Information and High Frequency Trading

2008 North American Summer Meeting

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Motivation
The UHF Revolution

Fact (The UHF Revolution)

*Financial markets data sets at the transaction level available to scholars (TAQ, TORQ, Nyse Open Book, ECNs, Nastraq, London QMG, etc.*)
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- Most papers models assume exogenous arrivals, restrict order type decisions.
My research in a nutshell

*Link the main features of UHF financial data (including time spacing and order process) to rational economic decisions within an equilibrium structural model with asymmetrically informed traders (this talk)*
The market: Continuous time anonymous market for a single risky asset. Asset liquidation common value $v \in \{0, 1\}$, no dividends
The Setting
Market and Information Structure

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- **Participants**: dealers and ordinary traders

- **Information Structure**: single information epoch, random duration of info advantage. One trader observes realization of \( v \).
Example
Easley, O’Hara, Engle and Wu (2008)
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Easley, O’Hara, Engle and Wu (2008)
Contributions: New Framework (1)

Strategic Dimension

- Studying full scale dynamic decision problem of agents that
  - can trade motivated by some information advantage or for liquidity reasons.
  - can employ different trading instruments (order types) in designing their optimal trading strategies.
  - can actively monitor the market to implement optimal trading strategies in a continuous fashion.
  - can strategically choose when to submit orders.
  - understand their actions have consequences on market dynamics and depend upon the collective strategies of all other market participants.
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Concentrations: New Framework (1)
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Information and High Frequency Trading
E. Pagnotta Norhwestern University

Motivation
Contributions
The Model
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Conclusion
Contributions: New Framework (1)
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   5. understand their actions have consequences on market dynamics and depend upon the collective strategies of all other market participants.
Contributions: New Framework (2)
Market Microstructure Dimension
Contributions: New Framework (2)
Market Microstructure

Trading Venue

Dealers

Pure Dealers’ Market

Market Microstructure
Contributions: New Framework (2)
Market Microstructure

Trading Venue

Market Microstructure

Dealers

Limit Order Book

Pure Dealers’ Market

Pure Limit Order Market
Contributions: New Framework (2)
Integrate Market Designs

Trading Venue

Market Microstructure

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Hybrid
Contributions: New Framework (2)
Integrate Market Designs

- Compare different market design within single dynamic framework
Contributions: New Framework (2)
Integrate Market Designs

- Compare different market design within single dynamic framework
- Speed of price discovery.
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  - The speed of information transmission into prices is lowered in the version of the model that includes a limit order book.
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Integrate Market Designs

- Compare different market design within single dynamic framework
- Speed of price discovery.
  - The speed of information transmission into prices is lowered in the version of the model that includes a limit order book.
  - This suggests that a limit order market permits speculators to delay information revelation further.
The Model
Traders and Trading Venues

Liquidity Traders

Informed Trader
The Model

Traders and Trading Venues

Min Costs st Q.T.

Liquidity Traders

Liquidity Traders

Max Profits over Random Horizon

Informed Trader

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Equilibrium

- Traders order placing strategy follows a (controlled) multidimensional Markov doubly stochastic point process. Submission intensities: $x$ for the informed trader, $z$ for liquidity traders.

**Definition (Equilibrium)**

A set $(x, z, \beta)$ is a stationary MPE of the SDG if (i) Given $\beta$, and $z$, the informed trader strategy $x$ maximize his profits (ii) given $x$ and beliefs in $\beta$, $z$ achieves liquidity buyers and sellers quantitative targets at minimum cost. (iii) given traders’ strategies $x$ and $z$, beliefs in $\beta$ are determined by Bayes rule.
Equilibrium

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Results
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• Results
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- show (numerically) how optimal strategies are affected by market conditions and the market environment
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- show (numerically) how optimal strategies are affected by market conditions and the market environment
- Convergence of beliefs
- Characterize the joint distribution of order types, interarrival times, prices, quotes and trading volume.
Selected Results

Price Impact functions

**Motivation**

**Contributions**

**The Model**

**Selected Results**

**Conclusion**

![Graphs showing price impact functions for different scenarios.](image-url)
Selected Results
Endogenous informed liquidity provision

Motivation
Contributions
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Endogenous informed liquidity provision

- Behavior of the informed traders change in response to the dynamic adjustment of prices to information: they take (provide) liquidity when the value of their information is high (low).
- A marketmaking role emerges endogenously in the market (as in Bloomfield, O’Hara & Saar 2005)
Concluding Remarks

- Empirical work
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- Use the new structural framework as the building block to develop algorithms aimed at specific empirical applications
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  - How frequently do information events arrive to the market? How long are information asymmetries expected to last?
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   2. Which traders/group of traders are more likely to act motivated by private information?
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2. Stationary distribution of Microstructure noise (Realized Volatility, etc.)