

Written Exam for the M.Sc. in Economics summer 2014

Financial Markets

Final Exam

June 13, 2014 at 10.00 until June 15, 2014 at 10.00

This exam question consists of 5 pages in total

Please note that the language used in your exam paper must correspond to the language of the title for which you registered during exam registration. I.e. if you registered for the English title of the course, you must write your exam paper in English. Likewise, if you registered for the Danish title of the course or if you registered for the English title which was followed by “eksamen på dansk” in brackets, you must write your exam paper in Danish.

If you are in doubt about which title you registered for, please see the print of your exam registration from the students’ self-service system.

The paper must be uploaded as one PDF document (including the standard cover and the appendices). The PDF document must be named with exam number only (e.g. ‘1234.pdf’) and uploaded to Absalon.

Focus on Exam Cheating

In case of presumed exam cheating, which is observed by either the examination registration of the respective study programmes, the invigilation or the course lecturer, the Head of Studies will make a preliminary inquiry into the matter, requesting a statement from the course lecturer and possibly the invigilation, too. Furthermore, the Head of Studies will interview the student. If the Head of Studies finds that there are reasonable grounds to suspect exam cheating, the issue will be reported to the Rector. In the course of the study and during examinations, the student is expected to conform to the rules and regulations governing academic integrity. Academic dishonesty includes falsification, plagiarism, failure to disclose information, and any other kind of misrepresentation of the student’s own performance and results or assisting another student herewith. For example failure to indicate sources in written assignments is regarded as failure to disclose information. Attempts to cheat at examinations are dealt with in the same manner as exam cheating which has been carried through. In case of exam cheating, the following sanctions may be imposed by the Rector:

- 1. A warning
- 2. Expulsion from the examination
- 3. Suspension from the University for at limited period or permanent expulsion.

Please answer all 3 problems and all sub-questions below.

Problem 1:

(a) On page 183, the textbook notes in passing that “Intuitively, non-anonymous trading can mitigate informational asymmetries by helping dealers to tell apart informed and uninformed traders (see Chapter 8 for further discussion).” With reference to Chapter 8, please explain and discuss this intuition.

(b) On page 256, the textbook states that “trading can concentrate in market B even though liquidity traders with discretion would trade more cheaply if they all reconvened in market A ... this translates into a powerful barrier to entry.” Please give the context for this statement, and explain the intuition behind it.

(c) On page 394 of Dupont and Lee (2007), they state the following about a securities transaction tax: “Introducing such a tax could even lead to an increase in the depth while the gross-of-tax selling price could remain constant, increase as much as the tax, or increase much more.” Intuitively explain and discuss this claim.

Problem 2:

This problem reconsiders the limit order book model of Section 6.2 in the textbook. We will examine the quoted spread predicted by this model, and will therefore study both bid and ask prices.

We assume that there is no risk, so the final value of the traded asset is $v = \mu$ where $\mu \in \mathbb{R}$ is known.

Suppose that there is no price tick for limit orders, i.e., let $\Delta = 0$.

The timing of trade is as in Figure 6.2 of the textbook. In period 0, short-lived limit orders are placed by risk-neutral, competitive traders. There is cost $C > 0$ to displaying a limit order. These traders have no scope for trading with each other: if we let A^* denote the lowest ask price, and B^* the highest bid price, then $B^* \leq A^*$.

In period 1, a random net market order of size q arrives and executes against the limit

orders. If $q > 0$, it executes against the ask side of the limited order book, if $q < 0$ against the bid side. Suppose that q follows an exogenously given continuous distribution on the real line with cumulative probability distribution function F . Thus, $F(Q)$ is the probability that $q \leq Q$. Denote $P = 1 - F$, then $P(Q)$ is the probability that $q \geq Q$.

In period 2, payoffs are realized.

(a) Consider first the ask side of the book. Let $Y \geq 0$ denote the cumulative depth at ask price A , i.e., the total number of assets offered for sale at price A or less. Explain why we get, like the textbook's (6.7), that

$$A = \mu + \frac{C}{P(Y)}. \quad (1)$$

(b) Consider now the bid side. We use the convention that $Y \leq 0$ denotes the cumulative depth at bid price B , such that $|Y|$ is the total number of assets that limit order traders have offered to purchase at price B or higher. Explain why

$$B = \mu - \frac{C}{F(Y)}. \quad (2)$$

(c) An arriving order of numerical size $|q|$ may be seen to increase the price by $A - \mu$ when $Y = q \geq 0$ or to decrease the price by $\mu - B$ when $Y = q \leq 0$. Let us define that $A - B$ is the quoted spread, $QS(|q|)$ for an order of numerical size $|q|$. Using (a) and (b), derive that

$$QS(|q|) = \frac{C}{1 - F(|q|)} + \frac{C}{F(-|q|)}. \quad (3)$$

Show also that the inner spread, defined as $IS = QS(0) = A^* - B^*$, satisfies

$$IS = \frac{C}{F(0)[1 - F(0)]}. \quad (4)$$

(d) The number $F(0) \in \mathbb{R}$ is exogenously given. Interpret this number. Argue that the minimal possible inner spread is $4C$, when minimizing over all possible values for $F(0)$. Also argue, that there is no upper bound to the inner spread, when considering possible values for $F(0)$.

(e) Suppose that the distribution F is symmetric in the following fashion: for any q , we have $P(|q|) = F(-|q|)$. Interpret this assumption. Show under this assumption that the quoted spread is $2C/F(-|q|)$, and that the inner spread is $4C$.

(f) Continue to assume that F is symmetric. Find the function F for which $QS(|q|) = 4C + 2\lambda|q|$ for any $\lambda > 0$.

(g) Explain the difference between our linear expression for $QS(|q|)$ from (f) and the textbook's linear expression (2.8) for the price impact.

Problem 3:

Below is an article from the Financial Times on April 14, 2014. Please write a short essay discussing to which extent the course readings can relate to the issue of this text. In particular, consider the role of high-frequency trade and of early access to order information. If you wish to elaborate your answer beyond the syllabus, you are welcome to seek more information about this on the internet.

“Lawsuit claims CME gives HFTs unfair advantage. By Neil Munshi in Chicago.

A group of traders has sued CME Group, operator of the world's largest derivatives exchange, for allegedly selling market data to high frequency traders earlier than to other market participants.

The traders allege that the Chicago-based company has perpetuated a “fraud on the marketplace” since 2007 by allowing high-frequency traders, who use sophisticated computer algorithms to shave fractions of a second off trading times, early access to buy and sell orders. Such practices changed prices for all other participants, the complaint alleges. CME has denied any wrongdoing.

The plaintiffs — William Braman and two other traders — are seeking class-action status and say they paid for real-time market data even as CME allowed HFT groups to trade on early non-public data, according to the complaint filed on Friday in a federal court in Chicago. CME ‘concealed the fact that they were not providing a marketplace free of market manipulation because they allowed HFTs to trade based upon non-public information’, the complaint alleges.

In a statement, CME said the suit was ‘devoid of any facts supporting the allegations’ and ‘demonstrates a fundamental misunderstanding of how our markets operate’. ‘The case is without merit, and we intend to defend ourselves vigorously,’ the exchange operator said.

The lawsuit comes amid an intensifying public debate over the merits of high-speed trading, fuelled by the recent publication of author Michael Lewis' latest book, *Flash Boys*. Earlier this month, New York's attorney-general announced a probe into US stock exchanges to determine whether they provide services to HFTs that give them unfair advantages in the marketplace. Critics allege that such groups are favoured by exchanges and wreak havoc on market stability, while proponents of high-speed trading argue that the groups provide much needed liquidity to markets.

Virtu, a top HFT group, delayed its high-profile listing earlier this month amid the furore and the attention that has been given to revelations in its initial public offering filing that it has had just one losing trading day over the past five years.

This is not the first time CME has been sued for allegedly favouring electronic traders. Last month an Illinois judge ruled in favour of the exchange against floor traders who had sued CME to overturn rules that factor in electronic trades to settle end-of-day grain futures prices. The traders had said the rules were forcing many of them out of business.”