Written Exam Economics Summer 2016

Financial Markets

Date: June 28 at 10am to June 30 at 10am

This exam question consists of 10 pages in total

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 <u>one PDF document</u>. The PDF document must be named with exam number only (e.g. '1234.pdf') and uploaded to Digital Exam.

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.

The Faculty of Social Sciences
The Study and Examination Office
October 2006

Maximum length of exam paper: The maximum size of the exam paper is **12** 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.

Problem 1

(a). Shiller famously argued in 1981 that there was *excess volatility* in stock prices in the sense that they moved too much to be justified by subsequent changes in dividends (fundamentals). Discuss this claim in the context of what you have learned in the course. For instance, should price changes necessarily be followed by equivalent dividend changes if the market were efficient? You can answer this question using models seen in the course, but you are welcome to bring in alternative explanations.

(b). Consider the following sequence of orders.

(1). A limit sell order of 300 units at price 3.6.

(2). A limit sell order of 100 units at price 3.5.

(3). A limit buy order of 200 units at price 3.6.

(4). A limit sell order of 500 units at price 3.7.

(5). A limit buy order of 400 units at price 3.65.

(6). A market buy order of 200 units.

(7). A limit buy order of 400 units at price 3.5.

(8). A market sell order of 400 units.

We now investigate the execution of these orders under two different assumptions about the market structure.

(i). First, suppose that the market is a **continuous limit order book**, where orders are cleared sequentially in the manner described in chapter 1.2.1 of the textbook, pages 18 to 21.[1] Describe at each step in the sequence what happens with the incoming order: does it enter the book and if so on which side, or does it execute, and if so, how many units at what price. Find the total number of units traded.

(ii). Second, suppose instead that the market is cleared through a call auction, as described in chapter 1.2.1 of the textbook, pages 21 to 23. Find the market-clearing price and the number of units traded.

[1] In particular, suppose that orders are filled according to time preference (not pro-rata), that limit orders which are partially marketable will execute the marketable part and enter the remaining amount in the limit order book, and that market orders that can be only partially filled execute against the available amount.

(iii). Use the results from (i) and (ii) to compare the number of units traded in each auction, and discuss their efficiency properties. Is one better than the other? Why?

(c). We have noted on several occasions that traders may not receive information at the same time. Suppose we are in a setting with 2 periods where one trader arrives in each period. There are three cases: (i) both traders are noise traders, (ii) both traders are informed and each trader observes an independent signal,[2] or (iii) both traders are informed, but one trader is a *fast trader* and the other is a *slow trader*, who both observe the same piece of private information, but the fast trader gets to trade before the slow trader.[3] The market maker cannot distinguish between these three settings.

Write up a model of this in the style of the Glosten-Milgrom model. Without solving the model, answer the following: Compared to a standard model where we are either in case (i) or (ii), but never in case (iii), how do you think prices will be different? That is to say, what is the effect of potentially having traders who trade at different times with the same information?

[2]In particular, suppose each trader i observes a signal s_i that is informative but imperfectly correlated with the asset value, but that s_1 and s_2 are drawn independently, conditional on the true value of the asset.

[3]Notice that the difference to case (ii) is that the traders observe the same signal.

Problem 2

In this exercise, we consider a model of the Glosten-Milgrom type, but we add the possibility of trading either one or two units each period.

Suppose there is a single asset with value

$$V \in \{v^H, v^L\},$$

where $\mathbb{P}(V = v^H) = \alpha$. Let $\overline{v} = \alpha v^H + (1-\alpha)v_L$. Market makers do not know the true value, but it is observed by traders. There is a single trader who is either a *rational* trader, with probability $\pi > 0$, or a *noise* trader, with probability $1 - \pi$.

- If the trader is rational, he maximizes his expected payoff (risk neutral).
- If he is a noise trader, with probability β he trades one unit, and with probability $1 - \beta$ he trades two units. In either case, he buys or sells with probability $\frac{1}{2}$ each.

The market maker is competitive and makes zero expected profits. He sets ask prices $a(1)$ and $a(2)$ for the cases where one and two units are bought, respectively, and similarly bid prices $b(1)$ and $b(2)$. Suppose that $a(k)$ is the per-unit price for k units, such that the price of buying one unit is $1 \cdot a(1)$ and the price of buying two units is $2 \cdot a(2)$, and similarly for $b(k)$. Finally, assume that the rational trader always buys when he observes $V = v^H$ and sells when he observes $V = v^L$.

(a). Suppose first that the rational trader always trades two units. What is $a(1)$ and $b(1)$?

(b). Suppose still that the rational trader always trades two units. What is $a(2)$ and $b(2)$?

(c). Given the prices you have derived in (a) and (b), show a condition for when it is optimal for the rational trader to trade two units. Comment on your result: why is it always/not always optimal to trade two units?

(If you can not show the result generally, try substituting a specific value for (α, β, π) and see what happens.)

(d). Now suppose that $\alpha = 1/2$. Show that for certain values of π it is also possible to have an equilibrium in mixed strategies where the rational trader sometimes trades one unit and sometimes two units. You can focus on the ask side for this question, i.e. you need

to show the existence of ask prices $a(1)$ and $a(2)$, as well as a mixed buying strategy for the rational trader, that form an equilibrium. Find the probability σ with which the trader buys two units in equilibrium.

(e). Consider now a two-period model, $t = 1, 2$, where the two periods can be thought of as trading in the morning and in the afternoon on the same day. Suppose that at the beginning of the day, with probability $\gamma > 0$ there is an information event, and $V = -1$ or $V = 1$ with equal probability. With probability $1 - \gamma$ there is no information event, and $V = 0$. If there is an information event, then in each period, with probability π a rational trader, who knows V, arrives. With probability $1 - \pi$ a noise trader arrives. The noise trader behaves as in (a)-(d), i.e. he buys/sells with equal probability, and trades one/two units with probability $\beta/1 - \beta$. If there is no event, the trader is a noise trader in both periods.

The market maker sets prices $a_t(k)$ and $b_t(k)$, where $k \in \{1, 2\}$ is the trade size and $t \in \{1, 2\}$ is the period. Notice that now, the period-2 prices depend on the trade in period 1 as well:

$$a_2(k) = \mathbb{E}[V|d_1, d_2 = k],$$
$$b_2(k) = \mathbb{E}[V|d_1, d_2 = -k],$$

where d_t is the signed period-t trade (i.e. 1 if a buy of size 1, -2 if a sell of size 2, etc.).

Suppose a separating equilibrium is played in both periods, where the rational trader always trades two units (just as in (a) and (b)). Suppose further that there was a buy order of size 2 in first period and a buy order of one unit in period 2, that is, suppose

$$d_1 = 2 \text{ and } d_2 = 1.$$

Calculate the resulting prices, i.e. calculate $a_1(2)$ and $a_2(1)$ conditional on $d_1 = 2$.

(f). Let the realized prices in (e) be denoted p_1 and p_2, i.e. $p_1 = a_1(2)$ and $p_2 = a_2(1)$. Is it possible that $p_2 < p_1$? If not possible, explain why this is so. If possible, explain how the price can decrease following a buy order.

Problem 3

In the following pages you will find a 2009 article from The Economist on transparency in financial markets. Discuss the article using what you have learned in the course. Summarize the main arguments, evaluate them using theory and discuss points which have been omitted. You are welcome to bring in theories and facts from outside the course in the discussion.

The Economist

Economics focus

Full disclosure

The case for transparency in financial markets is not clear-cut

Feb 19th 2009 | From the print edition

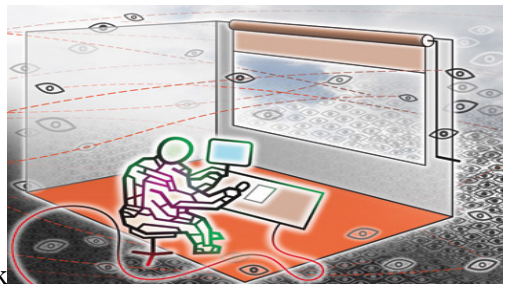

Illustration by Jac Depczyk

ITS promises are alluring, yet elusive; everyone, from politician to pundit, calls for more. In its recent report on financial reform, the Group of Thirty, a body of financial experts, mentioned it more than 30 times. Transparency is in vogue. Yet few ask whether it actually works.

Not long ago the cheerleaders of opacity were the loudest. Without privacy, they argued, financial entrepreneurs would be unable to capture the full value of their trading strategies and other ingenious intellectual property. Forcing them to disclose information would impair their incentive to uncover and correct market inefficiencies, to the detriment of all. And for years the so-called shadow banking system thrived, away from prying eyes. Then crisis hit, lending weight to the quip "What you see is what you get; what you don't see gets you." Few saw it coming, but if a lack of transparency was pervasive, how could they have?

As clear as mortgage-backed securities

"Sunlight is said to be the best of disinfectants," wrote Louis Brandeis, later a Supreme Court justice, in 1913, and almost a century later his words have become a maxim. Yet transparency is amorphous; it can, frustratingly, be anything but transparent and, implemented wrongly, may harm the very interests it is supposed to serve. In financial markets, the word is nearly always equated with information disclosure. The trouble is that the information is often incomplete, irrelevant or outright incomprehensible. Subprime-mortgage-backed securities

are a case in point. These instruments—whose value remains shrouded in mystery—can have prospectuses of about 500-600 pages, most of which are devoted to intricate legalese. Yet, inexplicably, they do not contain the information about individual loans that is needed to detect default risk.

Nor is transparency free. The Sarbanes-Oxley act, which partly restored confidence after the scandals of Enron, WorldCom and others, came at a cost—not only in terms of the burden of compliance it imposed on companies. In order to shield small firms, those with a stockmarket value of less than $75m were initially exempted. This created a peculiar incentive: at least one study suggests that firms just below the threshold began disbursing unusual amounts of cash to shareholders and making fewer investments. The act has also been accused of stifling risk-taking and increasing directors' pay.

At its onset, the turmoil in financial markets was described as a liquidity crisis. And transparency and liquidity are close relatives. One enemy of liquidity is “asymmetric information”. To illustrate this, look at a variation of the “Market for Lemons” identified by George Akerlof, a Nobel-prize-winning economist, in 1970. Suppose that a wine connoisseur and Joe Sixpack are haggling over the price of the 1998 Château Pétrus, which Joe recently inherited from his rich uncle. If Joe and the connoisseur only know that it is a red wine, they may strike a deal. They are equally uninformed. If vintage, region and grape are disclosed, Joe, fearing he will be taken for a ride, may refuse to sell. In financial markets, similarly, there are sophisticated and unsophisticated investors, and unless they have symmetrical information, liquidity can dry up. Unfortunately transparency may reduce liquidity. Symmetry, not the amount of information, matters.

The good news is that transparency can work. When information is relevant, standardised and public, it fosters intelligent decision-making. Lenders, for instance, are required to quote interest rates as annual percentage rates, making loans easy to compare. Some behavioural economists call this “simplified transparency”, and think similar requirements should be imposed on complex financial products. Information must also be accurate as the credit-rating debacle shows: an AAA rating is harmful rather than helpful if it describes a CCC asset.

But politics impedes the ideal of transparency for at least two reasons. First, the benefits of transparency are widely dispersed among information users, whereas the costs are borne by few information disclosers; the disclosers therefore dominate the political process. Second, disclosure requirements are often drawn up after crises. They therefore tend to be hurried and haphazard, and support for them fades with memory of the hard times.

And even well-designed disclosure requirements may not suffice. People may make ill-informed choices, simplified transparency or not. In a recent study, two groups (made up of Harvard University staff) were asked to pick mutual funds. One group was given

prospectuses which neatly summarised the funds' objectives, risk profiles, costs and past performance in a few pages. The other group received the standard long-winded and hard-to-understand prospectuses. They nonetheless made nearly identical choices, opting for funds with good past performance and largely neglecting fees. Academic research suggests that people should do precisely the opposite.

Still, for all its difficulties, transparency is usually better than the alternative. The opaque innovations of the recent past, rather than eliminating market inefficiencies, unintentionally created systemic risks. The important point is that financial markets are not created equal: they may require different levels of disclosure. Liquidity in the stockmarket, for example, thrives on differences of opinion about the value of a firm; information fuels the debate. The money markets rely more on trust than transparency because transactions are so quick that there is little time to assess information. The problem with hedge funds is that a lack of information hinders outsiders' ability to measure their contribution to systemic risk. A possible solution would be to impose delayed disclosure, which would allow the funds to profit from their strategies, provide data for experts to sift through, and allay fears about the legality of their activities. Transparency, like sunlight, needs to be looked at carefully.

From the print edition: Finance and economics