

Introduction

What?
Theory
Empirics

Experimental
Microstructure

Our First Experiment
Experimental Results

Additional
Experiments

Search Only
Multiple Assets

The Future

Experimental Microstructure: A Retrospective

Christopher G. Lamoureux

November 7, 2008

Market Microstructure is the study of *how* transactions take place.

For example:

- ▶ Pre-1998, NASDAQ was a pure dealer market.
- ▶ Post regulations (c. 1998) NASDAQ now has open limit order book.
- ▶ New York Stock Exchange approximates a continuous double auction (guided by a specialist).
- ▶ New York Stock Exchange at open uses a Call Market.
- ▶ Alternative Mechanisms competing for order flow.
 - ▶ Dark Pools. (Fragmentation of Trade.)

Introduction

What?

Theory
Empirics

Experimental
Microstructure

Our First Experiment
Experimental Results

Additional
Experiments

Search Only
Multiple Assets

The Future

- ▶ Generally immediacy (liquidity) is priced: Bid-Ask Spread.
- ▶ Large Trades (Blocks) may move the price (price pressure).
- ▶ Delay exposes trader to price uncertainty.

Many interesting research questions:

- ▶ Normative: How, when, where to trade?
- ▶ Economics of Dealership (Provision of liquidity.)
- ▶ Policy / Regulatory Issues.
- ▶ Price Discovery / Market Efficiency.

Kyle Model

Introduction

What?

Theory

Empirics

Experimental
Microstructure

Our First Experiment
Experimental Results

Additional
Experiments

Search Only
Multiple Assets

The Future

- ▶ End of Period Asset value: $V \sim N(\bar{V}, \sigma^2)$ (Common Knowledge).
- ▶ Monopoly Informed Trader observes V at beginning of period.
- ▶ Competitive Dealers: Call Market.
- ▶ Milgrom-Stokey No-Trade Theorem solved by *liquidity traders*.
- ▶ Liquidity Order: $u \sim N(0, \sigma_u^2)$.

In equilibrium:

- ▶ Competitive Dealers break even on average – profiting from liquidity trades and losing to informed trades.
- ▶ Informed Trader maximizes profit by submitting order: x .
- ▶ $x(V) = \beta(V - \bar{V})$
- ▶ $\beta = \left(\frac{\sigma_u^2}{\sigma^2} \right)$.

Introduction

What?

Theory

Empirics

Experimental
Microstructure

Our First Experiment

Experimental Results

Additional
Experiments

Search Only

Multiple Assets

The Future

- ▶ Dealers set the market clearing price using a linear price adjustment rule (function of orders):
- ▶ $P(x + \mu) = \bar{V} + \lambda(x + u)$.
- ▶ $\lambda = \frac{1}{2\beta} = \left(\frac{\sigma^2}{2\sigma_u^2} \right)$.
- ▶ Market efficiency defined in terms of public information set.
- ▶ Market Depth: $\frac{1}{\lambda}$. Ratio of (Amount of noise trading) to (Amount of Private Information).
- ▶ Insider's Expected Profits:
 - ▶ Unconditionally: $E(\pi) = \frac{1}{2} \sqrt{(\sigma^2 \sigma_u^2)}$
 - ▶ Conditionally: $E(\pi|V) = (V - \bar{V} - \lambda x)x$

Introduction

What?

Theory

Empirics

Experimental
Microstructure

Our First Experiment
Experimental Results

Additional
Experiments

Search Only
Multiple Assets

The Future

Kyle extends this base case to sequential auction. The equilibrium is very similar to the base model. Monopoly informed trader trades patiently to extract maximum value from information. At the end of the period, the market price converges to the true value.

Note that there is no explicit bid-ask spread in the Kyle model, since it is a call market (i.e., order-driven). But, there is an implicit spread for any net order size from the price adjustment rule.

In equilibrium, informed traders profit from liquidity traders with dealers serving as a conduit.

Introduction

What?

Theory

Empirics

Experimental
Microstructure

Our First Experiment
Experimental Results

Additional
Experiments

Search Only
Multiple Assets

The Future

- ▶ NASDAQ vs. NYSE. Pre 1995 most analysts expected that NYSE was a dinosaur, and would be replaced by NASDAQ-like electronic dealer markets. But Christie and Schultz (1995) showed that NASDAQ dealers were colluding. Regulators required open limit order book.
- ▶ Decimalization in US markets. Move from $1/8$ to penny *ticks* starting in August 2000.
 - ▶ Significant reduction in bid-ask spreads.
 - ▶ Evidence of reduced market depth.
 - ▶ Dramatic reduction in number of dealers on NASDAQ.
 - ▶ Dealers profit no longer from buying low and selling high, but by frontrunning customer orders.

When It's Not the Only Game in Town

Introduction

What?

Theory

Empirics

Experimental
Microstructure

Our First Experiment

Experimental Results

Additional
Experiments

Search Only

Multiple Assets

The Future

The idea was to bring the Kyle framework to the lab.

Research question: If dealers cannot internalize the benefits from *price discovery*, will that be underproduced? Compare a setting where dealers have a monopoly franchise to one where traders can trade directly with one another. We need experienced subjects who understand the market.

Pure Dealer Market Setting:

- ▶ Three competing dealers.
- ▶ Single Asset: $V \sim N(100, 8.7^2)$ [70, 130].
- ▶ Four liquidity traders: [-5, . . ., -1, 1, . . ., 5].
- ▶ Penalty for missing liquidity shock: 100 per share.
- ▶ All three dealers must have active quote on both sides of market.
- ▶ All trades and quotes for 1 share.
- ▶ Market stops when quote accepted. All agents see trade (and history) on screen.

When It's Not the Only Game in Town -2-

Introduction

What?
Theory
Empirics

Experimental
Microstructure

Our First Experiment
Experimental Results

Additional
Experiments
Search Only
Multiple Assets

The Future

- ▶ Market reopens when all dealers enter new quotes.
- ▶ Market open for 120 seconds then arbitrary halt, followed by 120 second trading interval. (1 market period takes 18 minutes).

Pure Dealer with Search.

- ▶ Information, random environment and players identical to Pure Dealer Market.
- ▶ Play pure quote driven for 120 seconds.
- ▶ Quote market shuts down, and traders' screens shift to bilateral search mode.
- ▶ Dealers' screens inactive during search market.
- ▶ After 8 minute search period, quote driven market re-opens.
- ▶ Trader's have record of all trades in quote-driven plus all trades they were involved in in search.
- ▶ Play pure quote driven for 120 seconds.

Introduction

What?
Theory
Empirics

Experimental
Microstructure

Our First Experiment
Experimental Results

Additional
Experiments

Search Only
Multiple Assets

The Future

In the Search market:

- ▶ Communication is all bilateral. Whether you want to buy or sell and at what price.
- ▶ Offer to trade is good for 25 seconds or until modified.
- ▶ Traders' screen show all outstanding offers - both incoming and outgoing + trading history of that trader (including counterparties and who originated).

Introduction

What?
Theory
Empirics

Experimental
Microstructure

Our First Experiment
Experimental Results

Additional
Experiments

Search Only
Multiple Assets

The Future

First order effect: Large Dealer Profits in the Pure Dealer Setting.

Completely unexpected.

Dealer Profits roughly zero in Dealer-cum-Search Setting.

Price Discovery more efficient in Search setting.

Inference: “Many” dealers find collusive strategy when there is a monopoly franchise. Allowing traders to circumvent dealers breaks the collusion.

Experimental
Microstructure: A
Retrospective

Introduction

- What?
- Theory
- Empirics

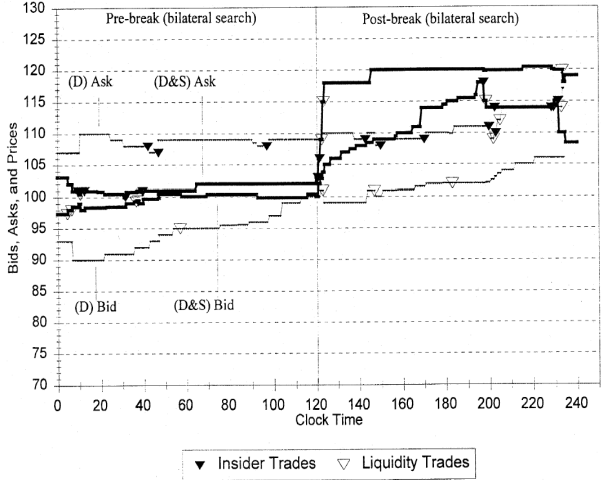
Experimental
Microstructure

- Our First Experiment
- Experimental Results**

Additional
Experiments

- Search Only
- Multiple Assets

The Future



Introduction

What?
Theory
Empirics

Experimental
Microstructure

Our First Experiment
Experimental Results

Additional
Experiments

Search Only
Multiple Assets

The Future

At the time of original experiment we also ran a pure Search market. It was identical to the previous settings. Dealers were allowed to participate in the markets and were designated to the counterparty as a dealer.

Outcome: Much harder for dealers to identify non-dominated strategies. Large dealer losses through first 5 Sessions (post training).

Problem: Experimental design not well-suited to study.

Introduction

What?
Theory
Empirics

Experimental
Microstructure

Our First Experiment
Experimental Results

Additional
Experiments

Search Only
Multiple Assets

The Future

In “Microstructure with Multiple Assets: An Experimental Investigation Into Direct and Indirect Dealer Competition,” (*Journal of Financial Markets* 2004), Schnitzlein and I extend the Pure Dealer Market to a multiple (3) asset setting. Here, liquidity traders see the 3 assets as perfect substitutes (ab initio).

Benefits to price discovery internalized.

Results:

- ▶ Bid-Ask spreads significantly lower in 3-asset case.
- ▶ Liquidity Traders better off in 3-asset case.
- ▶ Informed Traders indifferent.
- ▶ Prices more responsive to order flow in 3-asset case.

Introduction

What?
Theory
Empirics

Experimental
Microstructure

Our First Experiment
Experimental Results

Additional
Experiments

Search Only
Multiple Assets

The Future

In the three asset setting, we investigate choice determinants for the liquidity traders.

1. Spread Effect.
2. Inventory Effect (Weak).
3. Directional Effect. (If you have to buy, it is more likely that you will choose an asset whose price has moved down.)

Introduction

What?
Theory
Empirics

Experimental
Microstructure

Our First Experiment
Experimental Results

Additional
Experiments

Search Only
Multiple Assets

The Future

These microstructure experiments require careful control and monitoring of subjects. (Ex: No communication pre-play negotiations, etc.)

Costly. Subjects' pay: \$60 for 2-hour session. 8 - 12 subjects per session. 15 - 25 sessions.

Interesting if there could be simultaneous dealer market, limit order book, bilateral trade, and dark pools.

Learning effects and:

- ▶ Pure Search Markets. (And once subjects determine non-dominated strategies, what does equilibrium look like?)
- ▶ Collusive behavior.