

Written Exam for the M.Sc. in Economics Summer 2015

Financial Markets

Final Exam

June 13, 2015 at 10.00 until June 15, 2015 at 10.00

This exam question consists of 8 pages in total (including the instructions)

Notice on the next page the information about the maximum length of the exam paper.

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 and 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.

Maximum length of exam paper: The maximum size of the exam paper is **15** standard pages. Front page(s), table of contents and list of literature, if any, are not included when the number of pages is counted. A standard page is a page with a 12 pitch-font, all margins set to 2.5 cm and line spacing set to 1.5 cm. The students are welcome to use word processing packages like Scientific Workplace or a kind of Tex in which such a formatting is not natural. The student is then required to ensure that the formal requirements are met. Any tables, charts and footnotes etc. are considered part of the standard page and, consequently, form part of the total number of pages in the paper. If the requirement regarding the maximum number of pages is not adhered to, then the exam paper will be rejected and counted as one exam attempt. Each student writes his/ her own exam paper. Exam papers written by two or more students are not accepted.

Please answer all 3 questions and subquestions below.

Problem 1

- (a). In Kyle's dealer model (lecture 5) we obtained a price function $p = \mu + \lambda q$, which implies that the spread goes to zero as q goes to zero. In Glosten's model of the limit order book (lecture 7), this is not the case: the spread is strictly positive even for very small order sizes. Explain intuitively this difference.
- (b). The textbook notes on page 263 that fragmentation causes the limit order book to be deeper at each tick. Discuss the intuition behind this result, relating it to time priority versus price priority. I.e. why would there be no effect of fragmentation if the tick size were nil?
- (c). On slide 25 of the slides for lecture 10¹ we observe that a 'crowding out' equilibrium exists in the fast trading model of Biais, Foucault and Moinas (2011). In the paper, the authors explain that "(The equilibrium) P3 generates "crowding out" since slow institutions are sidelined and only fast institutions trade. Hence only a small fraction of the potential gains from trade can be reaped. Unfortunately, such equilibria can be pervasive." Explain intuitively how crowding out can be an equilibrium when there are potential gains from trade, and discuss whether this is realistic.

¹Notice that the slides and the handout are the same for lecture 10, therefore there is only one file uploaded in Absalon.

Problem 2

We consider an extension of the Glosten-Milgrom model that allows us to analyze speculation. In particular, we will allow for resale, but to maintain tractability we do so in a specific way.

To be concrete, suppose that we are in a Glosten-Milgrom setting where an asset has an unknown value: $v = -1$ or $v = 1$, with equal probability. There are three types of traders: informed traders (type I) know v and act as risk-neutral profit maximizers; uninformed rational traders (type U) do not know v and act as risk-neutral profit maximizers; noise traders (type N) buy and sell the asset with equal probability.

The game has two periods. To simplify matters, we assume that there are three cases:

- **Case A:** In the first period a type- I trader arrives and in the second a type- N trader. This case occurs with probability α .
- **Case B:** In the first period and second period the same type- U trader trades. This occurs with probability β .
- **Case C:** In the first period a type- N trader arrives and in the second period a different type- N trader arrives. This occurs with probability $1 - \alpha - \beta$.

Nature draws a case at the beginning of the game.² The case is known to the traders. For instance, in case **B** the trader knows that he is a type- U trader and that he will trade in both periods.

A risk-neutral market maker sets competitive (zero-profit) ask and bid prices in each period t , denoted a_t and b_t , respectively. In contrast to the traders, he does not observe which case has been drawn, and thus does not know the type of the traders he is facing. Finally, assume that in case **B**, the type- U traders do not own any units of the asset at the beginning of period 1, and they cannot go short – i.e. sell an asset they do not have.

We want to analyze whether in case **B** the uninformed trader would ever have an incentive to speculate, i.e. to buy in period 1 with a view to selling in period 2, in spite of his lack of information about the asset's value.

²The cases can be interpreted as follows: in case **A**, a rational informed trader arrives and trades based on his information. Since he will have no reason to trade again in the model, he exits the market place and any further trade is noise trade. In case **B**, an uninformed trader enters. If he trades, it must be for speculative reasons since he has no information. Therefore, he must trade again in order to make a profit. In case **C**, we have pure noise trade.

- (a). Argue that in case **A**, a type-*I* trader with $v = 1$ will always buy in period 1 in equilibrium, whereas a trader who saw $v = -1$ will never buy.
- (b). We start with period 1. Let us find the ask price. Notice that the expected asset value conditional on case **B** or **C** is zero, whereas conditional on case **A** it is 1 (viz. discussion in (a)), so³

$$\begin{aligned} a_1 &= \mathbb{E}[v|buy_1] \\ &= \mathbb{P}(\mathbf{A}|buy_1) \cdot (1) + \mathbb{P}(\mathbf{B}, \mathbf{C}|buy_1) \cdot (0). \end{aligned}$$

Bayes' Rule yields

$$\mathbb{P}(\mathbf{A}|buy_1) = \frac{\alpha \mathbb{P}(buy_1|\mathbf{A})}{\alpha \mathbb{P}(buy_1|\mathbf{A}) + \beta \mathbb{P}(buy_1|\mathbf{B}) + (1 - \alpha - \beta) \mathbb{P}(buy_1|\mathbf{C})}.$$

Assume that *U* types always buy in case **B**: $\mathbb{P}(buy_1|\mathbf{B}) = 1$. Using the above results, show that

$$a_1 = \frac{\alpha}{1 + \beta}.$$

- (c). Now we move to period 2. Suppose that in case **B** the *U* type always sells the asset: $\mathbb{P}(sell_2|\mathbf{B}) = 1$. Let us find b_2 conditional on a buy in period 1, and denote this $b_2|_{buy}$. We know from our previous analysis that it is impossible that a *I* type with $v = -1$ would have bought in period 1. So $b_2|_{buy} = \mathbb{P}(\mathbf{A}|buy_1, sell_2) \cdot (1) + \mathbb{P}(\mathbf{B}, \mathbf{C}|buy_1, sell_2) \cdot (0)$. Show that

$$b_2|_{buy} = \frac{\alpha}{1 + 3\beta}.$$

- (d). In case **B**, the *U*-type trader has no information about fundamentals, but he has private information in the sense that he knows his own type. Can he use this to make a profit? I.e. given a_1 and $b_2|_{buy}$, would he ever speculate in buying the asset in period 1 and selling it in period 2? Explain the intuition for this.
- (e). Given your answer to the previous point, what will be the *equilibrium* behavior of the traders, and the *equilibrium* prices $(a_1, b_2|_{buy})$ of the model?
- (f). Suppose now we introduce some noise into the model in the form of a public signal in period 2. Denote this signal by z . We make the following assumptions. In case **A**, the

³Here, buy_1 denotes a buy in period 1.

signal is fully informative: $z = v$. In case **B**, the signal is pure noise: $z = 1$ or $z = -1$ with equal probability and z is independent of v . In case **C**, there is no signal.⁴

Now a_1 and b_1 are the same as before. But period-2 prices will depend not just on the period-1 order, but also on the realization of the signal. Argue that $\mathbb{P}(\mathbf{C}|z = 1) = \mathbb{P}(\mathbf{C}|z = -1) = 0$. Suppose that in case **B** the type- U trader buys in period 1 and sells in period 2. Calculate the period-2 bid price conditional on a buy in period 1 and $z = 1$: $b_2|_{buy, z=1}$. Argue that $b_2|_{buy, z=-1} = 0$.

- (g). Finally, show that for certain parameter values α and β , it will be profitable for U types to speculate in case **B**: i.e. to buy in period 1 and sell in period 2. What is it that permits them to speculate now?

(Hint. You must calculate the expected bid price in period 2.)

Problem 3

Below is an article from the Financial Times on February 15, 2015. Please write a short essay discussing to which extent the course readings can relate to the issue of this text. In particular, consider the theories exposed in lecture 13, but feel free to include theories from other parts of the course (for instance the part on liquidity and asset prices). You are also welcome to elaborate your answer beyond the syllabus.

“A decade ago, the market for EM (emerging markets) hard currency corporate bonds hardly existed. Today, it is bigger than the US high-yield corporate bond market, an asset class familiar to investors for decades, and more than four times the size of Europe’s high-yield bond market.

What has driven such extraordinary growth? In just a few years before the global financial crisis of 2008-09, emerging markets won over the world’s investors. In 2001, Goldman Sachs identified the Bric economies – Brazil, Russia, India and China – as the new engines of global growth. Chinese demand drove a commodity boom that helped billions of people rise out of poverty and into the consuming classes.

⁴You may think of this as the signal taking some third value, e.g. $z = \emptyset$.

But with Brazil's economy imploding, China slowing and dark shadows over markets from Venezuela to Russia and Ukraine, some analysts worry that the party has gone on too long.

Stuart Oakley, global head of EM foreign exchange trading at Nomura in London, points to how easily things could go wrong. "It is entirely possible that we could see a default by a big, emerging market commodity exporting corporate," he says.

"In that scenario you would get people redeeming money from big EM asset managers, bids for the bonds from banks would dry up, there would be sharp price drops on those and all associated assets and a sell-off across this or another asset class."

Fears of a rout

One source of danger is that the EM corporate bond market, pumped up by years of often indiscriminate buying, is still being engorged by a search for yield among global investors. It is also showing alarming signs of distress at a time when the ability of the financial system to handle trades between buyers and sellers is much reduced, increasing the risk that any sudden exit could quickly turn into a disorderly rout.

(...)

As noted recently by Zoltan Pozsar, a former senior adviser at the US Treasury, while the yield on the benchmark US Treasury bond has fallen from 6 per cent in 2000 to less than 2 per cent today, the returns sought by many US public pension funds have barely changed at about 8 per cent. Other big institutional investors also have imperatives that are hard to satisfy by investing in what are usually seen as safe assets.

The result is known as "forced buying" – asset managers buying assets outside their usual area of expertise because they have to put their clients' cash to work somewhere.

(...)

This has led to a process that Sergio Trigo Paz, head of EM debt at BlackRock, calls shut your eyes and buy. Many crossover investors, who are new and often far from committed to emerging markets, have driven up the price of some bonds even as risks have become more apparent.

(...)

Flight to quality

The greater danger is that investors start to leave the asset class altogether. That could be triggered by a default, but also by a much lesser event. If a bond falls sharply in price, any investor who has borrowed money to buy it – as hedge funds habitually do – will have to sell

others to make up the loss. Such waves of selling can spread quickly, not only to other bonds but also to other asset classes.

(...)

Quantitative easing has pumped up the primary markets but, since the financial crisis, regulatory and other changes have caused a drought of liquidity on secondary markets. Investment banks that used to hold large inventories of bonds on their books can no longer do so. Analysts at UBS say the volume of assets held by banks is half the level of five years ago, while the volume of assets held by investors is four times what it was.

“When there are bouts of buying there are no sellers and when there are bouts of selling there are no buyers,” says Mr Spiegel. “It creates the perfect environment for distressed markets to get worse. This is the year of negative feedback loops.”

(...)

“Last year,” he says, “everything that could go wrong, did go wrong. China slowed down, commodity prices fell, we had QE (quantitative easing) tapering, the Ukraine crisis, Brazil blowing up – and the return on EM corporate bonds was 5 per cent. It is a very well diversified market.”

Nevertheless, others worry that the growth of the EM corporate asset class is a clear example of a bubble, one that is being blown up by the apparently unending tide of QE.

“The point of QE is to inflate the real economy,” says Mr Oakley at Nomura. “But instead of driving growth it is creating asset bubbles. The danger is that it will drive bubbles until they burst.” (...)