is real, but the true cost is unclear. Regulating intent is difficult.
- Markets and traders will continue to adapt.

How does this impact the small trader?

- Tighter bid-ask spreads = Better trade execution
 - Especially for small, low frequency traders
- Using limit orders is always risky
- Still difficult to identify fundamental vs trading-induced volatility
 - More research is needed to understand the reaction of HFT and other traders under different market conditions