MARKET MICROSTRUCTURE PHD COURSE
APPENDIX TO UTS COURSE OUTLINE

UTS Course code 25885; Part of the FIRN National PhD Program

COURSE COORDINATOR AND INSTRUCTOR

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COURSE DATES AND LOCATION

Module 1: 4–5 August, 2017
Module 2: 8–9 September, 2017
Module 3: 20–21 October, 2017

Location for all modules:
UTS Business School (Dr Chau Chak Wing Building), 14–28 Ultimo Rd, Ultimo, Sydney NSW
Room: Level 3, room 3.001 (Computer room)

COURSE DESCRIPTION

This course provides a rigorous overview of the field of market microstructure. It covers microstructure theory, the current state of practice in market design/regulation, and empirical models/methods used in microstructure research.

The microstructure theory covered in the course includes the classic models of the trading under information asymmetry, describing the interaction of different types of traders, the nature of adverse selection in financial markets, the effects of inventory management by liquidity providers, the causes of variation in liquidity, and the process by which information becomes reflected in prices.

The empirical market microstructure models and metrics covered in the course are organised into the two categories: (i) liquidity, including spreads, depth, price impact, and implementation shortfall; and (ii) price discovery, including high-frequency measures of informational efficiency, measures of the information content of individual trades or orders, and models to quantify contributions to price discovery from multiple prices.

The course also covers market design and how it affects the functioning of markets. This includes topical issues such as fragmentation of markets, dark trading, and algorithmic/high-frequency trading. The course places market microstructure in the broader context of finance by reviewing how market microstructure impacts on asset pricing and corporate finance.

The course places an emphasis on preparing students to conduct empirical market microstructure research. This is achieved through a set of practical tasks woven in throughout the course, starting with collection of market microstructure data, cleaning and preparing the data, estimating a range of market microstructure models and metrics using the SAS statistical software package, interpreting the results of the models/metrics, and finally applying the empirical tools to analysis of market microstructure research questions. The course allows students to learn by doing.

The course is structured around three intensive weekends of face-to-face instruction, involving a mix of lectures/discussions and practical sessions in a computer laboratory. Students are expected to complete pre-reading before each weekend and will have practical tasks to work on between weekends. The face-to-face sessions are supplemented by a collection of online materials including screencasts of the empirical exercises so that students can revise the covered materials at their own pace. At the end of the course students will undertake a small microstructure research project, which will draw together the knowledge and skills gained during the course.

COURSE OBJECTIVES

The course aims to prepare students for undertaking empirical market microstructure research. By the end of the course, students should be able to:

(i) identify good market microstructure research questions, including those stemming from recent developments in financial market structure;

(ii) design and execute empirical analysis, including sourcing and processing microstructure data and estimating microstructure models/metrics;

(iii) interpret results using theory and place them in the context of existing literature; and

(iv) discuss market design and how it influences outcomes, as well as how market microstructure interacts with other areas of finance, such as asset pricing and corporate finance.

PRE-REQUISITES

Knowledge of the SAS statistical software package is required. Students will not be able to learn SAS during the course. Students that wish to take the course and do not have working proficiency in SAS are advised to learn SAS before taking the course.[1] Without a sufficient working knowledge of SAS students will not be able to keep up with the empirical parts of the course and will not maximise their learning outcomes.

Statistics and econometrics at an advanced undergraduate level are also assumed knowledge.

[1] The SAS website has a number of tutorials and self-paced online learning resources. Some Universities and research centres offer short courses in SAS. There are a number of books that teach SAS.

COURSE CONTENT AND SCHEDULE

MODULE 1: Market design, microstructure theory, working with microstructure data
MODULE 2: Liquidity, and interactions between microstructure and asset pricing / corporate finance
MODULE 3: Price discovery, informational efficiency, and current issues in market microstructure

Below, compulsory readings are underlined, others are suggested readings and reference material.

MODULE 1: Market design, microstructure theory, working with microstructure data

Friday	Activity	Pre-reading and references
09:00 – 10:30	Introduction to course Lecture/Discussion 1 – Market design	Foucault, Pagano, and Röell (2013, Chapter 1 "Trading mechanisms and market structure") De Jong and Rindi (2009, Chapter 1 "Institutions and market structure") Hasbrouck (2007, Chapter 2 "Trading mechanisms") Madhavan (2000)
10:30 – 11:00	Coffee	
11:00 – 12:30	Lecture/Discussion 1 – Market design Preview of current issues in market microstructure	Pirrong (2014)
12:30 – 13:30	Lunch	
13:30 – 15:00	Lecture/Discussion 2 – Working with large datasets and processing market microstructure data	Course Notes for Empirical Work (Module 1) Boehmer, Broussard, and Kallunki (2002) Fraeman (2008)
15:00 – 15:30	Coffee	
15:30 – 17:00	Practical Task 1 – Sourcing market microstructure data	

Saturday		
09:00 – 10:30	Lecture/Discussion 3 – Market microstructure theory models (inventory control models, sequential trade models with adverse selection, batch auction models with adverse selection)	De Jong and Rindi (2009, Chapters 2–5) Foucault et al. (2013, Chapters 3–4) Hasbrouck (2007, Chapter 5 "Sequential trade models", Chapter 7 "Strategic trade models", Chapter 11 "Dealers and their inventories")

		O'Hara (1995) Brunnermeier (2003) Glosten and Milgrom (1985) Kyle (1985) Glosten and Putnins (2017)
10:30 – 11:00	Coffee	
11:00 – 12:30	Lecture/Discussion 3 – Market microstructure theory models (inventory control models, sequential trade models with adverse selection, batch auction models with adverse selection)	
12:30 – 13:30	Lunch	
13:30 – 15:00	Practical Task 2 – Processing market microstructure data	Lee and Ready (1991)

Homework 1: Obtaining and processing microstructure data (Revision Task 1) – details provided in class; due before the start of Module 2

Homework 2: Market microstructure theory model extension (Theory Task 1) – details provided in class; due during Module 2

MODULE 2: Liquidity and interactions between microstructure and asset pricing/corporate finance

Friday		
09:00 – 10:30	Lecture/Discussion 4 – Liquidity (spreads)	Goyenko, Holden, and Trzcinka (2009) Holden, Jacobsen, and Subrahmanyam (2013) Foucault et al. (2013, Chapter 2 "Measuring liquidity")
10:30 – 11:00	Coffee	
11:00 – 12:30	Lecture/Discussion 4 – Liquidity (depth, the limit order book, resiliency and price impact)	
12:30 – 13:30	Lunch	
13:30 – 15:00	Presentations of Homework 2	
15:00 – 15:30	Coffee	
15:30 – 17:00	Practical Task 3 – Estimate spreads Practical Task 4 – Estimate depth and the slope of the limit order book	Course Notes for Empirical Work (Module 2)

Saturday		
09:00 – 10:30	Lecture/Discussion 5 – Market microstructure and asset pricing	De Jong and Rindi (2009, Chapter 7 "Liquidity and asset pricing") Anthonisz and Putnins (2017) Easley and O'Hara (2003) Foucault et al. (2013, Chapter 9 "Liquidity and asset prices")
10:30 – 11:00	Coffee	
11:00 – 12:30	Lecture/Discussion 6 – Market microstructure and corporate finance	Amihud and Mendelson (2008) Holden et al. (2013) Foucault et al. (2013, Chapter 10 "Liquidity, price discovery and corporate policies")
12:30 – 13:30	Lunch	
13:30 – 15:00	Practical Task 5 – Estimate high- and low-frequency price impact measures	Fong, Holden, and Trzcinka (2017) Course Notes for Empirical Work (Module 2)

Homework 3: Liquidity estimation (Revision Task 2) – details provided in class; due before the start of Module 3

Homework 4: Research proposal (Research Task 1) – details provided in class; due during Module 3

MODULE 3: Price discovery and current issues in market microstructure

Friday		
09:00 – 10:30	Lecture/Discussion 7 – Price discovery, informational efficiency and information content of order flow	Hasbrouck (1991) Rösch, Subrahmanyam, and van Dijk (2017)
10:30 – 11:00	Coffee	
11:00 – 12:30	Practical Task 6 – Estimate high-frequency informational efficiency metrics	Course Notes for Empirical Work (Module 3) Lo and MacKinlay (1988) Hendershott and Jones (2005) Hou and Moskowitz (2005) Anderson, Eom, Hahn, and Park (2013) Comerton-Forde and Putnins (2015)

12:30 – 13:30	Lunch	
13:30 – 15:00	Presentations of research proposals (Homework 4)	
15:00 – 15:30	Coffee	
15:30 – 17:00	Practical Task 7 – Estimate information content of order flow	Course Notes for Empirical Work (Module 3) Hasbrouck (1991) Putnins and Michayluk (2015)

Saturday		
09:00 – 10:30	Lecture/Discussion 8 – Current issues in market microstructure: fragmentation, transparency, and automation/high-frequency trading	***Overviews and regulation:*** Pirrong (2014) Fox, Glosten, and Rauterberg (2015) Mahoney and Rauterberg (2017) ***Algorithmic trading and HFT:*** Menkveld (2016) Jones (2013) Hendershott, Jones, and Menkveld (2011) Menkveld (2014) Putnins and Barbara (2017) ***Dark trading:*** Foucault et al. (2013, Chapter 8 "Market transparency") Hendershott and Jones (2005) Zhu (2014) Foley and Putnins (2016) ***Fragmentation:*** Foucault et al. (2013, Chapter 7 "Market fragmentation") Gomber et al. (2017) Haslag and Ringgenberg (2017) O'Hara and Ye (2011)
	Lecture/Discussion 9 – Measuring	Putnins (2013)

	contributions to price discovery	Baillie, Booth, Tse, and Zabotina (2002)
10:30 – 11:00	Coffee	
11:00 – 12:30	Practical Task 8 – Estimate price discovery shares	Course Notes for Empirical Work (Module 3)
12:30 – 13:30	Lunch	
13:30 – 15:00	Lecture/Discussion 10 – Combining all estimated metrics to answer a microstructure research question; discussion of course assignment	Petersen (2009) Thompson (2011)

Homework 5: Price discovery estimation (Revision Task 3) – details provided in class; due two weeks after the end of Module 3

Homework 6: Research assignment (Research Task 2) – details provided in class; due five weeks after the end of Module 3

ASSESSMENT

Exercises throughout the course	50%
Practical assignment due five weeks after the course (and the Homeworks)	50%

TEXTS AND READINGS

There are many references below. However, as noted above, to make the reading manageable, only some are compulsory and the rest are there for students that want to dig deeper into a given topic, see some recent applications in a given topic, or find a classic reference. The readings below are a mix of the best and most up-to-date textbooks in microstructure, survey articles and chapters in edited books, and journal articles. The compulsory readings (underlined in the schedule above) are often the textbook chapters and survey articles as they cover a lot of ground in an efficient and approachable manner, however, some of the journal articles (which tend to be narrower) are also compulsory to provide exposure to the way market microstructure papers are written.

Books

Boehmer, E., J.P. Broussard, and J.P. Kallunki, 2002, *Using SAS in Financial Research* (SAS Institute, Cary).

Brunnermeier, M.K., 2003, *Asset Pricing Under Information Asymmetry* (Oxford University Press, Oxford).

De Jong, F., and B. Rindi, 2009, *The Microstructure of Financial Markets* (Cambridge University Press, New York).

Foucault, T., M. Pagano, and A. Röell, 2013. *Market Liquidity: Theory, Evidence, and Policy* (Oxford University Press, Oxford).

Hasbrouck, J., 2007, *Empirical Market Microstructure* (Oxford University Press, New York).

O'Hara, M., 1995, *Market Microstructure Theory* (Blackwell Publishers, Cambridge).

Articles/chapters

Amihud, Y., and H. Mendelson, 2008, Liquidity, the value of the firm, and corporate finance, *Journal of Applied Corporate Finance* 20, 32–45.

Anderson, R.M., K.S. Eom, S.B. Hahn, and J.-H. Park, 2013, Autocorrelation and partial price adjustment, *Journal of Empirical Finance* 24, 78–93.

Anthonisz, S., and T.J. Putnins, 2017, Asset pricing with downside liquidity risks, *Management Science* (forthcoming).

Baillie, R.T., G.G. Booth, G., Y. Tse, and T. Zabotina, 2002, Price discovery and common factor models, *Journal of Financial Markets* 5, 309–321.

Comerton-Forde, C., and T.J. Putnins, 2015, Dark trading and price discovery, *Journal of Financial Economics* 118, 70–92.

Easley D., and M. O'Hara, 2003, Microstructure and asset pricing, in Constantinides, G., M. Harris, and R. Stulz, (eds) *Handbook of the Economics of Finance: Volume 1B* (Elsevier, Amsterdam).

Foley, S., and T.J. Putnins, 2016, Should we be afraid of the dark? Dark trading and market quality, *Journal of Financial Economics* 122, 456–481.

Fong, K., C. Holden, and C. Trzcinka, 2017, What are the best liquidity proxies for global research?, *Review of Finance* 2017, 1–47.

Fox, M.B., L.R. Glosten, and G.V. Rauterberg, 2015, The new stock market: Sense and nonsense, *Duke Law Journal* 65, 191–277.

Fraeman, K., 2008, Common sense tips and clever tricks for programming with extremely large SAS data sets, Working paper.

Glosten, L.R., and P.R. Milgrom, 1985, Bid, ask, and transaction prices in a specialist market with heterogeneously informed traders, *Journal of Financial Economics* 14, 71–100.

Glosten, L.R., and T.J. Putnins, 2017, Welfare costs of informed trade, Working paper.

Goyenko, R.Y., C.W. Holden, and C.A. Trzcinka, 2009, Do liquidity measures measure liquidity?, *Journal of Financial Economics* 92, 153–181.

Hasbrouck, J., 1991, Measuring the information content of stock trades, *Journal of Finance* 46, 179–207.

Haslag, P., and M.C. Ringgenberg, 2017, The causal impact of market fragmentation on liquidity, Working paper.

Hendershott, T., and C.J. Jones, 2005, Island goes dark: Transparency, fragmentation, and regulation, *Review of Financial Studies* 18, 743–793.

Hendershott, T., C.M. Jones, and A.J. Menkveld, 2011, Does algorithmic trading improve liquidity?, *Journal of Finance* 66, 1–33.

Holden, C.W., S. Jacobsen, and A. Subrahmanyam, 2013, The empirical analysis of liquidity, *Foundations and Trends in Finance* 8, 263–365.

Hou, K., and T.J. Moskowitz, 2005, Market frictions, price delay, and the cross-section of expected returns, *Review of Financial Studies* 18, 981–1020.

Jones, C.M., 2013, What do we know about high-frequency trading?, Working paper.

Kyle, A., 1985, Continuous auctions and insider trading, *Econometrica* 53, 1315–1335.

Lee, C.M.C., and M.J. Ready, 1991, Inferring trade direction from intraday data, *Journal of Finance* 46, 733–746.

Lo, A., and C. MacKinlay, 1988, Stock market prices do not follow random walks: Evidence from a simple specification test, *Review of Financial Studies* 1, 41–66.

Mahoney, P.G., and G. Rauterberg, 2017, The regulation of trading markets: A survey and evaluation, *Virginia Law and Economics Research Paper* No. 2017-07.

Madhavan, A., 2000, Market microstructure: A survey, *Journal of Financial Markets* 3, 205–258.

Menkveld, A., 2014, High frequency traders and market structure, *Financial Review* 49, 333–344.

Menkveld, A.J., 2016, The economics of high-frequency trading: Taking stock, *Annual Review of Financial Economics* 8, 1–24.

O'Hara, M., and M. Ye, 2011, Is market fragmentation harming market quality?, *Journal of Financial Economics* 100, 459–474.

Petersen, M.A., 2009, Estimating standard errors in finance panel data sets: Comparing approaches, *Review of Financial Studies* 22, 435–480.

Pirrong, C., 2014, Pick your poison—Fragmentation or market power? An analysis of RegNMS, high frequency trading, and securities market structure, *Journal of Applied Corporate Finance* 26, 8–14.

Putnins, T.J., 2013, What do price discovery metrics really measure?, *Journal of Empirical Finance* 13, 3–33.

Putnins, T.J., and J. Barbara, 2017, Heterogeneity in the effects of algorithmic and high-frequency traders on institutional transaction costs, Working paper.

Putnins, T.J., and D. Michayluk, 2015, Liquidity provision in limit order markets, Working paper.

Rösch, D.M., A. Subrahmanyam, and M.A. van Dijk, 2017, The dynamics of market efficiency, *Review of Financial Studies* 30, 1151–1187.

Thompson, S.B., 2011, Simple formulas for standard errors that cluster by both firm and time, *Journal of Financial Economics* 99, 1–10.

Zhu, H., 2014, Do dark pools harm price discovery?, *Review of Financial Studies* 27, 747–789.