

Market Microstructure

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Course description

Like option pricing and fixed income, market microstructure has rapidly moved from the research domain of finance professors into the real world, where competition among exchanges, development of trading algorithms, and design of robust market systems all require combining the theory of market microstructure with an understanding of institutional detail of how financial markets work in practice. Liquidity, transaction costs, trading strategies, crashes, market design are topics of great interest to finance professors, market participants, policy makers, and sometimes even to the general public.

In the coming decade, market microstructure has potential to become one of the fastest growing fields of financial economics. All ingredients are indeed in place: Numerous topical questions still have no answers, while theorists are well equipped with game theoretic modeling tools for developing theories to answer those questions and empiricists have access to a vast amount of financial data to test those ideas.

This course uses a mixture of lectures and class discussion to examine various aspects of market microstructure. The course involves a mixture of finance and economics. The course will touch on numerous public policy issues, many of which are politically controversial and most of which are likely to continue to be important for years to come. A goal of the course is to provide students with a framework within which these public policy issues can be addressed in a useful manner.

Course requirements, grading, and attendance policies

The course grade will be based on the following: participation in class, regular homework assignments, in-class tests, and a final exam. Homework will be assigned every week.

Class participation: Class attendance and participation are required.

Homework assignments: Each week students have to read required material and submit a short write-up with their answers on the questions. Case write-ups should be succinct and self-contained. Long write-ups are not necessarily good write-ups. Good business writing makes points in a manner that respects the reader's time. Typically, the answers to questions will not be heavily mathematical, but mathematical intuition will often be required to address some of the questions. Write-ups should be uploaded onto mynes before the beginning of class, including the very first class. Students should be prepared to discuss and defend the ideas in their write-ups in class. For some questions, there is no "right" or "wrong" answer, in the sense that finance

and economics professors themselves are likely to disagree about the answers to the questions. Students may talk to other students about the assigned questions, but each student should

prepare a write-up individually, without looking at the write-ups of other students. Each student should list on the write-up the names of the other students with whom the student discussed the write-up.

In-class Tests: At the beginning of each lecture (except the very first one), there will be short 10-minute tests with one question about material of the previous lecture. A goal of these in-class tests is to help students not to fall behind on the material and to keep track of attendance.

Presentations: If you want to get extra credit, there are several opportunities for short 15-min presentations about market microstructure of Russian financial markets. Presentations can be made either by a student or a group of students. The possible topics are “Moscow Exchange” and “Central Bank as a mega-regulator”. Please let me know in case you are interested.

Final Exam: A final exam is in-class and closed-book. One double-sided cheat-sheet is allowed.

Grading: Grading will be based on case write-ups (25%), in-class tests (15%), class discussion (10%), and a final exam (50%). Missing class is strongly discouraged. Case write-ups are graded on a scale with the following interpretation: 10 = A + +, 9 = A+, 8 = A, 7 = A-, 6 = B+, 5 = B, 4 = B-, 3 = C, 2 = D, 1 = F, 0 = missing. Most grades are in the range 5 ; 6; 7; 8. Extra credit is added with extra points. For example, a grade of 6.0 + 0.5 = 6.5 indicates a score of 6 for assigned questions plus 0.5 points for extra credit questions.

Academic integrity policy

Cheating, plagiarism, and any other violations of academic ethics at NES are not tolerated.

Course materials

There is no textbook for the course, but these two books are good references for those interested in market microstructure:

Larry Harris. *Trading and Exchanges: Market Microstructure for Practitioners*. Oxford University Press, USA, 2002. This book contains a wealth of institutional details, descriptions of issues, and discussion of microstructure at the level of an advanced layman.

Thierry Foucault, Marco Pagano, and Ailsa Roell. *Market Liquidity: Theory, Evidence, and Policy*. Oxford University Press, 2013. This book is a good graduate level textbook. It is not necessary for the course to have it, but students can find discussions of most topics in this course.

Below are topics and questions that we will discuss in class. I reserve the right to change the syllabus as the course progresses.

The schedule of classes follows. “Required readings” should be completed before class. Students should come to class prepared to discuss required readings. “Optional readings” are materials students may want to read before class or after class, but they are not required. They may be the subject of class discussion, but the discussion should presume that not all students have read them. The “bedtime readings” are completely optional and include books students may want to read in the future, after the course is finished. They are included for general interest.

WEEK 1 (TUESDAY, MARCH 7): MARKET MAKING. ORGANIZED EXCHANGES. MODELING BID-ASK SPREAD AND PRICE IMPACT.

REQUIRED READING:

Jack Treynor. The only game in town. *Financial Analysts Journal*, 51(1):81–83, 1995. Reprint of W. Bagehot. The only game in town. *Financial Analysts Journal*, 27(2):12–22, 1971. Treynor used pseudonym Walter Bagehot in original version. Walter Bagehot is the author of *Walter Bagehot. Lombard Street: a description of the money market. Project Gutenberg Etext, 1878.*

Fischer Black. Noise. *The Journal of Finance*, 41(3):529–543, 1986.

Albert S. Kyle. Continuous auctions and insider trading. *Econometrica*, 53(6):1315–1335, 1985. (This is a difficult paper; take a look only at the first two sections.)

OPTIONAL READING:

Christie, W. G. and Schultz, P. H., Why do NASDAQ Market Makers Avoid Odd-Eighth Quotes? *The Journal of Finance*, 49: 1813–1840, 1994.

Bernanke, Ben, Clearing and Settlement during the Crash, 1990, *The Review of Financial Studies* 3 (1): 133-151, 1990.

Holden Craig, Stacey Jacobsen, and Avinadhar Subrahmanyam, The Empirical Analysis of Liquidity, *Working Paper*, 2014.

Questions for Write-Up (2 pages):

1. What explanations do the required readings provide why there is so much of trading?
2. How does Jack Treynor explain where bid-ask spread comes from?
3. How does Pete Kyle explain where market depth comes from?
4. According to Fisher Black, what is a good measure of market efficiency?
5. How do you expect the volatility of oil prices (or other assets) to change when many speculators decide to enter the market where it trades?
6. Suppose a large trader breaks a block into small pieces and executes the pieces over time? Would this inject a predictable trend into prices such that it might be profitable to trade against this trend?
7. If you knew the otherwise undisclosed positions of profitable hedge funds, could you make money using this information? If so, how?
8. If you knew the undisclosed inventory of market makers, could you make money on the basis of this information? If so, how?

WEEK 2 (TUESDAY, MARCH 21): EQUITIES AND FUTURES MARKETS. HIGH-FREQUENCY TRADING. FLASH CRASH ON 6 MAY 2010

REQUIRED READING:

Lawrence Harris, What to do about high-frequency trading? *Financial Analysts Journal*. 2013

Report of the staffs of the CFTC and SEC to the Joint Advisory Committee on Emerging Regulatory Issues, Findings Regarding the Markets Events of May 6, 2010, September 30, 2010

CFTC complaint, Sarao case, April 17 2015, with Appendix

OPTIONAL READING:

Andrei A. Kirilenko, Albert S. Kyle, Mehrdad Samadi, and Tuzun, Tugkan, The Flash Crash: the impact of high frequency trading on an electronic market, *Working Paper*, 2014.

Eric Budish, Peter Cramton, and John Shim, The high-frequency trading arms race: Frequent batch auctions as a market design response, *Working Paper*, 2013.

Andersen Torben and Oleg Bondarenko, VPIN and flash crash, *Journal of Financial Markets*, 2014.

Andersen Torben and Oleg Bondarenko, Reflecting on the VPIN dispute, *Research letter*, 2014.

CFTC Response to Allegations Pertaining to the Office of Chief Economist, February 2014.

Andrew Verstein, Revolution in manipulation law: The new CFTC rules and the urgent need for economic and empirical analysis, 2013.

CFTC Complaint, Igor Oystacher case, 19 October 2015

Questions for Write-Up (2 pages):

1. According to the CFTC, did high frequency traders create the Flash crash on May 6, 2010?
2. According to the regulators, does high-frequency trading destabilize financial markets and make them more volatile?
3. In your opinion, which of the markets, the U.S. E-mini futures market or the U.S. equity market, functioned better during the events of May 2010? What was the main reason?
4. The report regarding the market events of May 6, 2010 was the combination of the separate work done the staffs at the CFTC and the SEC. Which of them did a more professional analysis?
5. According to Larry Harris, what is the most harmful in high-frequency trading and how to deal with that issue?
6. Would high-frequency traders prefer to trade in markets with high or low tick size?
7. Would Sarao agree with CFTC charges? List his arguments.

WEEK 3 (TUESDAY, APRIL 4): TRANSACTION COSTS. INVARIANCE. PUBLIC POLICY ISSUES

REQUIRED READING:

Mark Kritzman, Kyle, Albert S., and Anna A. Obizhaeva, A practitioner's guide for market microstructure invariance, 2014 (explanation of invariance for practitioners)

Andre F. Perold. Shortfall: Paper versus reality. *Journal of Portfolio Management*, 14(3): 4-9,

1988. Ananth Madhavan. VWAP Strategies. 2002.

Angel, James, Lawrence Harris, Chester Spatt, Equity trading in the 21st century. 2010

OPTIONAL READING:

Kyle, Albert S. and Anna A. Obizhaeva, Dimensional analysis and market microstructure invariance, October 2015 (explanation of invariance for physicists)

Kyle, Albert S. and Anna A. Obizhaeva, 2016, Market microstructure invariance: Empirical hypotheses, *Econometrica*, 84(4), 1345-1404. (This is a difficult academic paper but take a look at it to get an idea of what type of research I do)

Questions for Write-Up (2 pages):

1. According to market microstructure invariance, what is a bet? Is it the same as a trade, or transaction, or an order?
2. According to invariance, if one compares transaction costs for liquid and illiquid securities, would the dollar costs of executing the average bet be the same across markets? Would the percentage costs of executing the average bet be the same?
3. According to invariance, what is a good measure of liquidity?
4. According to Angel, Harris and Spatt (2010), bid-ask spreads decreased a lot over the last twenty years (see page 8). What is the main reason?
5. Calculate "implementation shortfall" for the following scenario: At 10:00 a.m., the stock price is \$40.00 and you decide to buy 100,000 shares. During the next six hours, you purchase 80,000 shares at an average price of \$40.50. At 4:00 p.m., the market closes at a price of \$43.00 and you cancel the unexecuted balance of 20,000 shares.
6. Calculate implementation shortfall for the following modified scenario: At 10:00 a.m., the stock price is \$40.00 and you decide to buy 60,000 shares. You think you might buy some more, but you are not sure how much more. At noon, you have already bought 60,000 shares at an average price of \$40.25; the current stock price is \$41.00; you increase the size of your desired purchases for the day from 60,000 shares to 100,000 shares. Over the course of the rest of the day, you buy 20,000 additional shares at an average price of \$41.25. At the 4:00 p.m. close, the price is \$43.00, and you cancel the unexecuted balance.
7. Would Fischer Black like the idea of a VWAP order? Are VWAP orders a good idea? Can a dishonest agent exploit a naive customer who places a VWAP order?
8. What would you expect the relationship between transactions costs and alpha to be for a very successful hedge fund with modestly scalable trading strategy?

WEEK 4 (TUESDAY, APRIL 18): FICC MARKETS. RUBLE CRASH IN DECEMBER 2014. PAST AND FUTURE MARKET CRASHES.

REQUIRED READING:

Kyle, Albert S. and Anna A. Obizhaeva, “Large bets and stock market crashes”. *Working paper*. 2014.

Анна Обижаева, Анализ событий на российском валютном рынке 15-16 декабря 2014 года
CFTC, SEC, Treasury, Joint Staff Report on the U.S. Treasury Market on October 15,

2014 Bank of England, Fair and Effective Markets Review, June 2013

OPTIONAL READING:

Larry Harris, Albert S. Kyle, Erik Sirri, FAJ, 2015, The structure of trading in bonds market. Anna Obizhaeva, A little note on Chinese market crash of 2015

Tugkan Tuzun, “Are leveraged and inverse ETFs the new portfolio insurers?”, *Working paper*. 2014.

Video:

Roundtable on banking and financial markets, July 13, 2015:

www.c-span.org/video/?327066-1/roundtable-banking-financial-markets

Questions for Write-Up (2 pages):

1. What are FICC markets?
2. Based on Bank of England’s Review, what are common themes in recent FICC misconduct cases?
3. Compare the report on the flash crash in U.S. Treasuries market on October 15, 2014 with the report on the flash crash on May 6, 2010. Which of the two reports is better? Which recommendations are stronger?
4. What evidence does the report present to back up its assertion that the U.S. Treasury market is the “deepest and most liquid government securities market in the world,” e.g., more liquid than the government securities markets of the U.K., China, Japan, or Germany?
5. Why do the Report writers believe that a circuit breaker which triggers during extremely rapid price movements mitigate activity or price movements which may not accurately reflect fundamental forces of supply and demand?
6. According to Obizhaeva, could expectations of a large bet have caused a crash in USDRUB market?