Written Exam Economics Summer 2020

Financial Markets Microstructure

June 12 10am-10pm, 2020

This exam question consists of 5 pages in total

Answers only in English.

A take-home exam paper cannot exceed 10 pages – and one page is defined as 2400 keystrokes

The paper must be uploaded as <u>one PDF document</u>. The PDF document must be named with exam number only (e.g. '127.pdf') and uploaded to Digital Exam.

Be careful not to cheat at exams!

Exam cheating is for example if you:

- Copy other people's texts without making use of quotation marks and source referencing, so that it may appear to be your own text
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- Reuse parts of a written paper that you have previously submitted and for which you have received a pass grade without making use of quotation marks or source references (self-plagiarism)
- Receive help from others in contrary to the rules laid down in part 4.12 of the Faculty of Social Science's common part of the curriculum on cooperation/sparring

You can read more about the rules on exam cheating on your Study Site and in part 4.12 of the Faculty of Social Science's common part of the curriculum.

Exam cheating is always sanctioned by a written warning and expulsion from the exam in question. In most cases, the student will also be expelled from the University for one semester.

Problem 1

In the Glosten-Milgrom model, as well as many other models we had in the class (e.g., Glosten, Parlour, Duffie-Garleanu-Pedersen, etc), strategic traders are restricted to trading at most one unit of the asset. Without this restriction, they would be willing to buy or sell infinite amounts.

1. What factors preclude or disincentivize such behavior in the real world?
2. Is it reasonable to model these factors as an exogenous constraint on trade size? If not, how would you incorporate them in the Glosten-Milgrom model?

Problem 2

Consider an asymmetric Glosten-Milgrom model in which the fundamental value v is $v = 10$ with probability $\gamma < 1/2$ and $v = 5$ w.p. $1 - \gamma$. The arriving trader can submit a buy or a sell order for one unit of the asset. The trader is informed w.p. π and is a noise trader w.p. $1 - \pi$. In the latter case the trader submits a buy order w.p. $\rho > 1/2$ and a sell order w.p. $1 - \rho$ independently of v. The informed trader knows v and trades so as to maximize profit. The dealer is risk-neutral and competitive.

1. Derive the ask and bid quotes set by the dealer.
2. Calculate the bid-ask spread. How would the spread react to an increase in ρ? How does your answer depend on π?
3. What is the intuition behind this dependence on π?

Problem 3

This question is based on the Kondor model. Suppose that the fundamental value of the asset is given by the sum of L individual components:

$$\theta = \theta_1 + \theta_2 + ... + \theta_L,$$

where each component $\theta_l \sim$ i.i.d.$\mathcal{N}(0, \sigma^2)$. There are two strategic traders, label them i and j. Trader i observes the first I components of θ (denote their sum as $x_i = \theta_1 + ... + \theta_I)$), while trader j observes the last J components (denote their sum as $x_j = \theta_{L-J+1} + ... + \theta_L$). Assume $I + J < L$, so there are no components observed by both traders, but there are some which are not observed by either one (denote their sum as $x_k = \theta_{I+1} + ... + \theta_{L-J}$). In addition, both traders observe the same public signal $y = \theta + \epsilon$, where $\epsilon \sim \mathcal{N}(0, \sigma_\epsilon^2)$.

In answering the questions below, you can use the following fact:

If $q = v + u$, where $v \sim \mathcal{N}(\mu_v, \sigma_v^2)$ and $u \sim \mathcal{N}(\mu_u, \sigma_u^2)$, and the two are independent, then: (1) $q \sim \mathcal{N}(\mu_v + \mu_u, \sigma_v^2 + \sigma_u^2)$, and (2) $\mathbb{E}[v|q] = \mathbb{E}[v] + (q - \mathbb{E}[q])\frac{\mathbb{C}(v,q)}{\mathbb{V}(q)}$.

1. Calculate $\mathbb{E}[\theta|x_j, y]$, i.e., trader j's asset valuation conditional on the information available to him.[1]

2. Calculate the second-order expectation $\mathbb{E}[\mathbb{E}[\theta|x_j, y] \mid x_i, y]$, i.e., trader i's expectation of trader j's valuation, conditional on i's information.

   HINT: you should get an expression of the form $\mathbb{E}[\mathbb{E}[\theta|x_j, y] \mid x_i, y] = \alpha y + \beta(y - x_i)$. *You need to find* α *and* β.

3. Take the coefficient β you have obtained in part 2 (if you did everything correctly, it should be positive). It captures the degree of divergence of second-order beliefs: the higher is trader I's private signal of asset value, the lower he expects J's valuation to be, and the higher is β, the stronger this effect is. How does β depend on I, the number of components that trader i observes? Explain the inuition behind this.

4. How does β depend on J, the number of components that trader j observes? Explain the inuition behind this.

NOTE: if you could not solve part 2, you can still try to provide an educated guess for the directions and the reasons of the effects in parts 3 and 4.

Problem 4

Below you can find an Economist article from July 17, 2019 on the liquidity of the corporate bond market.[2] The article mentions that the actual liquidity in that market is well below what the investors seem to expect it to be. What are the possible consequences of such misalignment? Should we attempt to alleviate it by making the market more transparent? How does it relate to the discussion of market transparency we had in class?

Buttonwood – Why everybody is concerned about corporate-bond liquidity

In September 2007 Britain suffered its first bank run in a century. Television pictures showed a long queue of depositors outside a branch of Northern Rock. Alistair Darling watched in dismay from Portugal, where he and his fellow European Union finance ministers were gathered. "They're behaving perfectly rationally, you know," Mervyn King, the governor of the Bank of England, said

[1] In general, conditioning on x_j is not the same as conditioning on $(\theta_{L-J+1}, ..., \theta_L)$, since the latter contains more information. But the two are equivalent in this problem.

[2] Also available at: `https://www.economist.com/finance-and-economics/2019/07/11/why-everybody-is-concerned-about-corporate-bond-liquidity`

in the smarty-pants manner that economists are cherished for. Mr Darling was uncharmed. "It was not what I wanted to hear," he recalled.

What Lord King probably had in mind was a well-thumbed textbook model. Banks have a liquidity mismatch. One side of the balance-sheet is hard-to-sell loans; the other side is deposits that can be withdrawn in a trice. If depositors believe that a bank is sound, there will be no runs on it. But if enough start to demand their deposits back, it makes sense for everybody to join the rush.

This model can also be applied in other areas. Take the corporate-bond market. Every policy body of stature, from the IMF to the European Central Bank (ECB), has worried about a growing mismatch between investors' expectations that they can sell out at any moment and an underlying shortage of liquidity in the market. More investors are using corporate-bond funds as an alternative to cash. But fewer dealers are willing to trade bonds in size. A big scare could feasibly start a run.

The dynamics of capital-market runs are similar to those of bank runs. You see them in currency crises. Foreign-exchange reserves, say, are slim relative to the scale of local-currency assets held by flighty investors. Should enough of those investors sell out, others will soon follow. The result is a rout. There is a similar pattern with investment funds that promise speedy withdrawals but hold assets that cannot be sold quickly. Bad news prompts withdrawals. The speedy get paid. Other investors then try to get out, too. But the fund cannot sell assets fast enough. It is forced to suspend redemptions.

Such trouble is especially likely with corporate bonds, which are inherently illiquid. In contrast with trading in shares, where buy and sell orders are matched on electronic order books, corporate bonds are traded over-the-counter. Bonds are not as standardised as shares. A company may have bonds of several different maturities. If you want to buy or sell, you call a dealer.

The ease with which investors can trade bonds—the market's liquidity—depends a lot, then, on the readiness of dealer banks to stockpile securities. Where there is heavy selling, dealers would ideally warehouse cheaper bonds for when people want to buy again. But since the financial crisis new rules have made it less cost-effective for banks to use capital for trading of any kind. The inventory of corporate bonds held by dealers has fallen sharply in the past decade.

As the role of dealers has shrunk, the thirst for instant liquidity has increased. Derisory yields on the safest government debt have drawn investors towards riskier securities, including corporate bonds. A cheap and convenient way to invest in them is to buy an exchange-traded fund, or ETF. These are low-cost investment funds that hold a basket of bonds, usually mirroring a benchmark index. They trade on stock exchanges just as listed shares do. The ease of buying and selling bond ETFs is a big part of their appeal. They are also often used as depositories for spare cash. Studies are divided on whether ETFs make the underlying bonds more or less liquid. But there are concerns that in a stressed market, outflows from ETFs might make a bad situation worse. And it is not hard to make a case that the corporate-bond market has become more fragile. Many firms in America have issued lots of bonds to buy back their own shares. With extra leverage comes more risk. Half of all investment-grade bonds have a credit rating of BBB. In a recession a chunk of those

bonds will be downgraded to junk. Many mutual funds and ETF s can hold only investment-grade bonds. If a lot of bonds have to change hands quickly, that could easily overwhelm the market's limited liquidity. Prices might fall a long way.

Just how messy the next big shake-out in the corporate-bond market is depends on many things: on how weak the economy gets; on how many BBB borrowers can avert a downgrade; on how quickly funds can be raised to buy at fire-sale prices. For now, it seems rational to hold bonds that afford a little extra yield. Smart-alecks say this will surely end badly. But who wants to hear that?