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Case Study: Making Markets with High-Frequency Trading

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Best Execution
USA
2010

Topics for discussion

Outline

1. Overview of HFT Strategies
2. HFT Market Making – a simple example
3. Common Questions and Issues
   – Enhancements and Scalability
   – Liquidity and Quote Stuffing
   – Trading Speed and Regulatory Impact
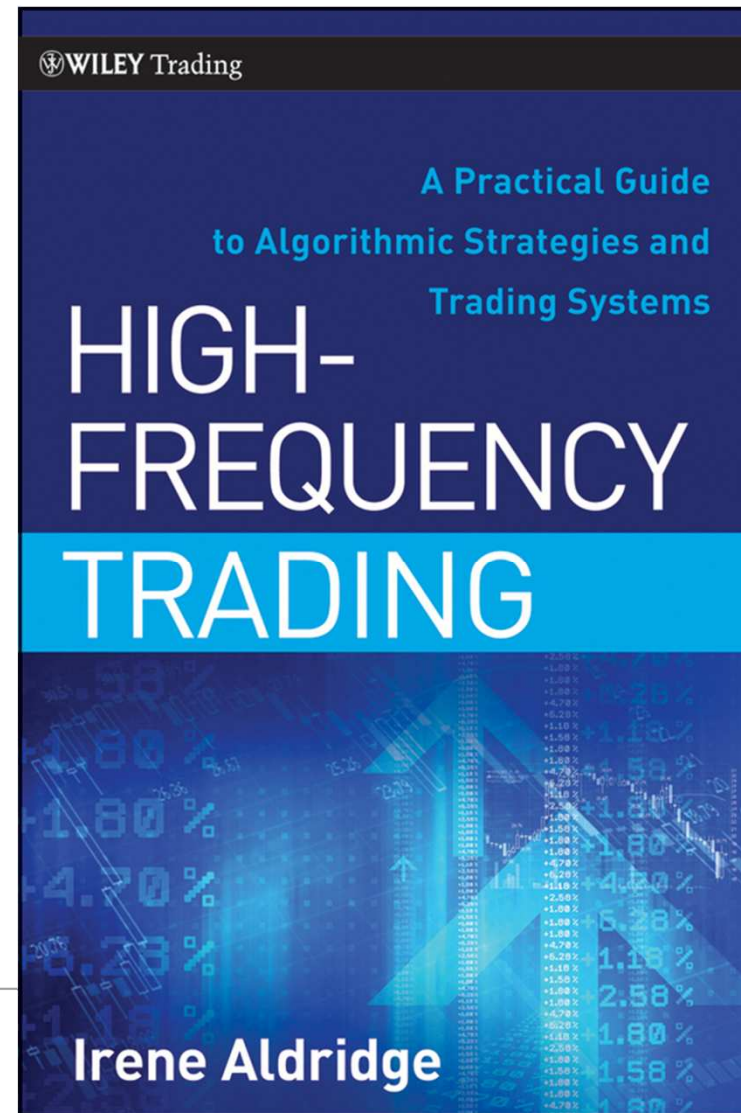   – How can sell-side attract buy-side flow?

**Comparative Performance of SPY Models
Non-reinvested daily capital
= 100 shares of SPY**
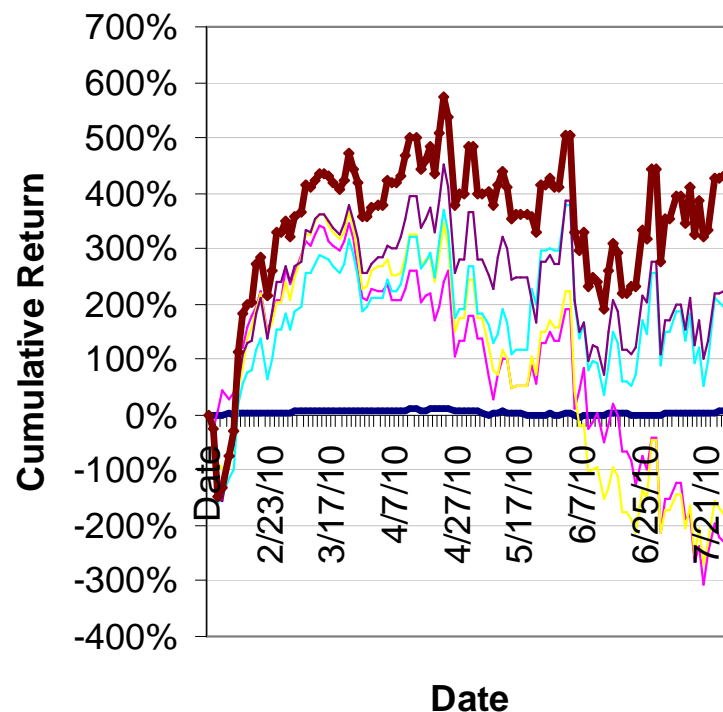
1. Overview of HFT Strategies

Overview of HFT Strategies

- Pure market-making (microstructure inventory models – Chapter 10)

- Ticker-tape reading (microstructure information models – Chapter 11)

- Event arbitrage – Chapter 12

- Statistical arbitrage – Chapter 13

WILEY Trading

A Practical Guide
to Algorithmic Strategies and
Trading Systems

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2. HFT Market Making (HFT MM)

Market-Making is a Service

- Bridges buyers and sellers
- Takes on inventory risk
- ⇒ Charges spread as a result

- Market-making is not so different from your local grocer
  - Equities ~ non-perishable items
  - Futures, options ~ rapidly approach their expiration dates

Implementation Basics

- Find and satisfy the need for liquidity

- Buy low, sell high

- Offer liquidity => post limit orders only

- Hedge inventory exposure

Market-making is a simple and useful activity

2. HFT Market Making – How to open positions?

Process to open positions

1. Identify gaps in demand or supply
   - Various intelligent forecasting techniques
   - See the High-Frequency Trading book
2. Fill these gaps
   - Low demand: post bids
   - Low supply: post offers (asks)

At what prices to set bids and offers?

- Speed is of the essence:
  - Quickly grab the "customer": fill in the void in demand and supply

- Orders better than the current best bid/ask are most profitable

- Orders far from the best bid and offer do not execute fast enough

Both sell-side and buy-side HFTs are better off opening positions aggressively

2. HFT Market Making – How to close positions?

Aggressive orders?

- Closer to or better than best bid/ask
- Aggressive closing orders allow more volume
- Great for sell-side

Passive orders?

- Far away from the market
- Passive closing orders bring potentially bigger gain
- Passive orders can be riskier (the risk of being run over by market)
- Better for buy-side

Sell-side HFT is better off closing aggressively, while buy-side HFT can close passively.

2. HFT Market Making – Sell-side HFT and buy-side HFT comparisons

Sell-side Perspective

- Objective:
    - To capture alpha AND commission income

- Optimal implementation:
    - High volume (high commissions revenue)
    - Small gains per trade
    - Aggressive position open to capture opportunities
    - Aggressive position close to maximize capital turnover

Buy-side Perspective

- Objective:
    - To capture alpha and minimize transaction costs

- Optimal implementation:
    - Smaller volume (low transaction expense)
    - Larger gains per trade
    - Aggressive position open to capture opportunities
    - Passive position close to maximize per trade profitability

2. HFT Market Making – implications for all market makers
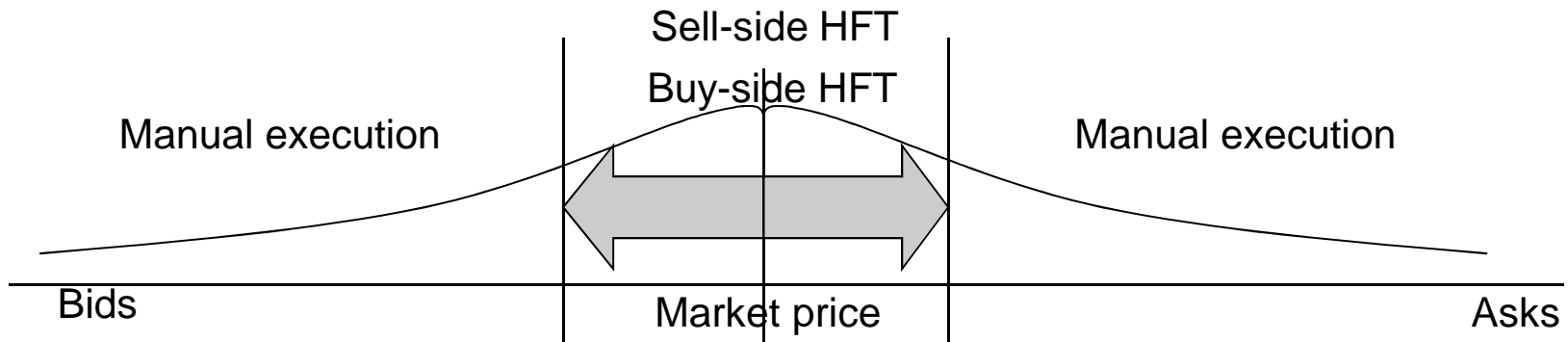
On position open

- Buy-side HFTs compete with sell-side HFTs to fill the void in supply and demand

- Both buy-side HFT and sell-side HFT use aggressive orders

- Manual execution has an ample range of passive orders at their disposal
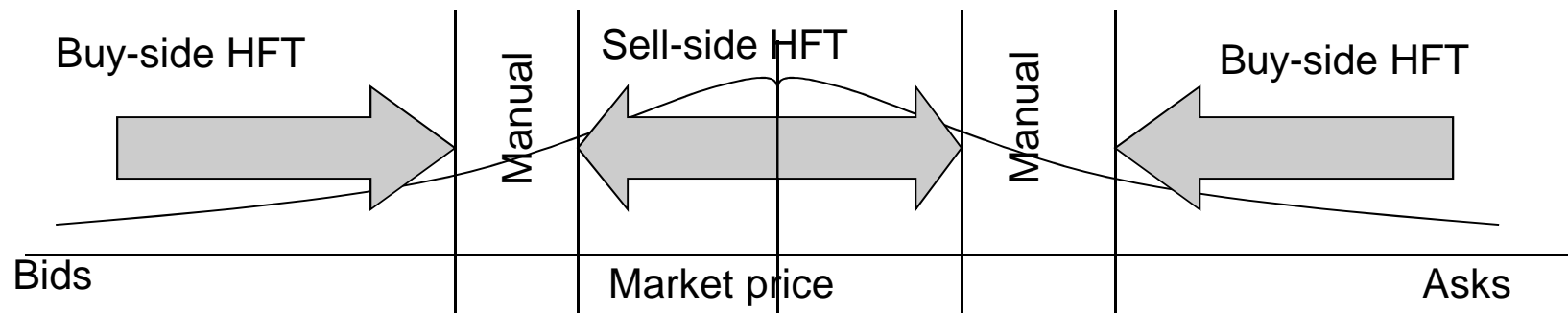
On position close

- Sell-side HFTs use aggressive orders, while buy-side HFTs use passive orders.

- Manual execution is "squeezed," describe the phenomenon as "flashing quotes," cannot compete.

2. HFT Market Making – implications for all market makers

On position open

Sell-side HFT

Buy-side HFT

Manual execution

Manual execution

Bids

Market price

Asks

On position close

Buy-side HFT

Manual

Sell-side HFT

Manual

Buy-side HFT

Bids

Market price

Asks

2. HFT Market Making – implications for all market participants
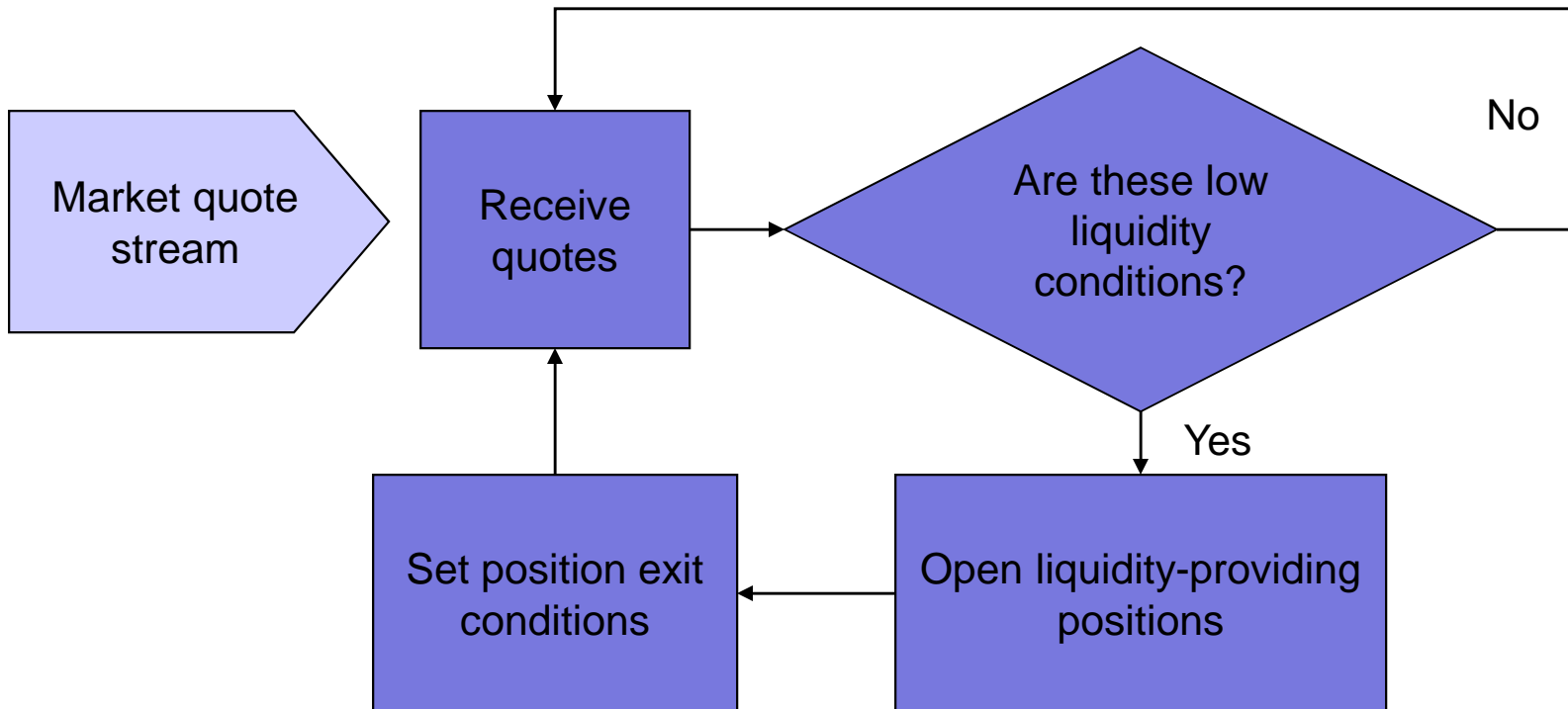
Who wins?

- HF traders
- End investor ("mom-n-pop", institutional investors) gain:
  - Higher liquidity
  - Lower costs

Who loses?

- Manual execution squeezed
  - Can't compete
  - Too inefficient, not fast enough, priced too high (too much overhead – too many traders, etc.)

HFT market-making will become the standard.

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2. HFT Market Making – the simplest algorithm

Market quote stream

Receive quotes

Are these low liquidity conditions?

No

Yes

Open liquidity-providing positions

Set position exit conditions

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2. HFT Market Making – performance of the simplest algorithm

Model ID	1	2	3	4	5	SPY
Open order aggressiveness	BB+0.02/ BO-0.02	BB+0.02/ BO-0.02	BB+0.02/ BO-0.02	BB+0.03/ BO-0.03	BB+0.05/ BO-0.05	
Closing order aggressiveness	BB-0.05/ BO+0.05	BB-0.10/ BO+0.10	BB-0.20/ BO+0.20	BB-0.50/ BO+0.50	BB–0.80/ BO+0.80	
Sum Gain %	-227.4%	-181.7%	196.3%	222.9%	429.4%	5.5%
Daily Average	-2.1%	-1.7%	1.8%	2.0%	3.9%	0.05%
Stdev	45.2%	48.3%	53.2%	52.2%	53.8%	1.3%
Avg # orders	41.7	39.7	39.2	38.7	38.0	
Avg # trades	11.3	7.2	4.7	3.7	2.1	
Avg daily execution rate	21.6%	14.8%	9.8%	7.8%	4.7%	

BB = best bid, BO = best offer
2/1/2010-7/28/2010, only 100 shares of SPY traded at all times

2. HFT Market Making – performance of the simplest algorithm

Comparative Performance of SPY Models
Non-reinvested daily capital = 100 shares of SPY
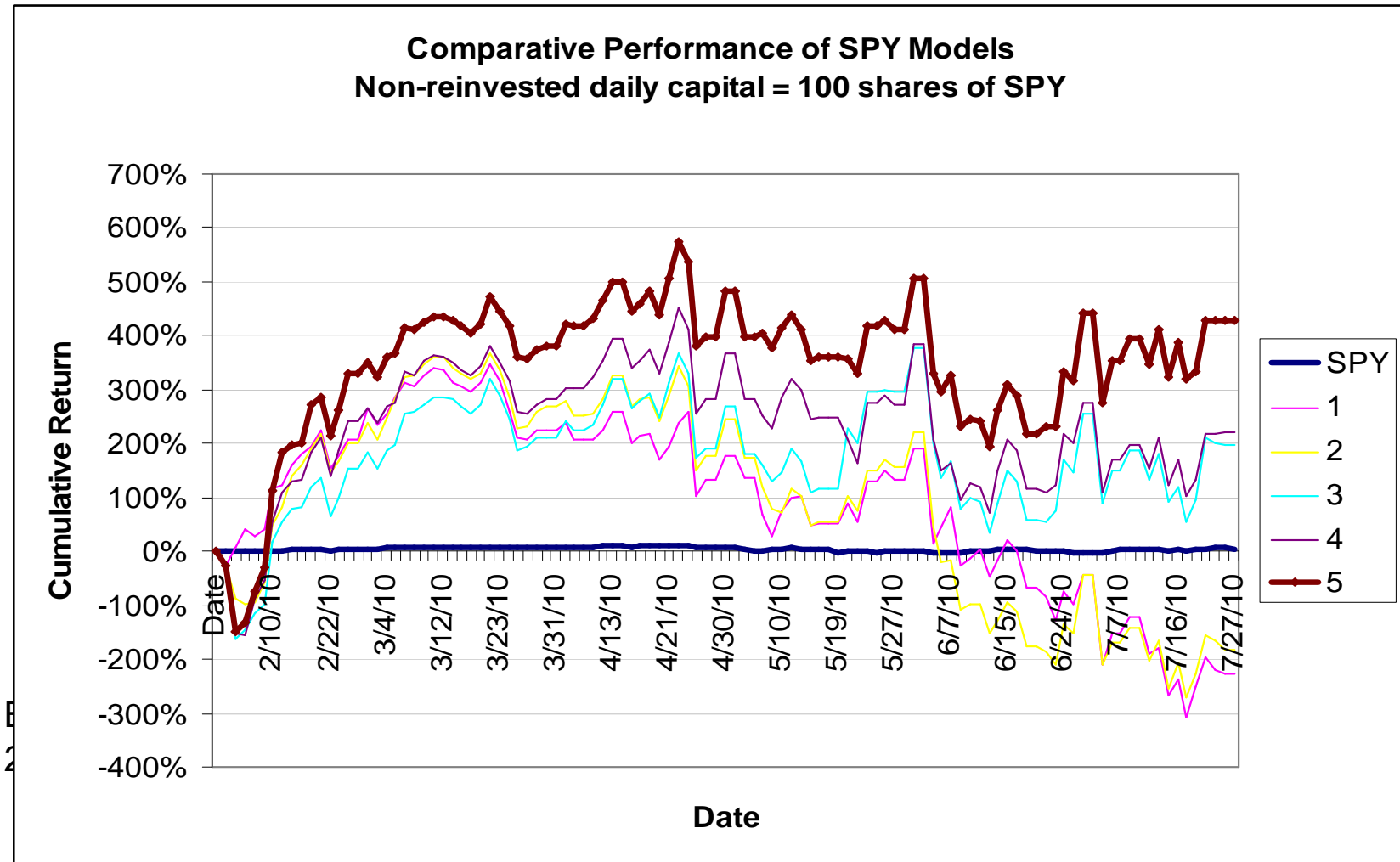
2. HFT Market Making – performance of the simplest algorithm

Ticker	SPY	USO	SLV	GLD	EEM
Open order aggressiveness	BB+0.05/ BO-0.05	BB+0.05/ BO-0.05	BB+0.05/ BO-0.05	BB+0.05/ BO-0.05	BB+0.05/ BO-0.05
Closing order aggressiveness	BB–0.80/ BO+0.80	BB–0.80/ BO+0.80	BB–0.80/ BO+0.80	BB–0.80/ BO+0.80	BB–0.80/ BO+0.80
Sum Gain %	429.4%	18.0%	16.3%	189.6%	304.1%
Daily Average	3.9%	1.1%	1.1%	2.8%	3.7%
Stdev	53.8%	51.4%	204.5%	29.2%	54.8%
Avg # orders	38.0	38.2	69.7	69.9	49.1
Avg # trades	2.1	1.7	1.7	2.0	1.7
Avg daily execution rate	4.7%	3.8%	2.4%	2.6%	3.2%
Buy and hold gain over the same period	5.5%	-18.4%	1.2%	6.6%	-12.0%

Results for Model 5
BB = best bid, BO = best offer
2/1/2010-7/28/2010, only 100 shares of each stock or ETF traded at all times

3. Common Questions and Issues

How to enhance the basic HFT

- Stop losses (fixed or rolling)
- Better short-term forecasting
  - Volume/order flow analysis
  - Price trends
  - Arbitrage
- See High-Frequency Trading book

How scalable is the basic HFT?

- In assessing liquidity gaps, aggregate liquidity across, say, 5 best bids, best offers
- HFT is potentially scalable to up to 5% of equity capitalization, the sky is the limit in FX
- Across all stocks, supports several billion in capital
- Each tweak in forecasting = new model, new cap

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3. Common Questions and Issues

Does HFT Really Provide Liquidity?

- Yes

- Is it "quality" liquidity?

- Yes. Definition of liquidity: the aggregate supply and demand outstanding at any given point in time.

- Any liquidity from a solvent counterparty is quality liquidity.

Low execution ratio => "quote stuffing"?

- No

- All orders are placed in good faith with the intention of being executed.

- Some orders are not picked up by the markets.

- Grocery store analogy: a grocer can choose to price jam any way he wants. If the price is too high, no one buys the jam. Should the grocer be told at which prices to sell the jam?

Most contemporary arguments against HFT is fluff generated by manual execution.

3. Common Questions and Issues

Is any trading speed too high?

- Trading speed matters most for sell side.
- High trading speed => high capital turnover => high revenue from commissions
- No speed can be high enough for sell side
- To regulate speed is to impose caps on how much money sell side can generate (manual execution would love to have a piece of HFT revenues)

What about potential regulation of speed?

- Slowing down HFT
  - Will hurt sell side the most
  - Will force some sell-side participants to abandon markets
  - Will make the markets less efficient (think dark ages)
- Requiring all market makers to register on exchanges
  - Designed to prevent buy-side HFT from entering the competition
  - Little impact: many exchanges seek HFT flow, offer free registration to all
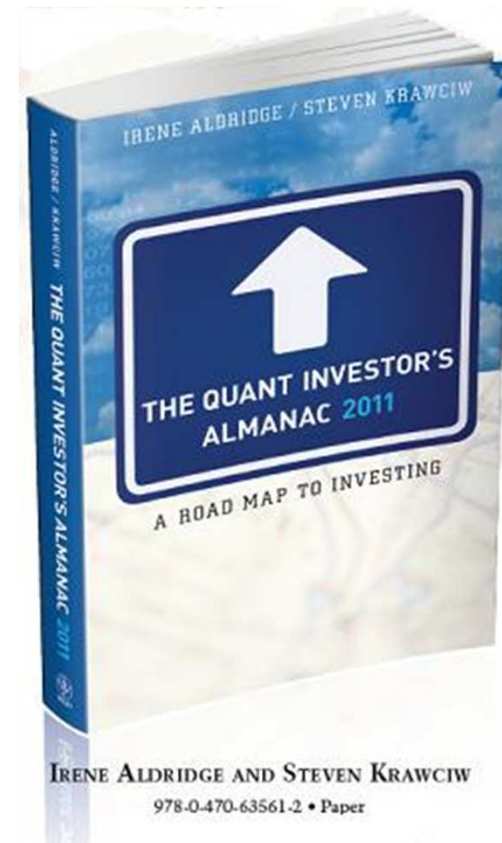
3. Common Questions and Issues

How can sell-side attract HFT flow?

- Very difficult:
  - Mostly by competing on price
  - HFTs can go directly to exchanges
  - Most HFT algos are designed to split the flow among many players
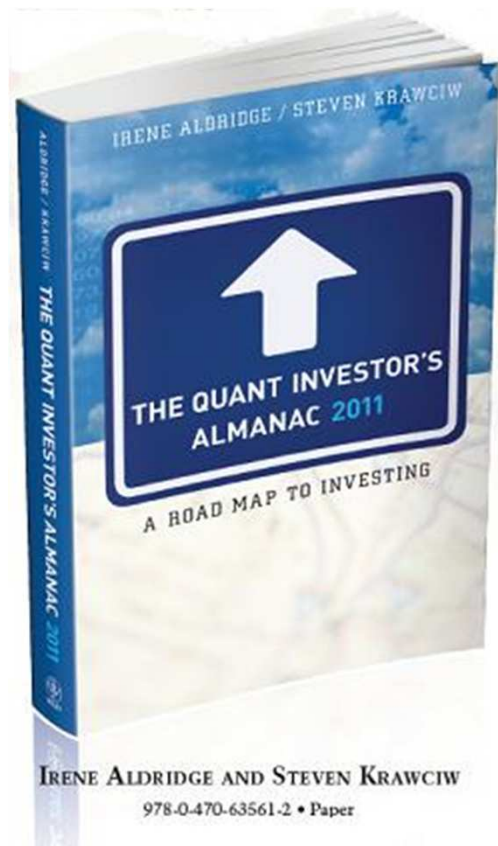
Can sell-side attract dedicated flow?

- Yes

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