Written Exam for the M.Sc. in Economics summer 2012

Financial Markets

Final Exam

March 31, 2012 at 10.00 until April 2, 2012 at 10.00

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> (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) In suggested EU regulation, traders may face punitive fees when they create market volatility by placing excessive numbers of canceled orders. Discuss the conditions under which excessive limit orders may erode market quality.

(b) The textbook mentions on page 61 that market depth increases with the number of perfectly informed strategic insider traders. Intuitively explain this effect.

(c) The abstract of Cespa and Foucault (2011) mentions that "a for-profit exchange optimally restricts access to price information more than if price information was sold by a pure information seller." Intuitively explain the reasoning behind their claim.

Problem 2:

This problem considers the problem of detecting insider trading in the Glosten-Milgrom model. It is related to chapter 4 of the textbook and the lecture slides of February 21.

Bid-ask prices for one unit of an asset are quoted by competitive, risk-neutral market makers. The traded asset has unknown value V with expected value $\bar{V}$. Traders arrive sequentially to trade. Each trader can buy one asset unit, sell one asset unit, or abstain from trading. In the basic model, trader types are identically and independently distributed as follows: there is chance α that the trader is risk-neutral and informed about the true V, chance $(1-\alpha)\beta_B$ that the trader is an uninformed buyer, chance $(1-\alpha)\beta_S$ that the trader is an uninformed seller, and remaining chance $(1-\alpha)(1-\beta_B-\beta_S)$ that the trader is uninformed and abstains.

The analysis in the book and slides concludes that the equilibrium has the following property. Market makers quote bid and ask prices taking into account the next trade. The ask price satisfies $a = \mathrm{E}[V|\text{Buyer}] > \bar{V}$ and the bid price satisfies $b = \mathrm{E}[V|\text{Seller}] < \bar{V}$.

We now introduce a new feature of this model. Suppose there is chance γ that anyone has information, and the model is as above. With remaining chance $1-\gamma$, all traders are

uninformed, and buy/sell/abstain with conditional probabilities $\beta_B/\beta_S/(1 - \beta_B - \beta_S)$. Our goal is to see how market makers may update their beliefs about the presence of informed traders, after seeing the choice made by an arriving trader.

(a) Define $\delta = \alpha\gamma$. Calculate the probabilities of the arrival of different trader types, and verify that in the new model, there is chance δ that the trader is risk-neutral and informed about the true V, chance $(1 - \delta)\beta_B$ that the trader is an uninformed buyer, chance $(1 - \delta)\beta_S$ that the trader is an uninformed seller, and remaining chance $(1 - \delta)(1 - \beta_B - \beta_S)$ that the trader is uninformed and abstains.

(b) Conclude that ask and bid prices are determined in equilibrium as in the basic model, simply with modified parameters: the original α is replaced by the new δ.

(c) Argue that if informed traders are present, then

$$\Pr\left(\text{Buyer}|\text{Info}\right) = (1 - \alpha)\beta_B + \Pr\left(V \geq a\right), \tag{1}$$

while if no informed traders are present, then

$$\Pr\left(\text{Buyer}|\text{No info}\right) = \beta_B. \tag{2}$$

(d) Bayes' rule states that after observing an incoming buyer, market makers update their prior belief γ that informed traders are present to the posterior belief

$$\Pr\left(\text{Info}|\text{Buyer}\right) = \frac{\gamma\Pr\left(\text{Buyer}|\text{Info}\right)}{\gamma\Pr\left(\text{Buyer}|\text{Info}\right) + (1 - \gamma)\Pr\left(\text{Buyer}|\text{No info}\right)}. \tag{3}$$

Using the result from (c), show that the posterior belief satisfies $\Pr\left(\text{Info}|\text{Buyer}\right) \geq \gamma$ if and only if $\Pr\left(V \geq a\right) \geq \beta_B$. Argue by analogy, that $\Pr\left(\text{Info}|\text{Seller}\right) \geq \gamma$ if and only if $\Pr\left(V \leq b\right) \geq \beta_S$, and that $\Pr\left(\text{Info}|\text{Abstention}\right) \geq \gamma$ if and only if $\Pr\left(b < V < A\right) \geq 1 - \beta_B - \beta_S$.

(e) Consider the example that V is uniformly distributed on $[0, 1]$, and $\beta_B = \beta_S = 1/2$. Argue that $\Pr\left(V \geq a\right) = \Pr\left(V \leq b\right) < 1/2$. Using (d), show that trading activity (buying and selling) indicates the absence of informed traders, while abstention reveals the presence of informed traders. Discuss the realism of such a result.

Problem 3:

Below is an excerpt of an article from the Economist magazine on December 31, 2011. Please write a short essay discussing to which extent the course readings can relate to the issue of this text. In particular, consider market resiliency and the regulation of market transparency. If you wish to elaborate your answer beyond the syllabus, you are welcome to seek more information about the potential means of financial terrorism.

"Leon Panetta, America's defence secretary, has suggested that a cyberattack on financial markets, the power grid and government systems could be "the next Pearl Harbour". In a move that received surprisingly little attention, Barack Obama signed an unprecedented executive order in July declaring the infiltration of financial and commercial markets by transnational criminal groups to be a national emergency. It also pointed to "evidence of growing ties between [these groups] and terrorists". In a sign that Congress, too, is twitchy, its latest appropriations bill calls for a report into the risks posed by financial terrorism.

Officials' anxiety has grown amid circumstantial evidence that malefactors helped to exacerbate the market turmoil in late 2008. A report on the risks of economic warfare by Cross Consulting—which was written in 2009 for the Pentagon's Irregular Warfare Support" Programme (IWSP) but which surfaced only in 2011—cites a paper prepared for lawenforcement officials by a group of anonymous moneymen who were alarmed by trading patterns around the time that Lehman Brothers failed.

The paper analyses trading data from American exchanges. It shows that a handful of small and midsized regional brokers saw their market share in equities trading skyrocket in 2008 to the point where some were, for a while, doing more business than giants such as Goldman Sachs and JPMorgan Chase. The brokers' business was conducted under multiple trading symbols, the market-making identities used in electronic trading so that counterparties know whom they are dealing with.

The bulk of the trading appears to have been "sponsored access" agreements, under which established brokers can in effect rent their identities to other traders so that the latter do not have to jump through the usual regulatory hoops. There is no suggestion that the brokers in question were doing anything wrong. They say they were doing business with regulated entities, including other brokers, but the report raises questions about the trades these sponsored entities were conducting.

These trades were heavily concentrated in big, troubled stocks such as Citigroup and Wachovia, the survival of which was seen as critical to the stability of the financial system. They were mostly short-selling, the paper concludes, and a good deal of the shorting may have been of the illegal "naked" kind, where the short-seller does not bother to locate and borrow the shares first. (Borrowing a broker's identity could have made this easier, since

marketmakers were exempt from the ban on naked shorting in certain circumstances.) Supporting this conclusion is a huge spike in trades that failed to settle at the time—in Lehman's case, the number shot from tens of thousands to tens of millions. One cause of "fails" is naked shorting, because you cannot deliver a share that you have not really borrowed.

Trading data alone are insufficient to draw firm conclusions about motives, but the anonymous paper raises red flags. If the brokers were inadvertently greasing the wheels for bear raiders, then who was doing the raiding? The obvious suspects are hedge funds looking to make a killing. But rumours persist of involvement by those with non-economic motives.

Regulators have been tightening the rules. In November America's Securities and Exchange Commission (SEC) voted through various restrictions on sponsored access, which Mary Schapiro, the SEC's chairman, had previously likened to handing car keys to an unlicensed driver. In private, SEC staffers worry that some of the driving might be deliberately dangerous. Not every jurisdiction is moving as fast as America. In an October report, the International Organisation of Securities Commissions (IOSCO) expressed concern that some countries' monitoring of sponsored-access agreements was inadequate.

Sponsored access is not the only way that a determined assailant could create havoc. The "flash crash" of May 6th 2010, in which American equities spectacularly nosedived, showed the damage that can be done by high-speed algorithmic trading. It is much easier to drag markets down when they are already reeling, by the use of such things as short-selling, options and swaps, points out James Rickards of Tangent Capital, an expert on financial threats. This is what the military would call a "force multiplier".

Just how much danger America's financial system is in from deliberate attack is hard to judge from the outside. What is clear is that politicians, regulators and the industry have struggled to forge a coherent response. The Financial Services Sector Coordinating Council (FSSCC), an industry group that works under the auspices of the US Treasury, has developed a "threat matrix" in consultation with a group of financial regulators with an equally snappy name, the Financial and Banking Information Infrastructure Committee. But information is not always shared promptly. Banks were miffed that regulators did not tell them about a big attack on NASDAQ in 2010 until more than three months later.

Within government, responsibility is fragmented. In America the Treasury, other financial regulators, the Department of Homeland Security, the Pentagon, the FBI, the National Security Agency and others all have a hand in financial cybersecurity. Dots are not always joined even within departments. The Treasury has been keenly focused on combating the financing of terrorists, for example, but appears to have given less thought to how they might use that money to undermine banks and markets. That is unfortunate. As policymakers wrestle to protect finance from its own instability, they shouldn't neglect the potential for threats from outside."