

High frequency trading

Bruno Biais (Toulouse School of Economics)

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Outline

- 1) Description
- 2) Motivation for HFT
- 3) The darker arts
- 4) Perspectives & policy implications

1) Definition

Algorithms use computers to

=> collect & process information

=> reach investment & trading decisions

=> route orders

Around 2/3 of trades in US equity, a bit less in Europe, also in commodities derivatives & forex

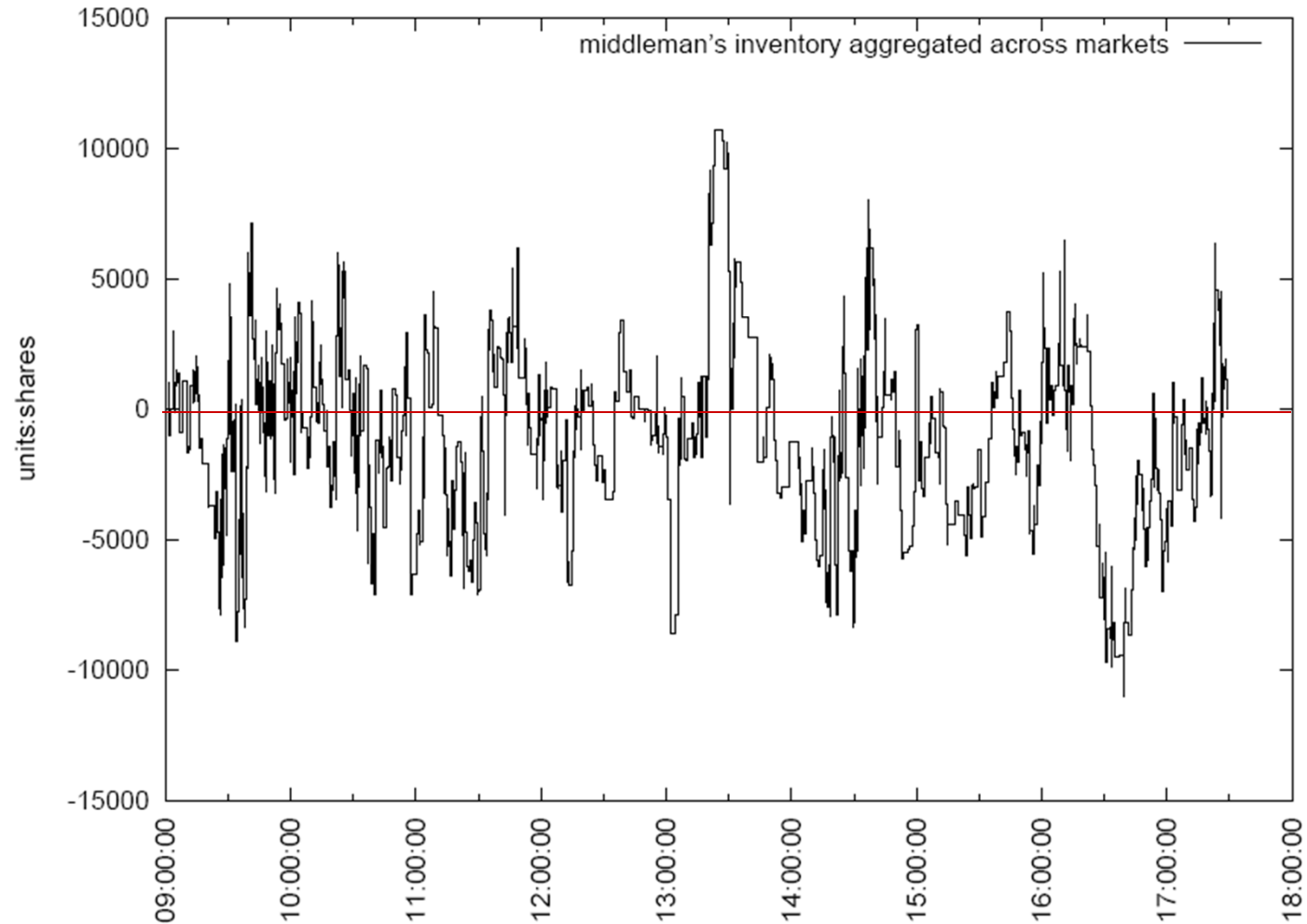
Brokers, fund managers

=> order routing, splitting, execution

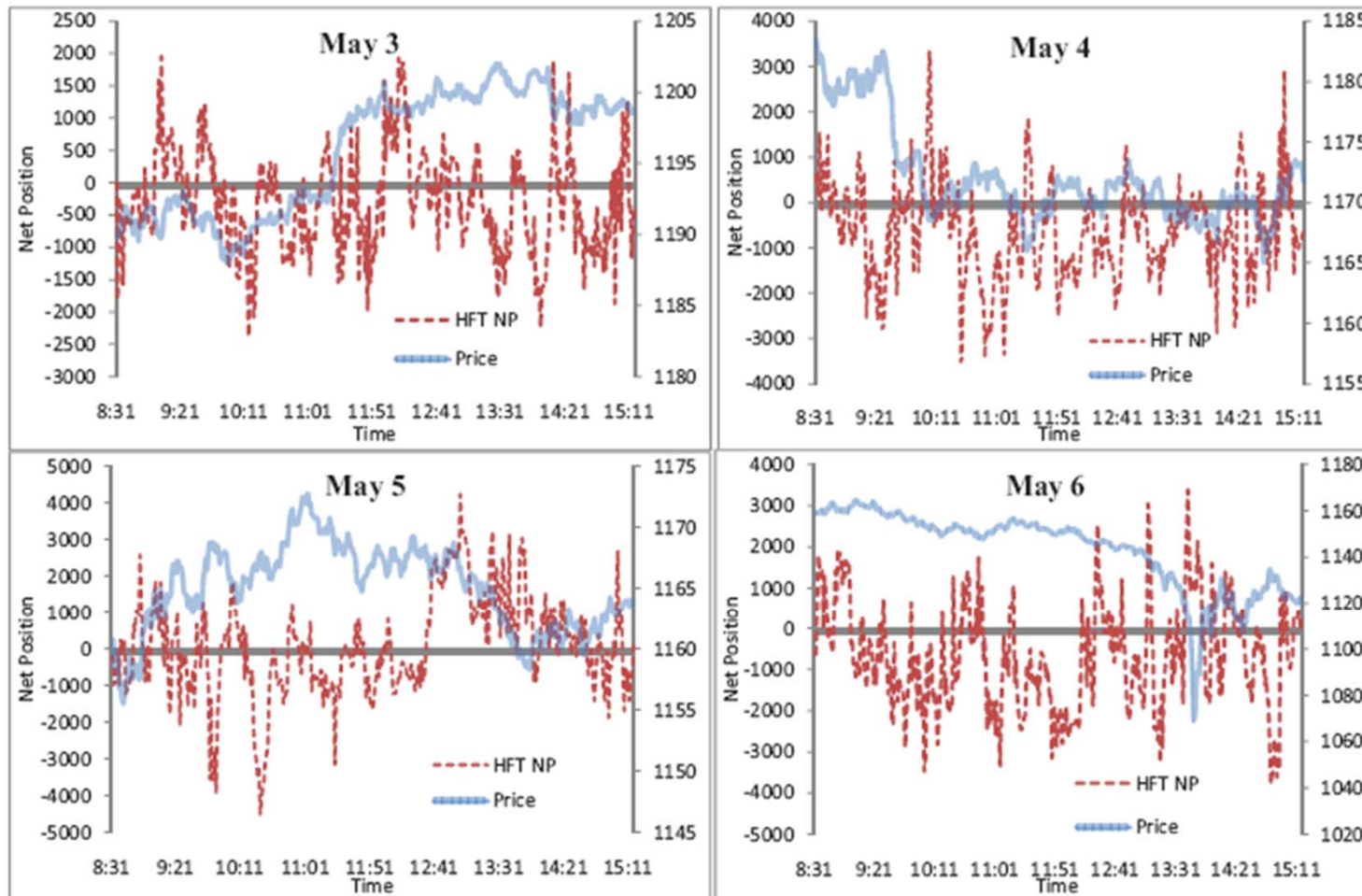
Hedge funds, investment banks, algo trading firms

=> prop trading, **high frequency**

Position of the high frequency trader
studied by Jovanovic and Menkveld (2010) ,
aggregated across Euronext & ChiX, January 30, 2008.



Net position of high frequency traders & transactions prices in June 2010 E-mini S&P futures contract over 1 minute intervals during May 3,4, 5 and 6. Kirilenko et al (2010)



2) Motivation for HFT algos

Algos help consistent pricing

Chaboud, Chiquoine, Hjalmarsson and Vega (2009)

€-\$, \$-yen, €-yen (cross rate)

“In this cross-rate ... computers have a clear advantage over humans in detecting and reacting more quickly to triangular arbitrage opportunities, where the euro-yen price is briefly out of line with prices in the euro-dollar and dollar-yen markets”

Market fragmentation

Natural tendency for liquidity to concentrate in one venue (Pagano, 1989)

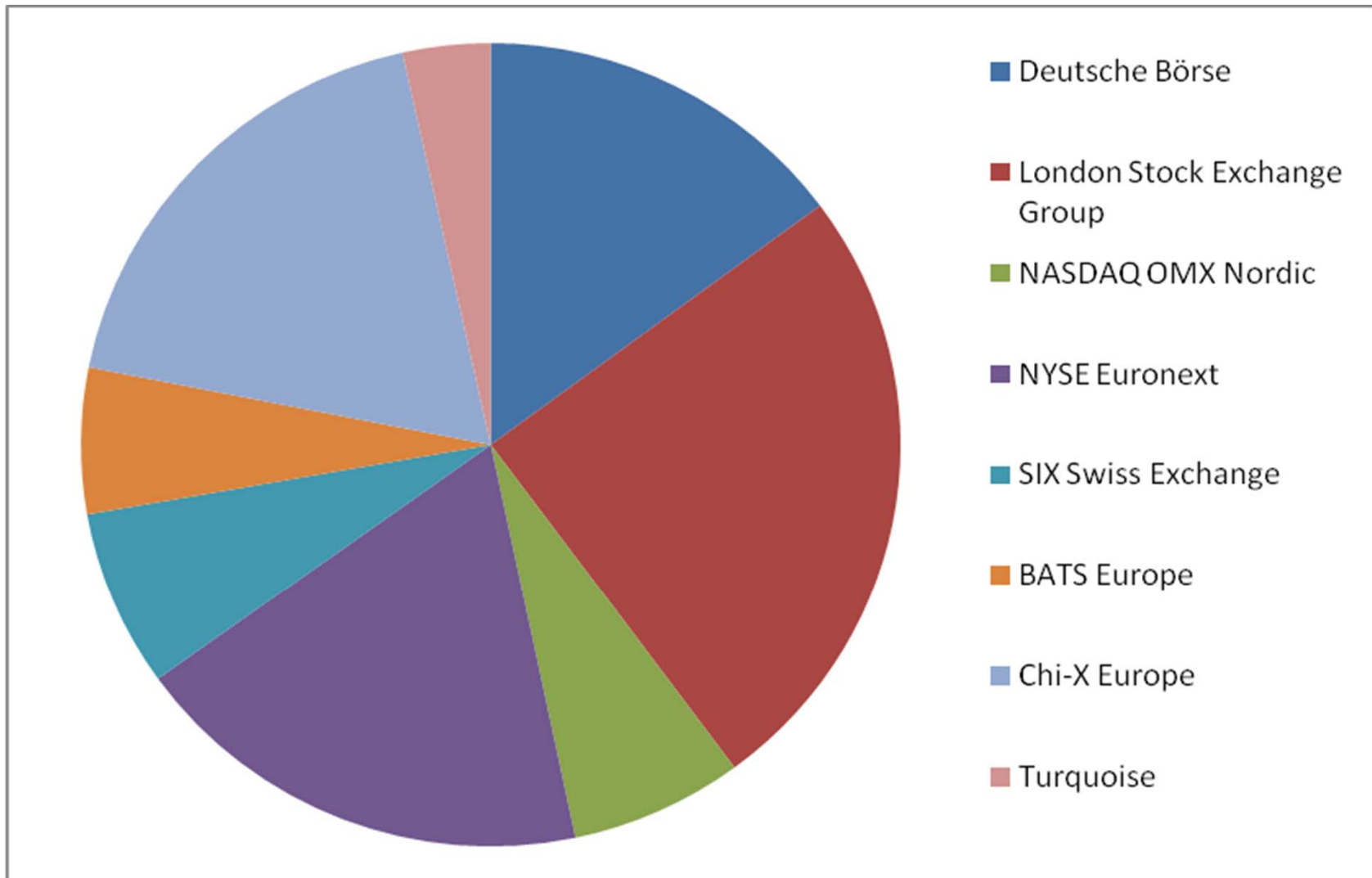
But incumbent exchanges take advantage of this to earn rents

To curb this, regulators (SEC, EU) favor competition

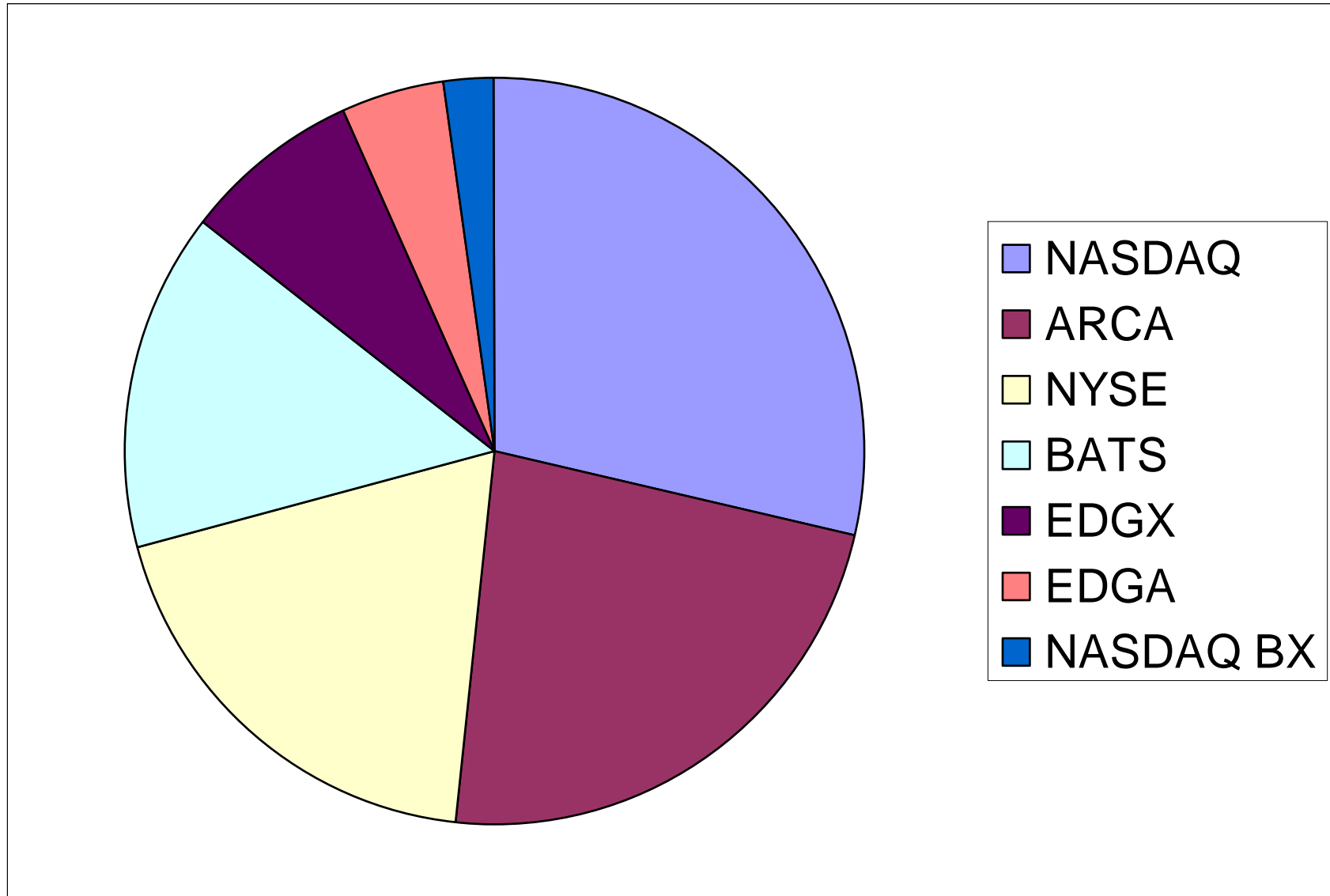
Information technology's advances facilitate development of new platforms

=> Market fragmentation

Market fragmentation Europe 2010



Market fragmentation US 2010



Algos help cope with fragmentation

Fragmentation

⇒ need to search for trading opportunities, compare prices, etc...

⇒ Algos reduce search costs & increase search speed

⇒ More trading opportunities can be identified and gains from trade reaped

Algos help mitigate cognition limits

Traders must analyze risk exposure, gross positions, net aggregate, compliance with regulation & limits

Especially tough when market hit by shock

While humans collect & process this info, can't make trading decision: algos can

3) The darker arts

3.1) Manipulation

Stuffing

HFT algos submit very large number of orders

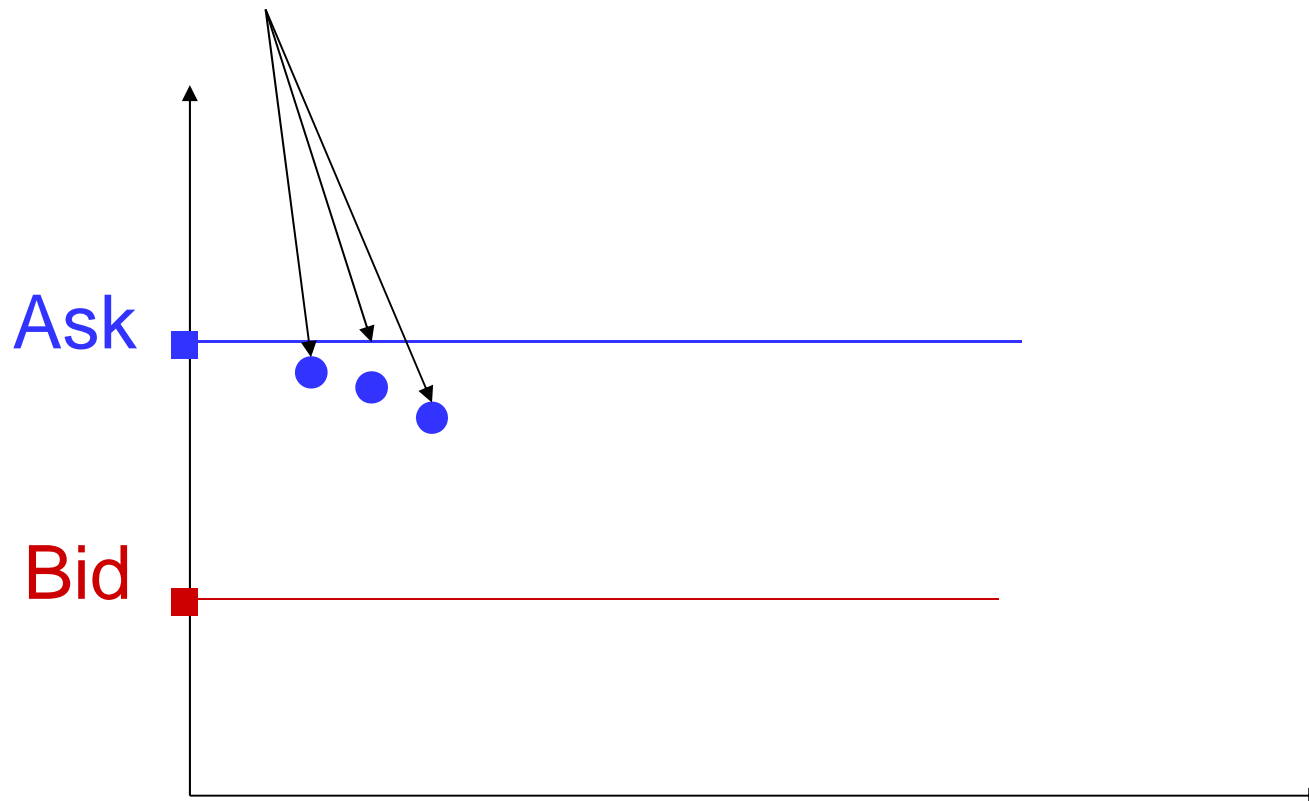
⇒ Access to market & visibility impaired for slow

⇒ Fast traders have better visibility & access

⇒ Execute profitable trades at slow traders' expense.

Smoking

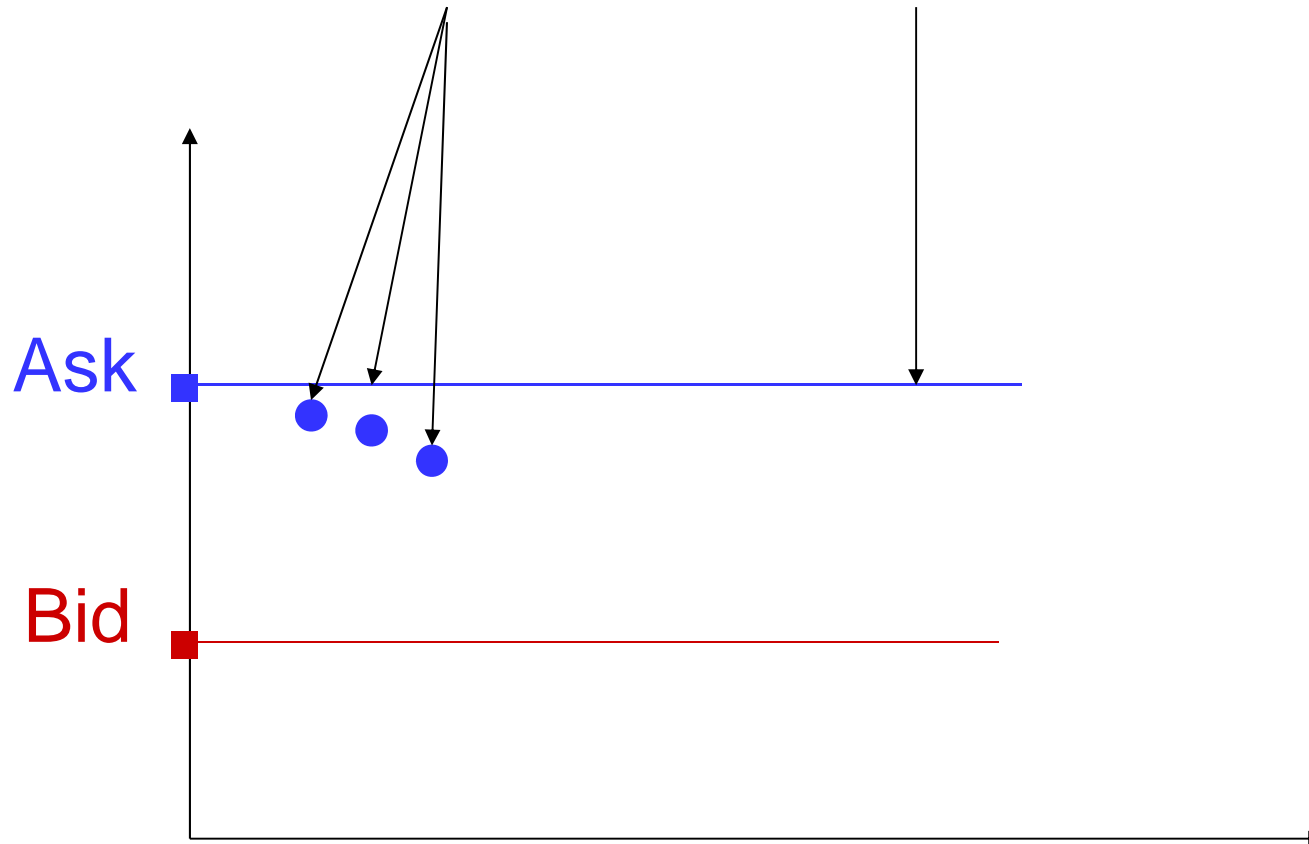
HF trader places
alluring ask quotes
to attract market
buy order



Smoking

Observing
these quotes

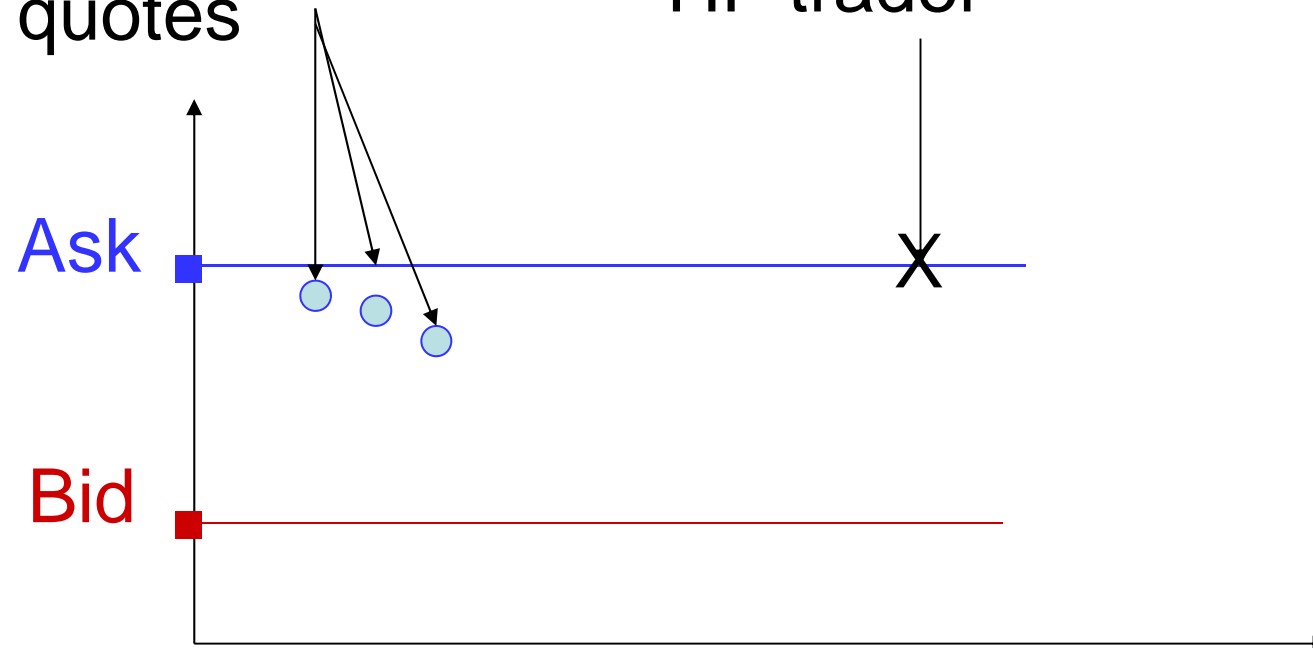
Slow buyers sends
market buy order



Smoking

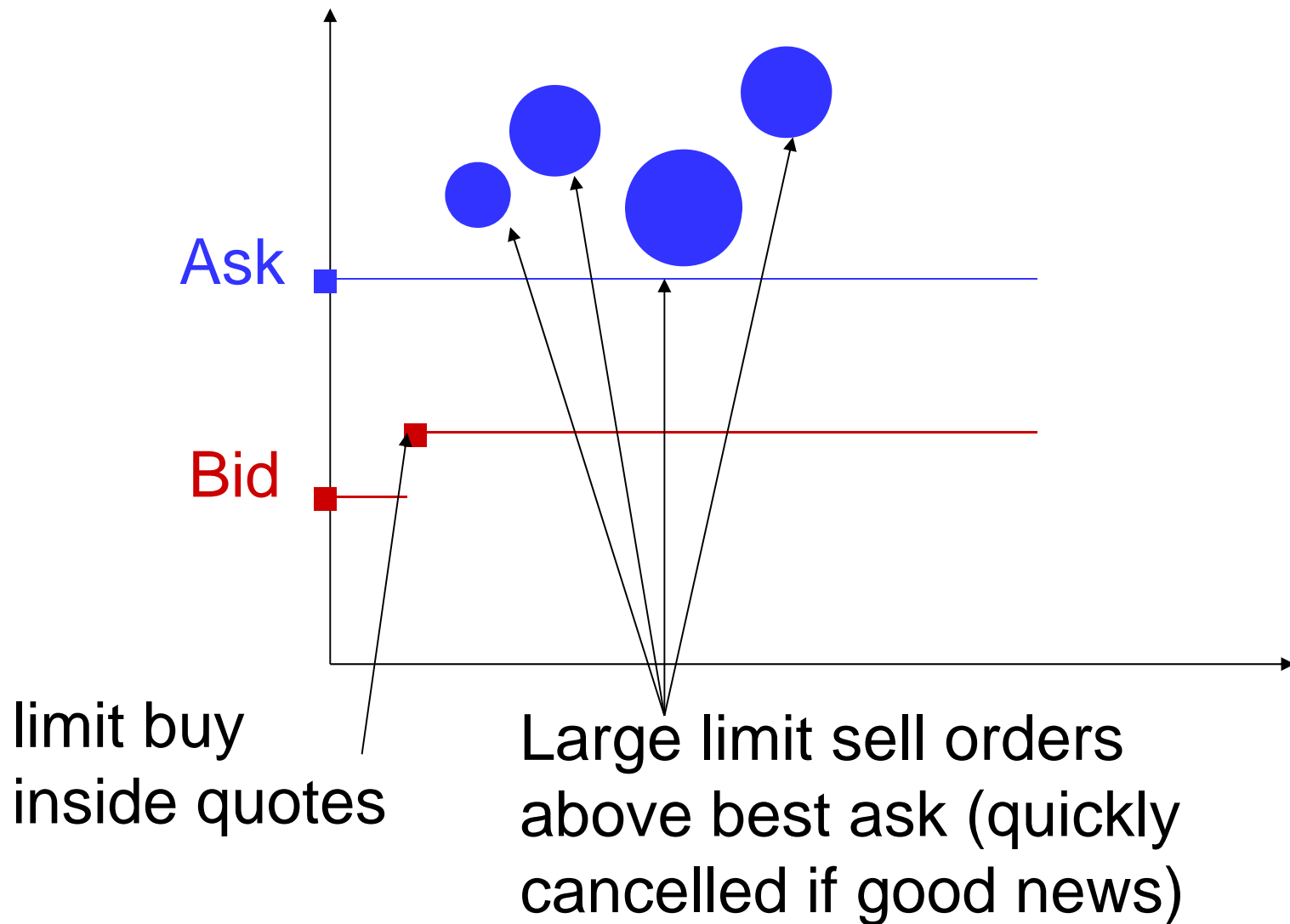
Before slow market buy reaches market, HFT cancels these quotes

Slow buyer's market buy hits larger ask previously posted by HF trader



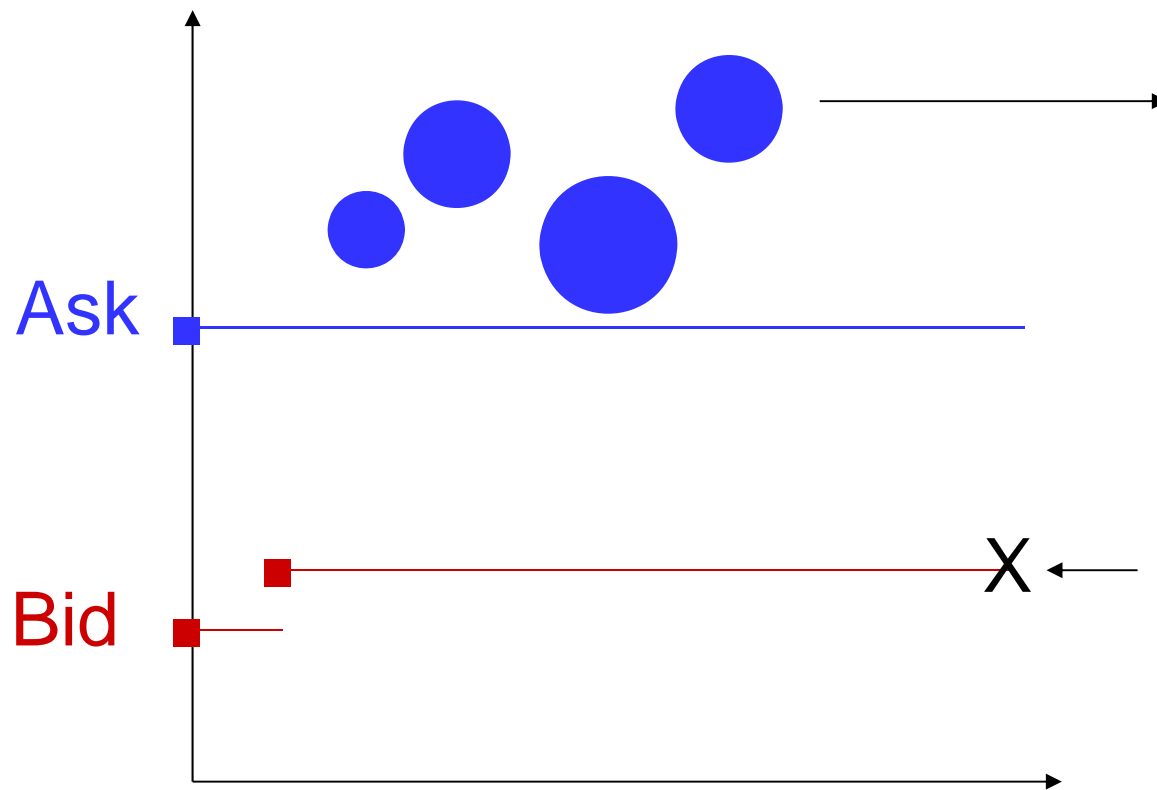
Spooing

HF trader wants to buy



Spoofing

HF trader wants to buy



Apparent
selling
pressure

↓
Scares naïve
investor

↓
Sells at HFT
bid

3.2) Adverse selection

High frequency traders informed before slow traders

Computers faster than human at collecting & aggregating info + colocation

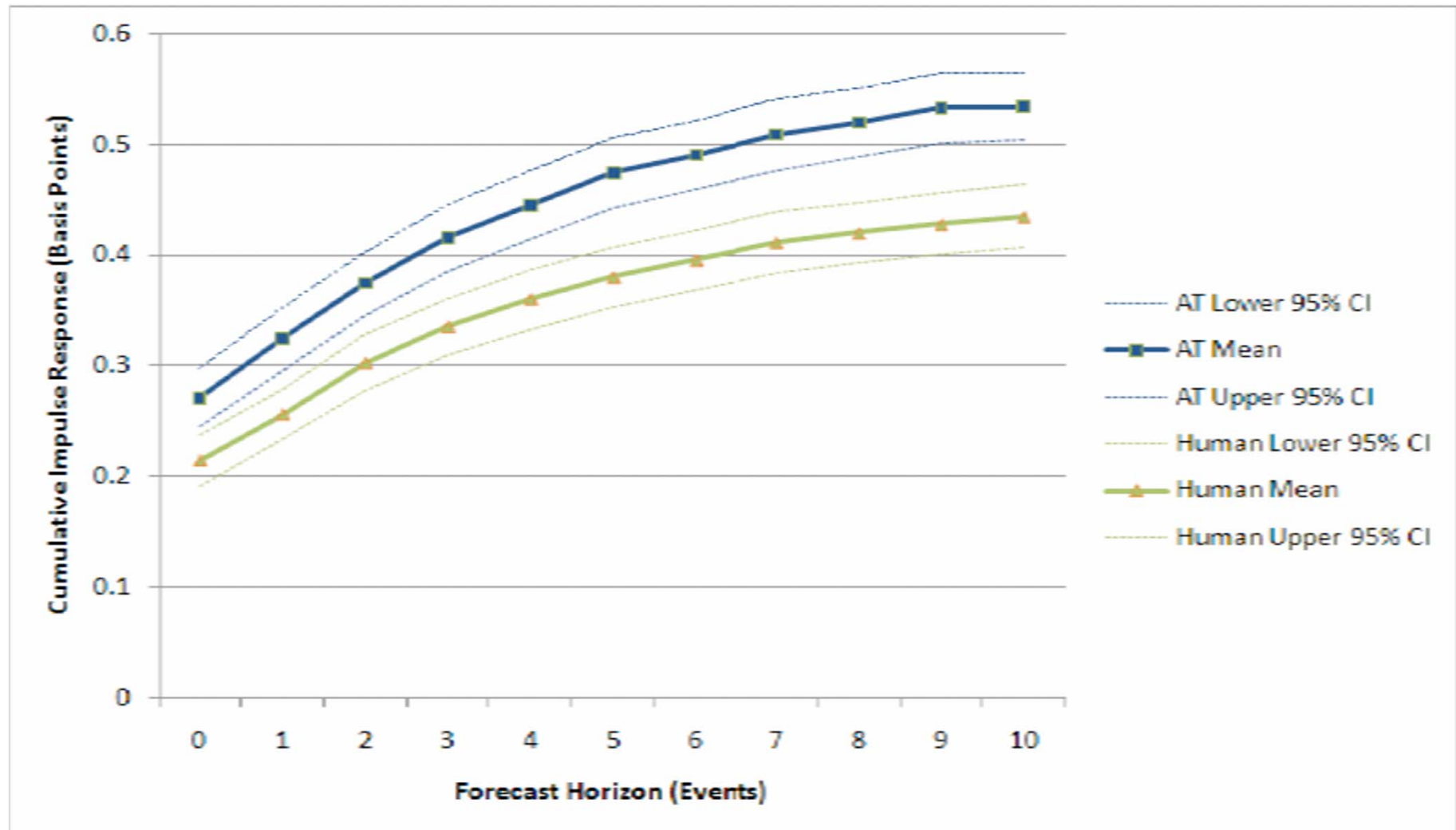
=> asymmetric information

Hendershott Riordan (2010), Brogaard (2010):

Algos have > permanent price impact

Algos lead price discovery

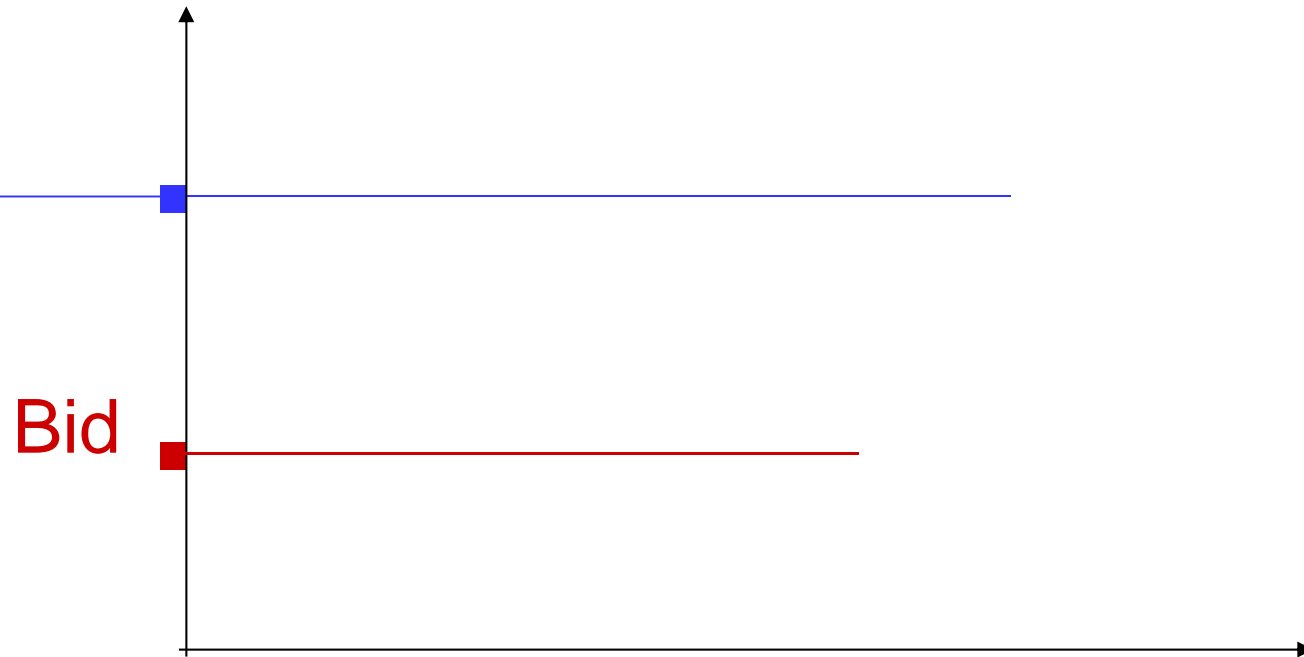
Cumulative impulse response function (measuring the informational impact of trades) for HFT and human trades. Hendershott and Riordan (2010).



Fast trading => adverse selection

Biais, Foucault, Moinas (2010)

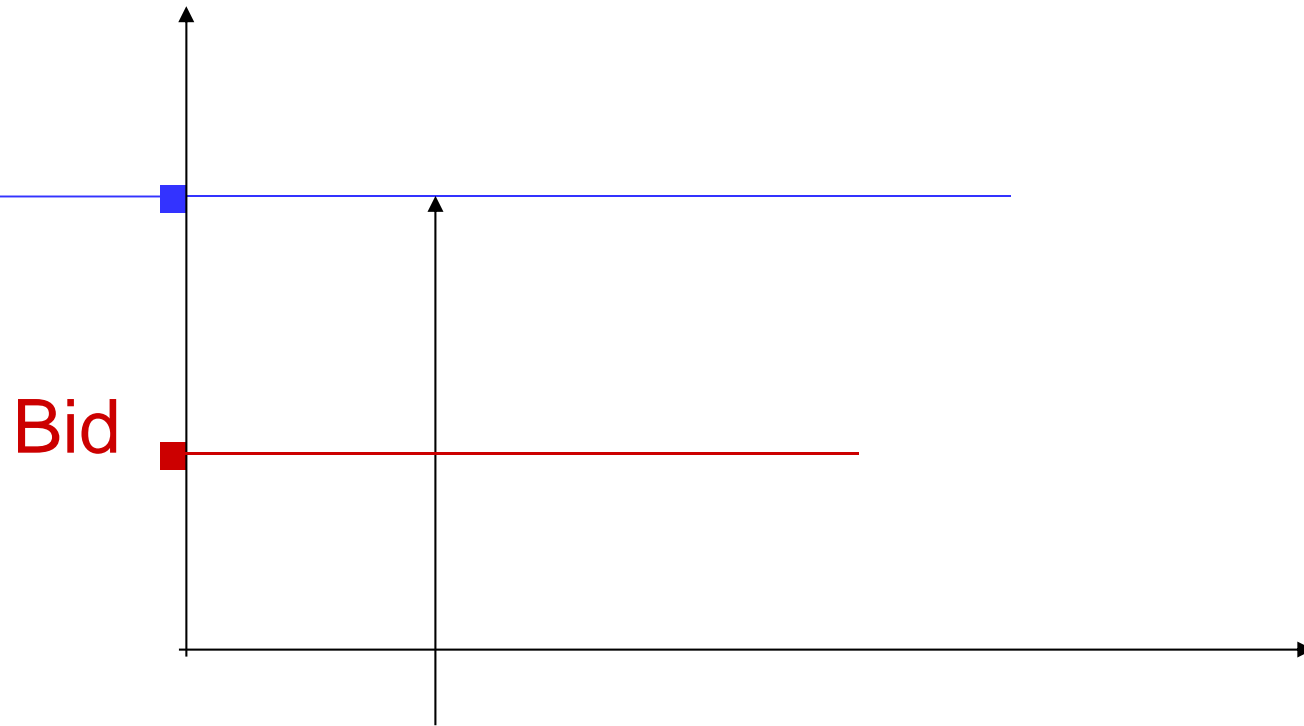
Slow human
posts
Ask = 100



Fast trading create adverse selection

Biais, Foucault, Moinas (2010)

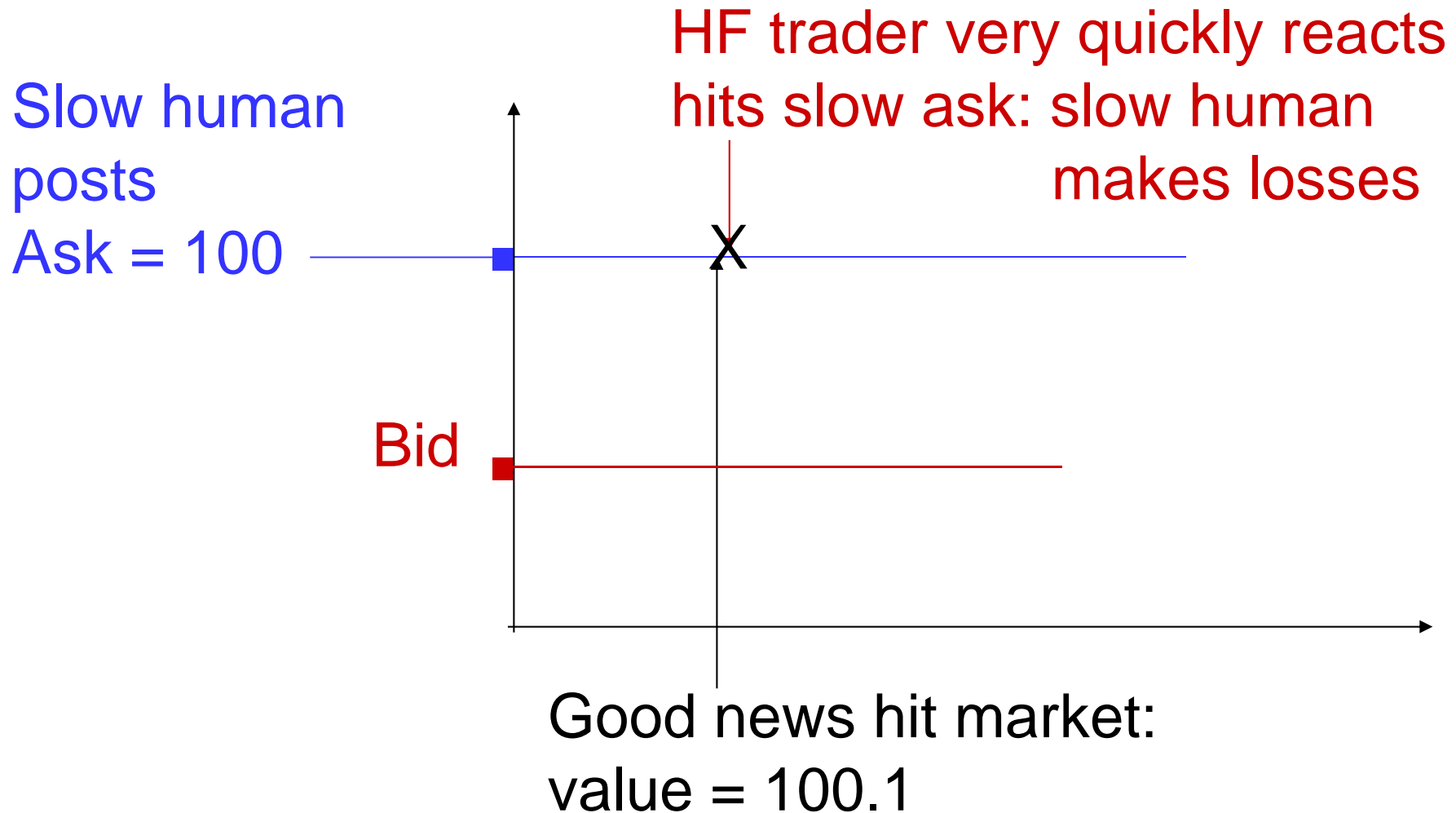
Slow human
posts
Ask = 100



Good news hit market:
value = 100.1

Fast trading create adverse selection

Biais, Foucault, Moinas (2010)



HFT evict slow market orders

Biais, Foucault, Moinas (2010)

Anticipating to be hit by fast informed

Traders quote wider spread

Cost for slow market orders

HFT // negative externality for slow traders

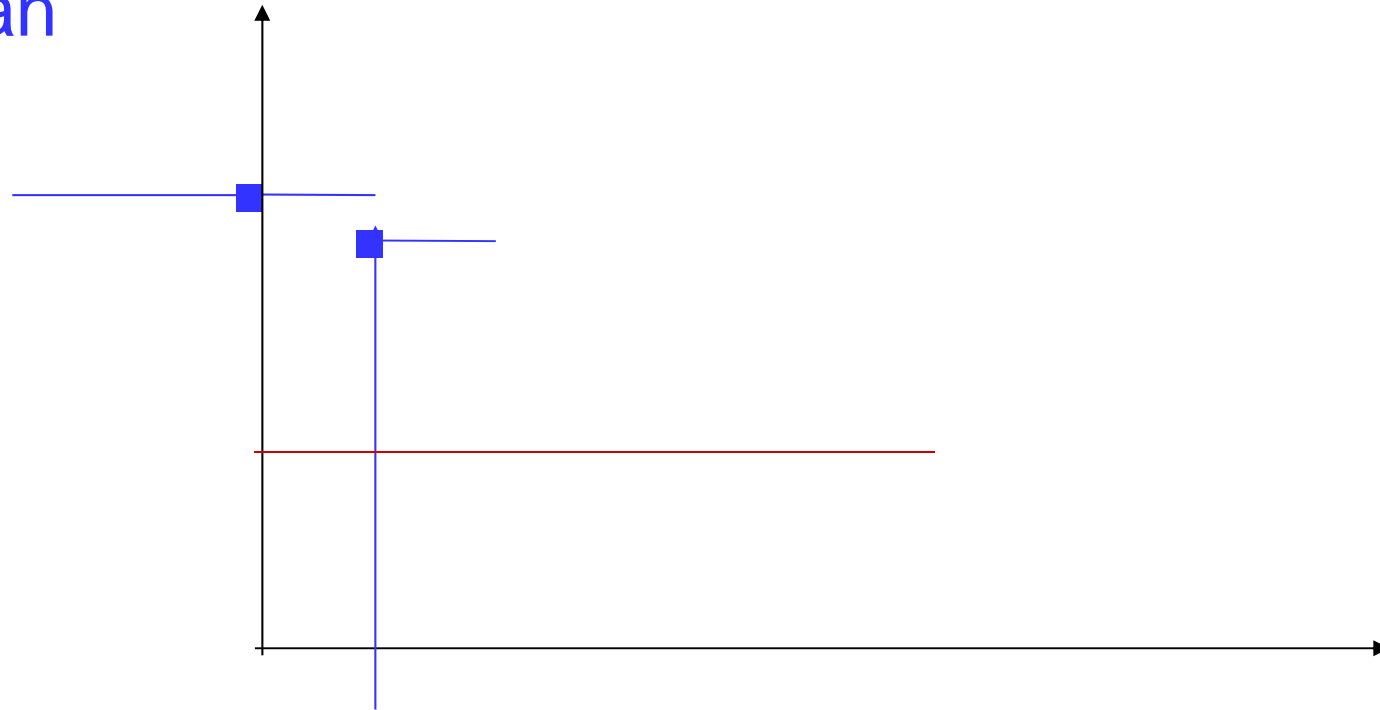
=> reduces market order placement by slow

=> eviction/market breakdown

A variant

Slow human posts

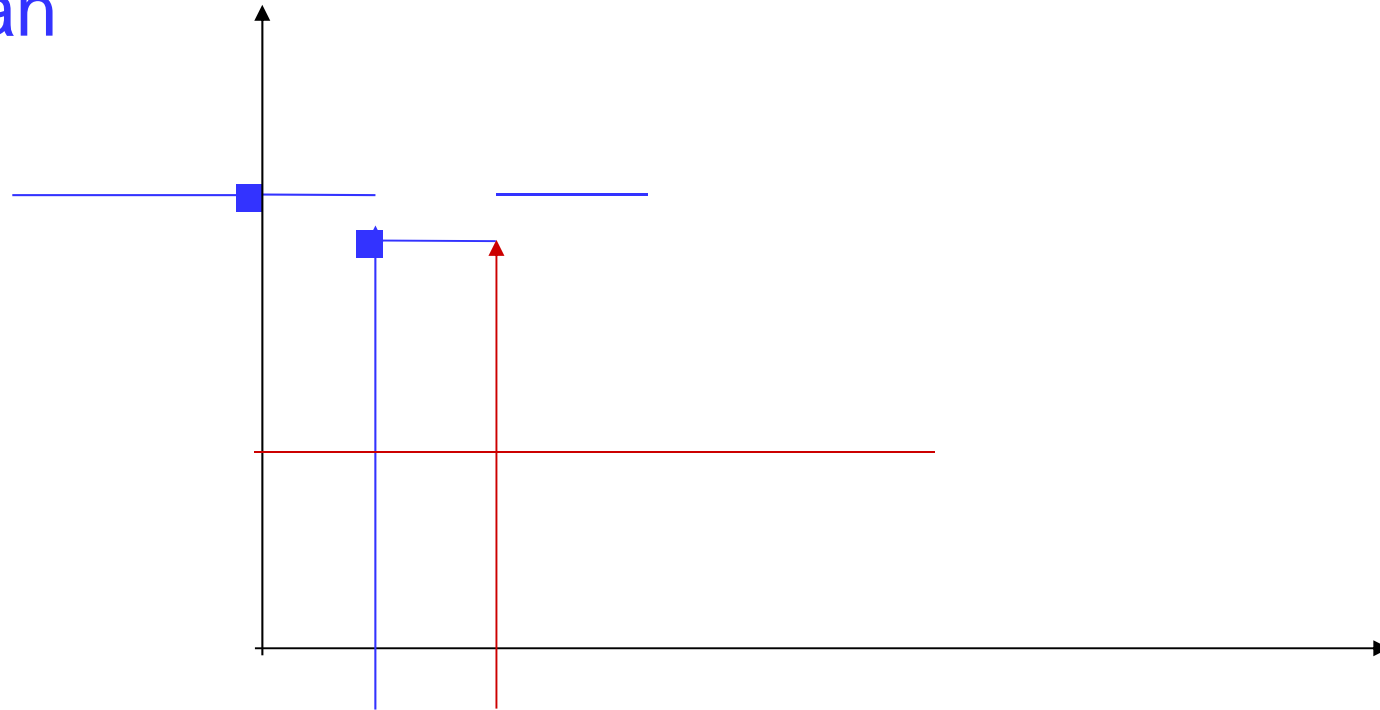
Ask = 100



HF trader undercuts:
ask at 99.99

A variant

Slow human
posts
Ask = 100

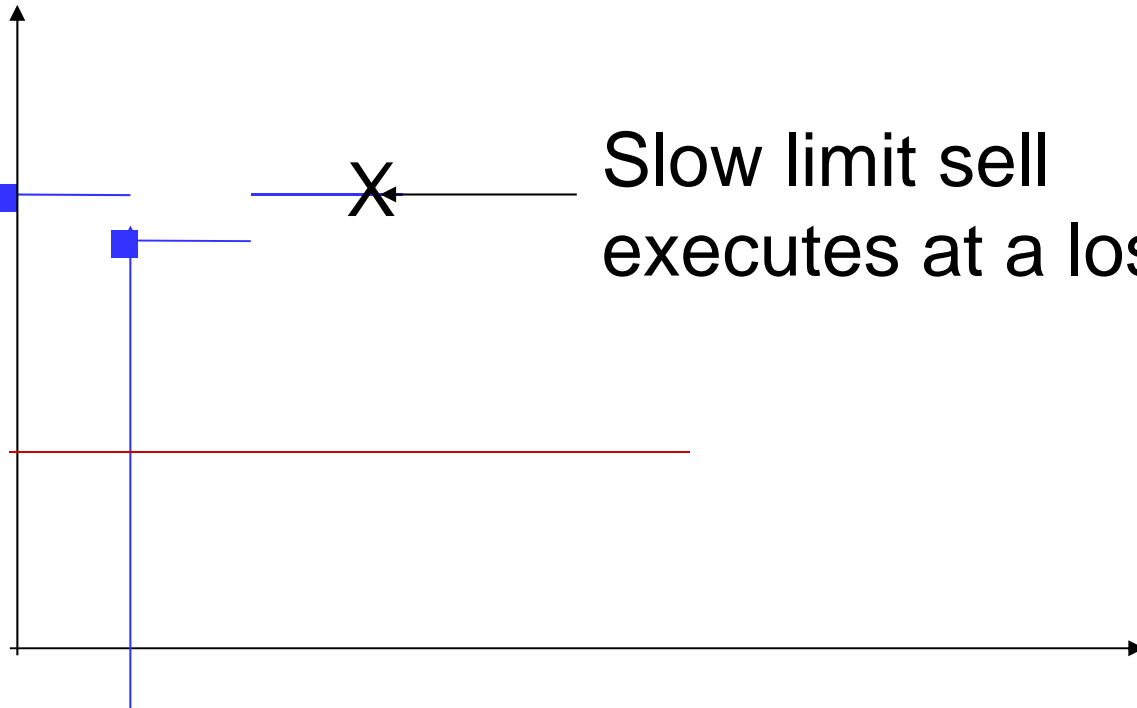


HF trader undercuts:
ask at 99.99

If good news
HFT cancels
immediately

A variant

Slow human
posts
Ask = 100



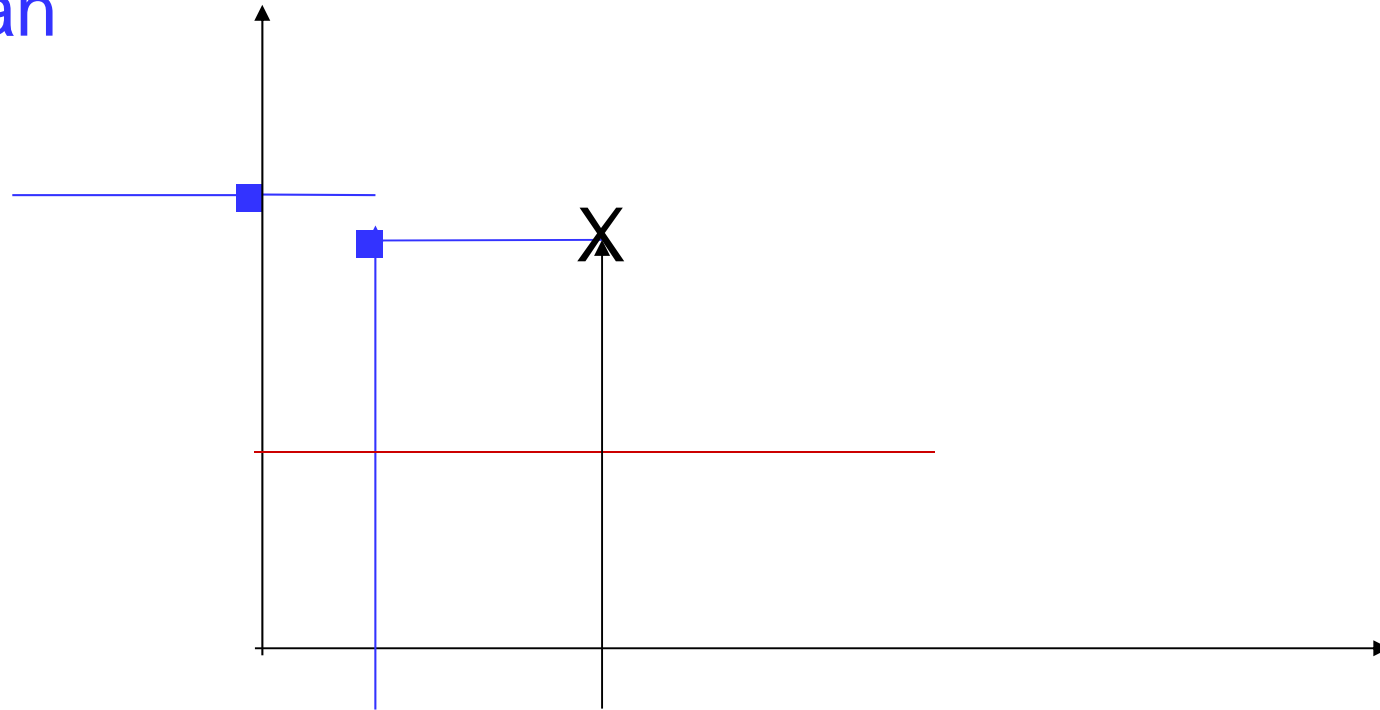
Slow limit sell
executes at a loss

HF trader undercuts:
ask at 99.99

If good news
HFT cancels
immediately

A variant

Slow human
posts
Ask = 100

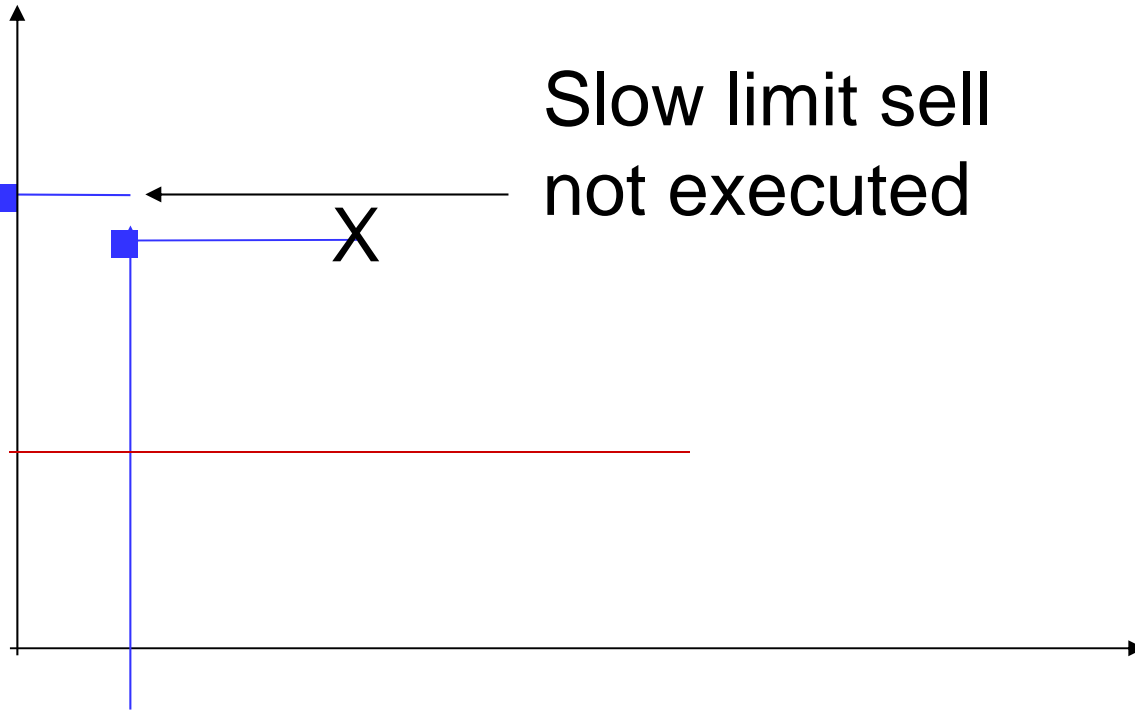


HF trader undercuts
ask at 99.99

If no good news:
HF trader's limit
sell executes

A variant

Slow human
posts
Ask = 100



Slow limit sell
not executed

HF trader undercuts
ask at 99.99

If no good news:
HF trader's limit
sell executes

Consistent with evidence from Chaboud, Chiquoine, Hjalmarsson & Vega (2009)

Permanent price impact of market orders greater when hit human quotes than when hit computer quotes

Limit order to sell placed by humans tend to execute just before prices rise

Not so for computer limit orders

Imperfect competition

HFT generates adverse selection for slow limit orders

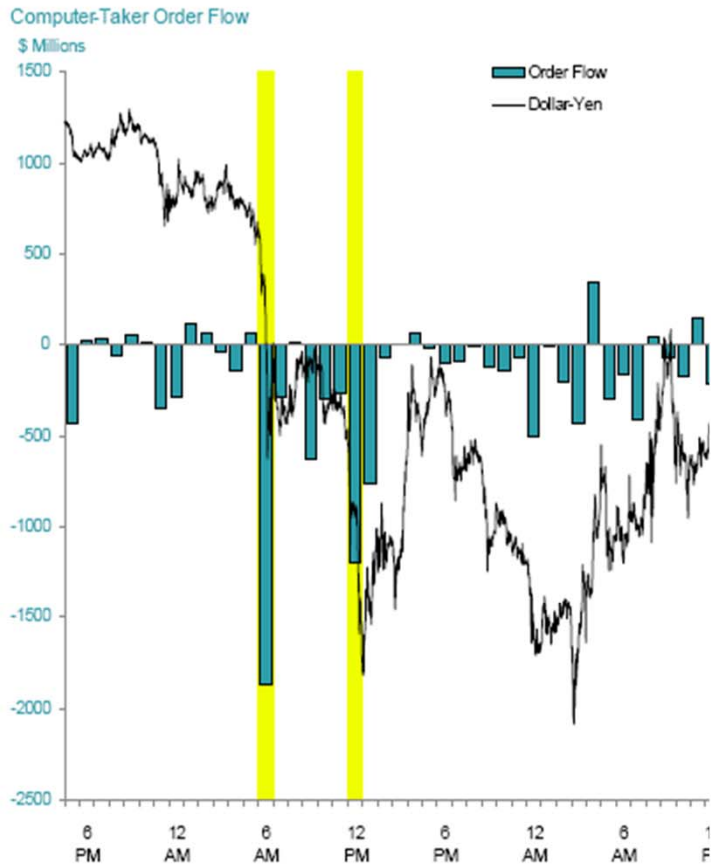
- ⇒ Hard for slow traders to compete to supply liquidity
- ⇒ Eviction of slow traders
- ⇒ Market power for fast traders

HFT = 2% of 20,000 firms operating in US equity market but 73% of trading volume (Aite group)

Jovanovic Menkveld (2010): 1 high frequency trader participated in > 35% of trades on Chi-X.

3.3) Systemic risk

Chaboud et al 2009



Correlated aggressive computer sales during drop



Humans buy \$ during recovery

HFT correlated

Chaboud et al (2009) HF trades more correlated than human traders

Using transition matrix methodology developed in Biais, Hillion and Spatt (1995), Brogaard(2010) finds greater serial autocorrelation in order types for HFT than humans

Algo crash

HFT = correlated + large fraction of trading

Shock hits key HF traders

=> correlated large sales

=> impacts whole market

Slow humans exposed to adverse selection
reluctant to provide liquidity when HF traders want it

Is this what happened during the flash crash ?

4) Perspectives & policy

Excessive growth of HFT

Biais, Foucault, Moinas (2010)

HFT get information before others

=> private profits => investment in HFT

<= but no social gain

Contagion:

If others invest in HFT

Then more costly to remain slow

I also invest in HFT

Investment in HFT // arm's race: expansive, socially useless, if the others do it you must also do it.

Laissez faire & no severe HFT crash

Banks, hedge funds & “pure play” : arms’ race

Minimize latency + sophisticated & rapid algos

Costly for slow traders (adverse selection/manip.)

Buy-side join arms’ race

Slow retreat from lit markets

⇒ Migrate to dark pools & OTC

⇒ Order flow diversion from transparent exchanges

⇒ Hinders price discovery

⇒ Internalization raises agency issues

Laissez faire & severe HFT crash

Operational risk (hardware or code) or outside shock (mini-crash August 2007)

⇒ HFT try to close positions

⇒ Downward price spiral (Gromb Vayanos)

⇒ HFT firms loose millions of dollars

⇒ Lightly capitalized HFT firms go bankrupt

⇒ Counterparty problems

multiple markets, different clearing & settlement
clearing & settlement at lower frequency (day..s)
than trades of HFT firms

Oversight & capital requirements

Non-banks HFT firms (hedge funds, pure play, etc...): currently no capital requirements

Yet could be systemically risky

Capital requirements would be useful

Stress tests too: How would market react to default of one HFT firm? of several? Consequences for pricing, trading, counterparty risk, clearing?

Competition policy

Fixed costs of HFT + adverse selection

=> market concentration

=> imperfect competition

Monitor market: investigate if excessive concentration

Policy moves to level playing field: minimum latency

Slowing the market

To deter arms' race + reduce adverse selection + level playing field:

Impose minimum latency

Can it seriously hinder informational role of market if latency of 1/10 instead of 1/1000 ?

Impossible to prevent use of technology?

Speed limits on roads

Minimum latency not always optimal

Pigovian tax

HFT should be taxed if negative externality:

adverse selection cost for slow traders
systemic risk

more market data to analyze

=> market surveillance more difficult

Use tax proceeds to fund market surveillance
and/or stability fund to be used in case of
crash