

# MICHIGAN BUSINESS SCHOOL

## EMPIRICAL MARKET MICROSTRUCTURE -- Fin 891 Spring 2004

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### 1. Outline

This course is concerned with the workings of financial markets on the micro level. We study both the core theoretical models of trading processes, and the rich empirical literature that tests the proposed theories. While market microstructure theory is well developed (See, e. g., O'Hara (1995)), no single model is capable of capturing all the complex attributes of real-life securities markets. Therefore, it should not come as a surprise that a tremendous amount of work in the literature has been devoted to developing "stylized facts" from real markets. In fact, many of the theoretical models were developed to explain patterns in microstructure data that were observed by empiricists (e.g., Admati and Pfleiderer (1988)).

### 2. Course Materials

We will use materials from a course-outline that Prof. Maureen O'Hara, Cornell University, and I prepared for the Nasdaq Educational Foundation (NEF). These materials are available on my web-page at Ohio State:

Source: <http://fisher.osu.edu/fin/faculty/werner/courses.html>

We will also rely on an excellent set of teaching notes that Prof. Joel Hasbrouck, New York University, has made available to us free of charge. You may download the notes in .pdf format (about 200 pages) from Prof. Hasbrouck's web-site. The notes are also available in .html format (which among other things includes Mathematica code).

Hasbrouck, Joel, 2004, *Empirical Market Microstructure, Economic and Statistical Perspectives on the Dynamics of Trade in Securities Markets*, January 8.

Source: <http://www.stern.nyu.edu/~jhasbrou>

Finally, you should acquire the standard textbook for PhD level courses in the area:

O'Hara, Maureen, 1995, *Market Microstructure Theory*, Blackwell Publishers.

For those of you that are relatively unfamiliar with the institutional detail of securities markets and the securities industry, a good source for information is:

Harris, Larry, 2003, *Trading and Exchanges, Market Microstructure for Practitioners*, Oxford University Press.

### **3. Assignments**

Microstructure data is both rewarding and challenging to work with. The data sets are large in terms of the number of observations, but often small in terms of calendar time. They are “fresh” in that the first transactions data sets date from the early 1990s. At the same time, these datasets quickly become “stale” since market structures have an annoying tendency to change rapidly.

The only way to appreciate the challenges an empirical researcher in market microstructure faces is to actually do hands-on work with market microstructure data. Hence, we will use a number of empirical exercises based on data from different markets around the world during the course. These empirical exercises will require some SAS programming skills, and lots of patience in dealing with large data sets. Most of the problem sets and data that you need are available from my web-page (see above). There are also a few case studies included in Prof. Hasbrouck’s notes that we will use, and the data and code for these problems are available on his web-page (see above).

Laura Tuttle, one of my PhD students at OSU who has extensive experience working with microstructure data has kindly agreed to help us with the empirical exercises.

**Teaching Assistant:** Ms. Laura Tuttle  
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### **4. Schedule**

The course will be given in compressed format, and we will meet on the following dates and times:

Friday 3/19, 3:00-6:00pm in P2011  
Monday 3/22, 3:00-6:00pm in P2011  
Wednesday 3/24, 3:00-6:00pm in D1220  
Friday 3/26, 3:00-6:00pm in P2011  
Friday 4/2, 3:00-6:00pm in P2011  
Friday 4/9, 3:00-6:00pm in P2011

### **5. Examination**

The empirical assignments account for 75 percent of the course grade, and there will be a final take-home exam for the remaining 25 percent.

# EMPIRICAL MARKET MICROSTRUCTURE -- Fin 891

## SCHEDULE

Note, to prevent copy-right infringement, I have not linked this document to published articles. However, many of the readings are also listed in the microstructure readings on Prof. Hasbrouck's web-page, and he provides electronics links.

### I. Friday 3/19, 3:00-6:00pm

#### INTRODUCTION AND MARKET MICROSTRUCTURE DATA

Hasbrouck Notes, Chapter 1 and the Appendix.

O'Hara, Chapter 1.

#### *Survey Articles:*

Madhavan, A., 2000, Market Microstructure, *Journal of Financial Markets*, 205-258.

Goodhart, C., and M. O'Hara, 1998 "High Frequency Data in Financial Markets: Issues and Applications", *Journal of Empirical Finance*

#### *Institutional Descriptions:*

Hasbrouck, J., G. Sofianos, and D. Sosebee, 1993, [New York Stock Exchange Trading Systems and Procedures](#). Unpublished working paper. The New York Stock Exchange.

Lee, C., and M. Ready, 1991, Inferring Trade Direction from Intraday Data, *Journal of Finance*, 46, 733-746.

Smith, J., J. Selway, and T. McCormick, 1998, [The Nasdaq Stock Market: Historical Background and Current Operation](#). Unpublished working paper. Nasdaq working paper 98-01.

Nasdaq, 2004, [Summary of SuperMontage System](#), February.

Archipelago, 2004, [Order and Trade Processing](#), February.

INET, 2004, [How does INET work?](#) February.

[Euronext Organization and Procedures](#), 2002. Unpublished working paper. Euronext.

[Euronext Book I – Harmonised Market Rules](#), 2004, Unpublished working paper. Euronext.

Dupont, D. and B. Sack, 1999, [The Treasury Securities Market: Overview and Recent Developments](#), *Federal Reserve Bulletin*.

#### *Data:*

O'Hara, M., and I. Werner, 2003, [Empirical Problem Sets – Data Description](#).

[TAQ 2 User's Guide](#), New York Stock Exchange Inc.

Hasbrouck, J., 1992, [Using the TORQ Database](#), Working Paper (New York Stock Exchange).

[Nastraq - Nasdaq Trade and Quote Data](#).

[BDM – The Paris Bourse Data Base](#).

[London Stock Exchange \(QMG\) Data](#).

## II. Monday 3/22, 3:00-6:00pm

### MARKET MAKING AND INVENTORY CONTROL

Hasbrouck Notes, Chapter 10.

O'Hara, Chapter 2.

#### *Theory Papers:*

Amihud, Y., and H. Mendelson, 1980, Dealership Markets: Market Making with Inventory, *Journal of Financial Economics* 8, 31-53.

Biais, B., 1993, Price Formation and Equilibrium Liquidity in Fragmented and Centralized Markets, *Journal of Finance* 48, 157-185.

Garman, M., 1976, Market Microstructure, *Journal of Financial Economics* 3, 257-275.

Ho, T., and H. Stoll, 1981, Optimal Dealer Pricing Under Transactions and Return Uncertainty, *Journal of Financial Economics* 9, 47-73.

Ho, T., and H. Stoll, 1983, The Dynamics of Dealer Markets Under Competition, *Journal of Finance* 38, 1053-1074.

O'Hara, M., and G. Oldfield, 1986, The Microeconomics of Market Making, *Journal of Financial and Quantitative Analysis* 21, 361-376.

Stoll, H., 1976, Dealer Inventory Behavior: An Empirical Investigation of Nasdaq Stocks, *Journal of Financial and Quantitative Analysis* 11, 359-380.

#### *Empirical Papers:*

Bacidore, J. and G. Sofianos, 2002, Liquidity Provision and Specialist Trading in NYSE-Listed Non-U.S. Stocks, *Journal of Financial Economics* 63, 133-158.

Chakravarty, S., and L. Kai, 2003, An Examination of Own Account Trading by Dual Traders in Futures Markets, *Journal of Financial Economics* 69, 375-397.

Hansch, O., Naik, N. and S. Viswanathan, 1998, Do Inventories Matter in Dealership Markets? Evidence from the London Stock Exchange, *Journal of Finance* 1623-1656.

Hasbrouck, J., and G. Sofianos, 1993, The Trades of Market Makers: An Empirical Analysis of NYSE Specialists, *Journal of Finance* 48, 1565-1593.

Kavajecz, K., and E. Odders-White, 2001, An Examination of Changes in Specialists' Posted Price Schedules, *Review of Financial Studies* 14, 681-704.

Lyons, R., 1993 "Tests of Microstructure Hypotheses in the Foreign Exchange Market", *Journal of Financial Economics* 39, 321-351.

Madhavan, A., and S. Smidt, 1993, An Intraday Analysis of Daily Changes in Specialists' Inventories and Quotations, *Journal of Finance* 48, 1595-1628.

Manaster, S., and S. Mann, Life in the Pits: Competitive Market Making and Inventory Control, *Review of Financial Studies* 6, 1996, 953-975.

Naik, N., and P. Yadav, 2003, Do Dealer Firms Manage Inventory on a Stock-by-stock or a Portfolio Basis? *Journal of Financial Economics* 69, 325-353.

Reiss, P. and I. Werner, 1998, Does Risk Sharing Motivate Interdealer trading? *Journal of Finance* 53, 1657-1703.

### III. Wednesday 3/24, 3:00-6:00pm

#### ASYMMETRIC INFORMATION AND STRATEGIC TRADING

Hasbrouck Notes, Chapters 2-9.

O'Hara, Chapter 3 and Appendix on Bayesian Learning.

O'Hara Chapter 4 and Appendix on Rational Expectations.

O'Hara Chapter 5.

##### *Theory Papers:*

Admati, A., and P. Pfleiderer, 1988, A Theory of Intraday Patterns: Volume and Price Variability, *Review of Financial Studies* 1, 3-40.

Brock, W., and A. Kleidon, 1992, Periodic Market Closure and Trading Volume: A Model of Intraday Bids and Asks, *Journal of Economic Dynamics and Control* 16, 451-489.

Bagehot, W., [pseud.] 1971, The Only Game in Town, *Financial Analysts Journal* 27, 12-14.

Copeland, T., and D. Galai, 1983, Information Effects and the Bid-Ask Spread, *Journal of Finance* 38, 1457-1469.

Easley, D., and M. O'Hara, 1987, Price, Trade Size, and Information in Securities Markets, *Journal of Financial Economics* 19, 69-90.

Foster, D., and S. Viswanathan, 1990, A Theory of the Intraday Variations in Volume, Variance, and Trading Costs in Securities Markets, *Review of Financial Studies* 3, 593-624.

Glosten, L., and P. Milgrom, 1985, Bid, Ask, and Transaction Prices in a Specialist Market with Heterogeneously Informed Traders, *Journal of Financial Economics* 14, 71-100.

Kyle, A., 1985, Continuous Auctions and Insider Trading, *Econometrica* 53, 1315-1335.

Speigel, M., and A. Subrahmanyam, 1995, On Intraday Risk Premia, *Journal of Finance* 50, 319-339.

##### *Empirical Papers:*

###### *a. Transactions costs*

Bernhardt, D., E. Hughson, V. Dvoracek, and I. Werner, 2003, [Why Do Large Orders Receive Discounts on the London Stock Exchange?](#) Unpublished working paper. University of Illinois.

Bessembinder, H., 2003, [Issues in Assessing Trade Execution Costs](#), *Journal of Financial Markets*.

Huang, R., and H. Stoll, 1996, Dealer versus Auction Markets: A Paired Comparison of Execution Costs on NASDAQ and the NYSE, *Journal of Financial Economics* 41, 313-357.

Madhavan, A., and S. Smidt, 1991, A Bayesian Model of Intraday Specialist Pricing, *Journal of Financial Economics* 31, 99-134.

- Madhavan, A., Richardson, M., and M. Roomans, 1997, Why Do Security Prices Change? A Transaction-Level Analysis of NYSE Stocks, *Review of Financial Studies* 6, 345-374.
- Reiss, P., and I. Werner, 1996, Transaction Costs in a Dealer Market: Evidence from the London Stock Exchange, in A. Lo Ed. *The Industrial Organization and Regulation of the Securities Industry*, University of Chicago Press, 125-175.
- Werner, I., 2003, NYSE Spreads, Order Flow, and Information, *Journal of Financial Markets* 6, 309-335.

*b. Decomposing the spread*

- George, T., G. Kaul, and Nimalendran, 1991, Estimation of the Bid-Ask Spread and its Components: A New Approach, *Review of Financial Studies* 4, 623-656.
- Glosten, L., and L. Harris, 1988, Estimating the Components of the Bid-Ask Spread, *Journal of Financial Economics* 21, 123-142.
- Huang, R., and H. Stoll, 1997, The Components of the Bid-Ask Spread: A General Approach, *Review of Financial Studies* 10, 995-1034.
- Petersen, M., and D. Fialkowski, 1994, Posted versus Effective Spreads, *Journal of Financial Economics* 35, 269-292.
- Roll, R., 1984, A Simple Implicit Measure of the Effective Bid-Ask Spread in an Efficient Market, *Journal of Finance* 39, 1127-1139.
- Stoll, H., 1989, Inferring the Components of the Bid-Ask Spread: Theory and Empirical Tests, *Journal of Finance* 44, 115-134.

*c. Intraday patterns*

- Chan, KC, W. Christie, and P. Schultz, 1995, Market Structure and the Intraday Patterns of Bid-Ask Spreads for Nasdaq Securities, *Journal of Business* 68, 35-60.
- Foster, D., and S. Viswanathan, 1993, Variations in Trading Volume, Variance, and Trading Costs: Evidence on Recent Price Formation Models, *Journal of Finance* 48, 187-211.
- Jain, P. and G. Joh, 1988, The Dependence Between Hourly Prices and Trading Volume, *Journal of Financial and Quantitative Analysis* 23, 269-284.
- McInish, T., and R. Wood, 1992, An Analysis of Intraday Patterns in Bid/Ask Spreads for NYSE Stocks, *Journal of Finance* 47, 753-764.
- Werner, I., and A. Kleidon, 1996, UK and US Trading of British Cross-Listed Stocks: An Intraday Analysis of Market Integration, *Review of Financial Studies* 9, 619-664.

*e. Price Process*

- Chakravarty, S., 2001, Stealth Trading: Which Traders' Trades Move Prices? *Journal of Financial Economics* 61, 289-307.
- Hasbrouck, J., 1991a, Measuring the Information Content of Stock Trades, *Journal of Finance* 46, 179-207.
- Hasbrouck, J., 1991b, The Summary Informativeness of Stock Trades: An Econometric Analysis, *Review of Financial Studies* 4, 571-595.
- Hasbrouck, J., 1993, Assessing the Quality of a Security Market: A New Approach to Transaction-Cost Measurement, *Review of Financial Studies* 6, 191-212.

## IV. Friday 3/26, 3:00-6:00pm

### BLOCK TRADES AND INSTITUTIONAL TRADING COSTS

O'Hara, Chapter 8 (particularly 8.3)

#### *Selected Papers:*

- Bessembinder, H., and K. Venkatamaran, 2003, [Does An Electronic Stock Exchange Need and Upstairs Market?](#), forthcoming *Journal of Financial Economics*.
- Bollen, N., and J. Busse, 2003, [Common Cents? Tick Size, Trading Cots, and Mutual Fund Performance](#), Unpublished working paper, Vanderbilt University.
- Burdett, K., and M. O'Hara, 1987, Building Blocks: An Introduction to Block Trading, *Journal of Banking and Finance* 11, 193-212.
- Chan, L., and J. Lakonishok, 1997, Institutional Equity Trading Costs: NYSE versus Nasdaq, *Journal of Finance* 52, 713-735.
- Chakravarty, S., V. Panchapagesan, R. Wood, 2003, [Has Decimalization Hurt Institutional Investors?](#) Unpublished working paper. Purdue University.
- Chiyachantana, C., P. Jain, C. Jiang, and R. Wood, 2004, [International Evidence on Institutional Trading Behavior and Price Impact](#), forthcoming *Journal of Finance*, April.
- Conrad, J., K. Johnson, and S. Wahal, 2003, Institutional Trading Costs and Alternative Trading Systems, *Journal of Financial Economics* 70, 99-134
- Coughenour, J., and L Harris, 2003, [Specialist Profits and the Minimum Price Increment](#), Unpublished working paper, University of Delaware.
- Grossman, S., and M. Miller, 1988, Liquidity and Market Structure, *Journal of Finance* 43, 617-633.
- Jones, C., and M. Lipson, 2001, Sixteenths: Direct Evidence on Institutional Execution Costs, *Journal of Financial Economics* 59, 253-278.
- Madhavan, A., and M. Cheng, 1997, In Search of Liquidity: An Analysis of Upstairs and Downstairs Trades, *Review of Financial Studies* 10, 175-204.
- Saar, G., 2001, Price Impact Asymmetry of Block Trades: An Institutional Trading Explanation, *Review of Financial Studies* 14, 1153-1181.
- Seppi, D., 1990, Equilibrium Block Trading and Asymmetric Information, *Journal of Finance* 45, 73-94.
- Sofianos, G., and I. Werner, 2000, The Trades of NYSE Floor Brokers, *Journal of Financial Markets* 3, 139-176.
- Werner, I., 2003, [Execution Quality for Institutional Orders Routed to Nasdaq Dealers – Before and After Decimals](#), Dice Center Working Paper 2003-25, Ohio State University.

#### **Project I due.**

## V. Friday 4/2, 3:00-6:00pm

### LIMIT ORDER BOOKS AND ORDER SUBMISSION STRATEGIES

Hasbrouck Notes, Chapters 18-21.

O'Hara, Chapter 7.2.

#### *Theory Papers:*

- Angel, J., 1997, Limit versus Market Orders. Unpublished working paper. School of Business Administration, Georgetown University.
- Bertsimas, D., and A. Lo, 1998, Optimal Control of Execution Costs, *Journal of Financial Markets* 1, 1-50.
- Cohen, K., S. Maier, R. Schwartz, and D. Whitcomb, 1981, Transaction Costs, Order Placement Strategy, and Existence of the Bid-Ask Spread, *Journal of Political Economy* 89, 287-305.
- Easley, D., and M. O'Hara, 1991, Order Form and Information in Securities Markets, *Journal of Finance* 46, 905-927.
- Foucault, T., 1999, Order Flow Composition and Trading Costs in a Dynamic Limit Order Market, *Journal of Financial Markets* 2, 99-134.
- Foucault, T., O. Kadan, and E. Kandel, 2001, [Limit Order Book as a Market for Liquidity](#), Unpublished working paper. HEC School of Management.
- Glosten, L., 1994, Is the Electronic Limit Order Book Inevitable? *Journal of Finance* 49, 1127-1161.
- Goettler, R., C. Parlour, and C. Rajan, 2003, [Equilibrium in a Dynamic Limit Order Market](#), Unpublished working paper. GSIA, Carnegie Mellon University.
- Harris, L., 1998, Optimal Dynamic Order Submission Strategies in Some Stylized Trading Problems, *Financial Markets, Institutions & Instruments*, 7.
- Hollifield, B., R. Miller, and P. Sandas, 2003, [Empirical Analysis of Limit Order Markets](#), Unpublished working paper. GSIA, Carnegie Mellon University.
- Kumar, P., and D. Seppi, 1994, Limit Orders and Market Orders with Optimizing Traders, Working Paper, (Carnegie-Mellon University).
- Parlour, C., 1998, Price Dynamics in a Limit Order Market, *Review of Financial Studies* 11, 789-816.
- Parlour, C., and D. Seppi, 2003, Liquidity-Based Competition for Order Flow, *Review of Financial Studies* 16, 301-343.
- Rock, K., 1996, The Specialist's Order Book and Price Anomalies, *Review of Financial Studies* forthcoming.
- Seppi, D., 1997, Liquidity Provision with Limit Orders and A Strategic Specialist, *Review of Financial Studies* 10, 103-150.

*Empirical/Experimental Papers:*

- Battalio, R., J. Greene, B. Hatch, and R. Jennings, 2002, Does the Limit Order Routing Decision Matter? *Review of Financial Studies* 15, 159-194.
- Biais, B, Hillion, P., and C., Spatt, 1995, An Empirical Analysis of the Limit Order Book and the Order Flow in the Paris Bourse, *Journal of Finance* 50, 1655-1689.
- Bloomfield, R., M. O'Hara, and G. Saar, 2003, [The Make or Take Decision in an Electronic Market: Evidence on the Evolution of Liquidity](#), forthcoming *Journal of Financial Economics*.
- Harris, L., and J. Hasbrouck, 1996, Market vs. Limit Orders: The SuperDOT Evidence on Order Submission Strategies, *Journal of Financial and Quantitative Analysis* 31, 213-231.
- Hasbrouck, J., and G. Saar, 2001, [Limit Orders and Volatility in a Hybrid Market: The Island ECN](#), Unpublished working paper, New York University.
- Kavajecz, Kenneth A., 1998, A Specialist's Quoted Depth and the Limit Order Book, *Journal of Finance* 54, 747-771.
- Lo, A., C. MacKinlay, and J. Zhang, 2001, Econometric Models of Limit-Order Executions, *Journal of Financial Economics* 65, 31-71.
- Ranaldo, A., 2004, [Order Aggressiveness in Limit Order Markets](#), *Journal of Financial Markets* 7, 53-74.
- Sandas, P., 2001, Adverse Selection and Competitive Market Making: Empirical Evidence from a Limit Order Market, *Review of Financial Studies* 14, 705-734.

**Project II due.**

## VI. Friday 4/9, 3:00-6:00pm

### ESTIMATING STRUCTURAL MICROSTRUCTURE MODELS (PIN), MODELING IRREGULARLY SPACED DATA (ACD), LINKING MICROSTRUCTURE TO ASSET PRICING, EVENT STUDIES, ETC.

Hasbrouck Notes, Chapters 15-16, and Chapter 22.

#### *Selected Papers:*

- Amihud, Y., and H. Mendelson, 1986, Asset Pricing and The Bid-Ask Spread, *Journal of Financial Economics* 17, 223-249.
- Bessembinder, H., 2003, [Trade Execution Costs and Market Quality after Decimalization](#), forthcoming in the *Journal of Financial and Quantitative Analysis*.
- Boehmer, E., G. Saar, L. Yu, 2003, [Lifting the Veil: An Analysis of Pre-Trade Transparency at the NYSE](#). Unpublished working paper, Texas A&M.
- Brennan, M., and A. Subrahmanyam, 1998, Market Microstructure and Asset Pricing: On the Compensation for Illiquidity in Stock Returns, *Journal of Financial Economics* 41, 441-464.
- Chordia, T., R. Roll and A. Subrahmanyam, 2001, Market Liquidity and Trading Activity, *Journal of Finance*.
- Chordia, T., R. Roll, and A. Subrahmanyam, 2002, Order Imbalance, Liquidity and Market Returns, *Journal of Financial Economics* 65, 111-130.
- Easley, D., S. Hvidkjaer, and M. O'Hara, 2002, Is Information Risk a Determinant of Asset Returns? *Journal of Finance* 57, 2185-2221.
- Easley, D., N. Kiefer, and M. O'Hara, 1997, One Day in the Life of a Very Common Stock, *Review of Financial Studies* 10, 805-835.
- Easley, D., N. Kiefer, M. O'Hara, Paperman, 1996, Liquidity, Information and Less Frequently Traded Stocks, *Journal of Finance*, 51, 1405-1436.
- Engle, R. and J. Russell, 2003, Autoregressive Conditional Duration: A New Model for Irregularly Spaced Data, *Econometrica*, 66, 1127-1162.
- Harris, L., and Hasbrouck, J., 1999, Trading Fast and Trading Slow, Working Paper, NYU.
- Hendershott, T., and C. Jones, 2003, [Island Goes Dark: Transparency, Fragmentation, Liquidity Externalities, and Multimarket Regulation](#), Unpublished working paper, Columbia University.
- Korajczyk, R., and R. Sadka, 2004, [Are Momentum Profits Robust to Trading Costs?](#) forthcoming *Journal of Finance*, June.
- Pastor, L. and R. Stambaugh, 2002, [Liquidity Risk and Expected Stock Returns](#), working paper, Wharton School.

#### **Project III due.**