

Equilibrium HFT
by Biais, Foucault and Moinas

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OUTLINE

- 1 Model Description
- 2 Results
- 3 Comments
- 4 Relationship with Literature and Policy

MODEL



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Glosten and Milgrom (1985):

- Risk neutrality, private values
- Competitive market makers
- Perfect value signal for some traders

Diamond (1982)

- Search for counterparty (liquidity)

Grossman Stiglitz (1980)

- Pre-trade investment



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Unique Ingredients

- Composite investment: see v + relax search
- No search externalities

Biais, Foucault, Moinas (2012)

MAIN RESULTS

Positive

- 1 Informational content of trades increases with α , which is also short-term vol. here (price impact)
- 2 An increase in α can increase or decrease trading volume
- 3 Strategic complementarities in HFT investments

Normative

- 1 HFT investments are inefficiently high
 - ▶ Note: No social use of information

EMPIRICAL EVIDENCE

- HFT can decrease or increase trading volume
 - ▶ Found in Jovanovic Menkveld (2010)
- HFT increase short-term volatility
 - ▶ Counterfactual: Brogaard (2011), using short selling ban of 2008
- HFT make prices more informative
 - ▶ Found in Hendershott Riordan (2011), Brogaard (2011), etc.
 - ▶ Is this proof of trading on fundamentals or anticipating order flow?
- Do HFT trade on fundamental information?
- Menkveld (2011): A large HFT firm in Chi-X Europe loses on average €0.45 per trade on positions < 5sec, and €1.33 on longer positions
 - ▶ HFT gets adversely selected, compensates with bid-ask spread and rebates

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HFT TRADING AROUND NEWS

- Trades NASDAQ sample. Dependent Variable:

$$\frac{\# \text{Passive HFT Trades}}{\# \text{Passive HFT Trades} + \# \text{Aggressive HFT Trades}}$$

- News: DowJones (millisecond stamps)
- Estimates

Sample	Window	Coeff.	t-stat
All firms	1sec	0.011	1.22
Large	1sec	0.010	1.19
All firms	10sec	0.03	7.18
Large	10sec	0.029	7.109

- **Interpretation:** NASDAQ sample definition, sample period, static price impact + limited qty. competition (e.g. Holden Subrahmanyam 1992)

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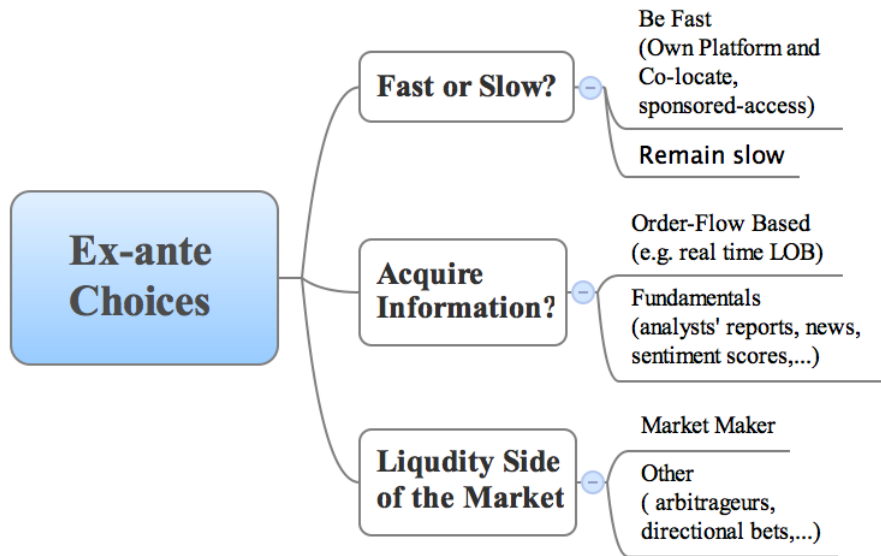
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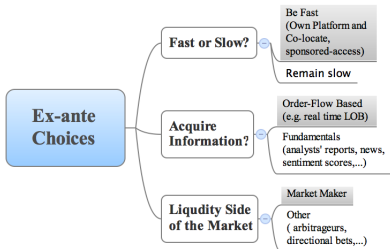
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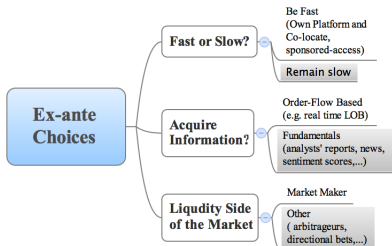
INVESTORS' PROFILES



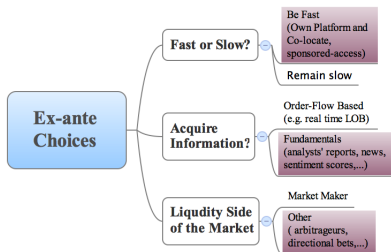
Traditional HFT (e.g. Getco)



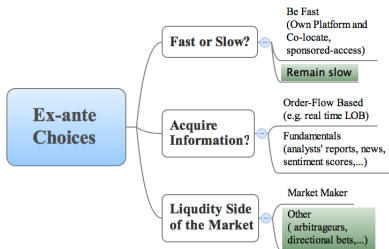
Traditional Active Fund (e.g. Buffett)



Fast Trader



Slow Trader



HETEROGENEOUS INFORMATION AND HETEROGENEOUS HORIZONS

- Consider a framework where:
 - ▶ Informed Traders are liquidity demanders
 - ▶ Traders can choose to learn about v or $x \perp v$
 - ▶ Trading horizons can be short or long
- Froot Scharfstein and Stein's (1992) Proposition 3:
 - ▶ If trading horizons are short enough there are positive spillovers in information acquisition
 - ▶ There is an equilibrium where some traders learn about v and others about x , reducing price efficiency
- **Slow traders** resemble long-horizon investors (Buffett), but cannot learn
- **Fast traders** resemble short-horizon investors (Getco), but cannot choose what to learn about

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SPEED, SEARCH, AND LIQUIDITY SIDE

- No liquidity externalities in the model: $\alpha \perp \rho$. Does it matter?

- In the data: HFT \approx market makers

- ▶ More HFT competition should render the market more liquid:

$$\rho'_S(\alpha) > 0$$

- ▶ Interesting trade-off: $\psi'(\alpha) < 0$ not obvious

- In the model: traders search for (limited) trading opportunities (i.e. $\rho < 1$)

- ▶ If trading opportunities are scarce:

$$\rho'_F(\alpha) < 0 \text{ and/or } \rho'_F(\alpha) < 0$$

- ▶ Strong enough to affect informational result?

- Large # of equilibria: exploring $\rho(\alpha)$ may help refining.

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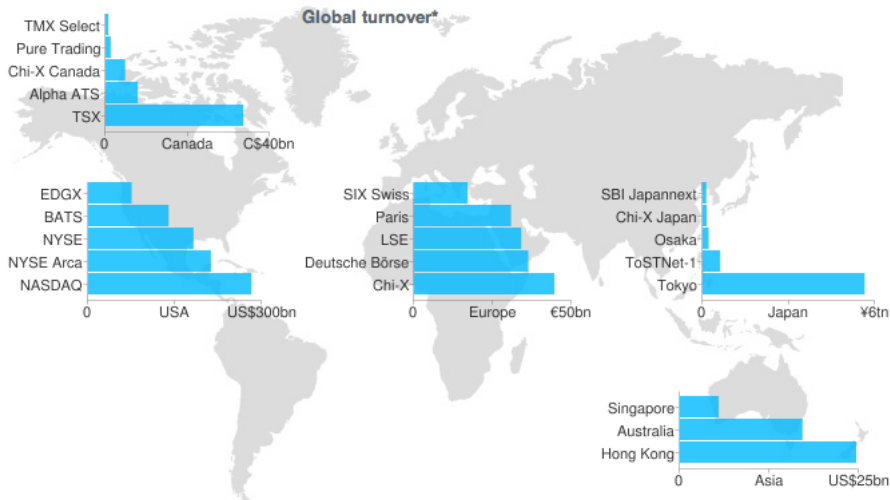
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CONNECTIONS WITH OWN RESEARCH

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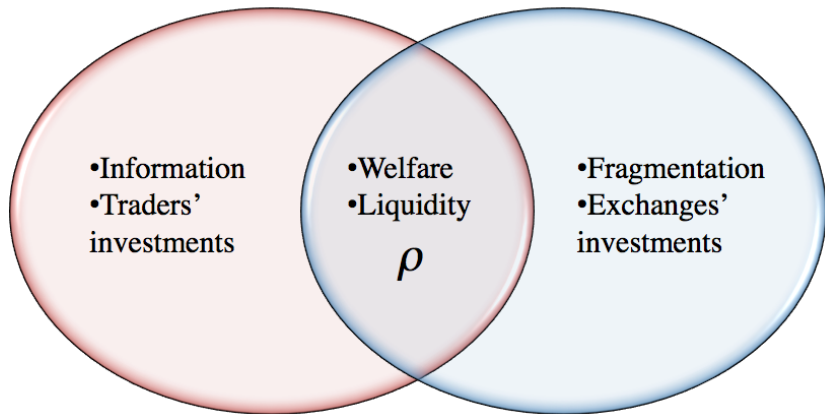
WE LIVE IN A FRAGMENTED WORLD



*Securities volume on electronic venues for week ending 16th Sep 2011

Biais, Foucault, Moinas

Pagnotta Philippon



MICRO FOUNDATIONS OF SPEED DEMAND

TRADING IN ONE MARKET (TIME 0 TO ∞)

- Two assets: cash (yields r), illiquid asset in fixed per-capita supply \bar{a} . Asset holdings a in $\{0, 1\}$
- Mass one continuum of investors enjoy flow utility

$$u_{\sigma, \epsilon_t}(a_t) = (\mu + \delta \epsilon_t) a_t$$

- ▶ time-varying type ϵ in $\{+, -\}$, times $\sim \exp(\gamma)$, $\Pr_{\{\epsilon=+\}} = 1/2$
- ▶ fixed type $\delta \in [0, \bar{\delta}]$ CDF G (can see as brokers' "clienteles")
- Trading
 - ▶ All trades intermediated by exchange (no agency with market makers), no limit orders
 - ▶ Contact rate (speed) is ρ
 - ▶ Conditional on contact market is Walrasian

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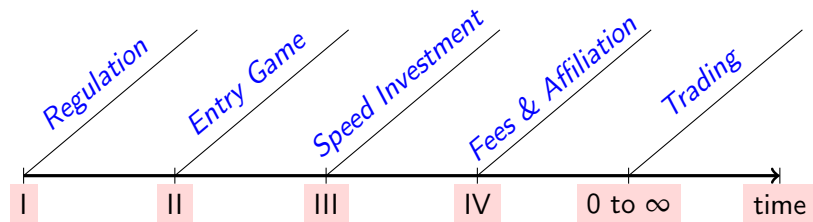
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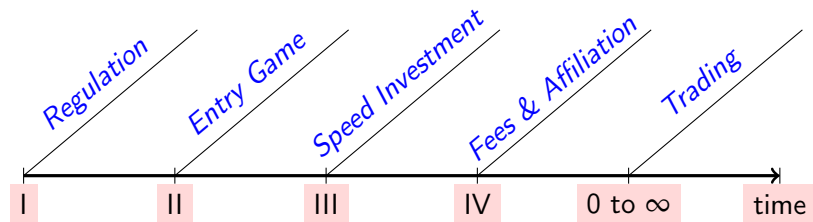
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ENDOGENOUS MARKET STRUCTURE



- Entry cost κ
- Marginal cost of speed c
- **EQUILIBRIUM**
 - ▶ Vertical differentiation: fast and slow market
 - ▶ Fast market chooses optimal co-location fee
 - ▶ Different liquidity levels \implies Different Prices

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SPEED, MARKETS, AND POLICY

- Entry: speed diff. breaks natural monopoly
 - ▶ Generally good, but risk of inefficient cost duplication
- Allocation efficiency: more gains from trade
 - ▶ Higher average liquidity in a fragmented market (as recent empirical studies find)
- Relaxes fee competition among markets
 - ▶ Room for taxes on speed even with perfect information (e.g. MiFID II revision)
- Different prices in fragmented markets
 - ▶ Room for investor protection: market-wide price priority. Good idea?

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REGULATION OF FRAGMENTED MARKETS

TABLE: Regulations and Investor Protection

Economic Area	Reg. Agency	Regulation	Year	Investor Protection Model
USA	SEC	Reg.NMS	2005	Trade-through (top of the book)
Europe	ESMA	MiFID*	2007	Principles-based
Japan	FSA, FIEA	FIEA	2007	Principles-based
Canada	IIROC, CSA	OPR	2011	Trade-through (full book)
South Korea	FSC	FSCMA**	2011	To be determined
Australia	ASIC	MIR	2011	Principles-based

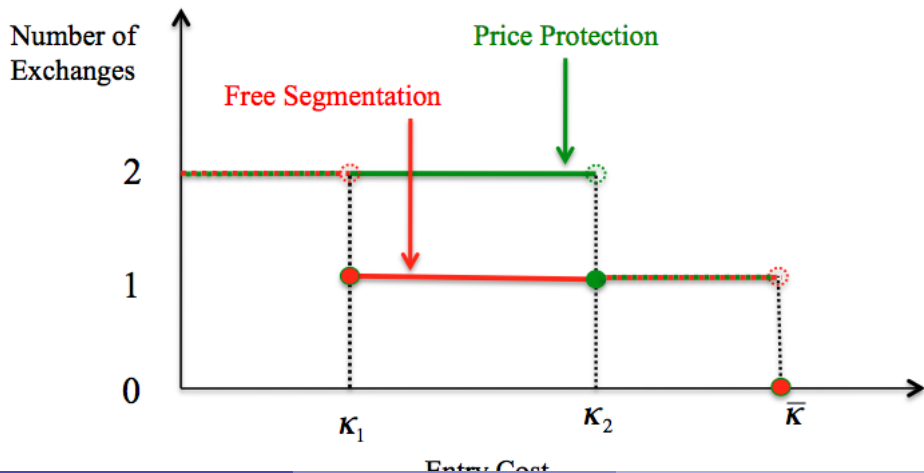
Source: www.fidessa.com

* Currently under revision

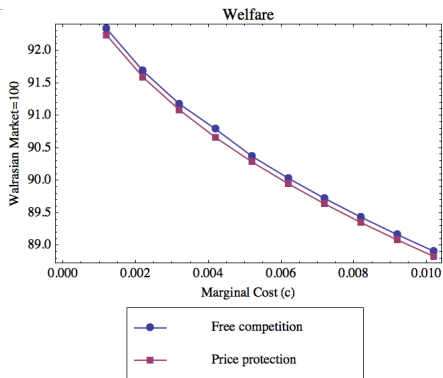
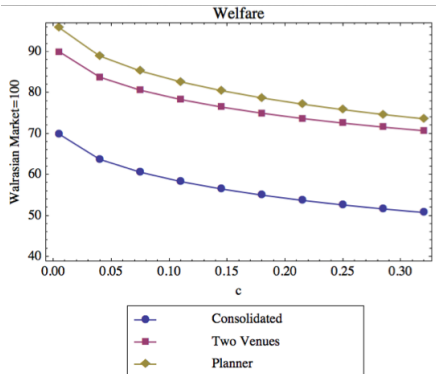
** Revision of 2009 version

PRICE PROTECTION AND WELFARE

- **Key result:** price protection works as a subsidy to low-speed exchange
⇒ Affects equilibrium fragmentation and allocation efficiency



PRICE PROTECTION AND WELFARE



FINAL REMARKS

- Neat parsimonious model of HFT! Integrates information and welfare
- Much needed given controversies around HFT
- Interesting extensions to explore: heterogeneous information, micro-founding search
- Results help understanding empirical findings
- Plenty of food for thought for regulators and policy makers