Written Exam Economics Summer 2016

Financial Markets

Date: August 24 at 10am to August 26 at 10am.

This exam question consists of 9 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

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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). In the final lecture of the course, we saw a long list of so-called *anomalies* that have been found to be more or less robust. Some of these we can argue are caused by completely rational phenomena (such as higher average returns to small firms due to a liquidity effect). But others seem better explained by *behavioral* theories (such as the disposition effect which would be 'explained' by prospect theory). A naive intuition would say that traders 'suffering' from behavioral biases would obtain substandard profits, and therefore be driven out of the market. What factors could limit the validity of this argument?

(b). Figure 5.2 on page 165 of the book shows that the bid-ask spread of a stock increases when it is dropped by analysts, i.e. when it is no longer being covered by financial analysts. The explanation is straightforward: financial analysts disseminate information to the market and thus eliminate or reduce informational asymmetries, and this leads to less adverse selection and thus lower spreads.

However, the story might not always be so clear-cut. Discuss why analysts might also be a source of uncertainty. Do you think it would be possible to have the opposite situation to that depicted in Figure 5.2? I.e., do you think it would be possible for bid-ask spreads to become lower (on average) after analyst coverage stopped?

(c). Explain why we assume noise traders, private value or uncertain supply in our models of financial markets. For instance, what would happen to prices and trading in one of our standard dealer models if we did not make this assumption? Do you find it realistic to make these assumptions?

Problem 2

In the course we generally assumed that market makers were uninformed and hence that the adverse selection came from informed traders. In this question, we will consider the reverse situation, where market makers may be informed and traders are always uninformed (liquidity) traders.

Suppose we are at a market for an asset that has value $V \in \{0, 1\}$, and takes each value with equal probability. There are two market makers (MMs), the *informed MM*, denoted I, and the *uninformed MM*, denoted U. The value V is known to I, but not to U. We assume that traders are always *liquidity traders* who either buy or sell a unit of the asset with equal probability by using a market order. The MMs simultaneously set bid and ask prices a_n and b_n, where $n = I, U$. There is price priority, so if $a_n < a_{n'}$ then an incoming buy market order will be executed against a_n. Similarly if $b_n > b_{n'}$. If $a_n = a_{n'}$, then the trader buys from I with probability q. Suppose throughout that $q = 1$. Similarly for $b_n = b_{n'}$.

We now analyze price-setting behavior in this market.

(a). We first look for an equilibrium in pure strategies, where the uninformed market maker sets prices a_U and b_U, and the informed market maker sets prices $\bar{a}_I$ and $\bar{b}_I$ when $V = 1$, and $\underline{a}_I$ and $\underline{b}_I$ when $V = 0$. Suppose that $a_U, b_U \in (0, 1)$. Find I's best response, and calculate U's expected profits.

(b). We continue looking at pure strategies. Now, analyze the case where $a_U = 1$ and $b_U = 0$. Find I's best response and calculate U's expected profits.

(c). Assume that U's equilibrium prices must be either the prices in (a) or in (b). Use your previous answers to show that there cannot be a pure-strategy equilibrium.

(d). Now we allow for mixed strategies. Suppose that I sets $\bar{a}_I = 1$ and $\underline{b}_I = 0$. Furthermore, suppose that U plays such that $\mathbb{P}(a_U < 1) = 1$ and $\mathbb{P}(b_U > 0) = 1$.

Show that I's expected profits when $V = 1$ (denoted $\overline{\Pi}_I$) and $V = 0$ (denoted $\underline{\Pi}_I$) are

$$\mathbb{E}[\overline{\Pi}_I] = \frac{1}{2} \cdot (1 - \bar{b}_I) \cdot \mathbb{P}(b_U \leq \bar{b}_I),$$

$$\mathbb{E}[\underline{\Pi}_I] = \frac{1}{2} \cdot \underline{a}_I \cdot \mathbb{P}(a_U \geq \underline{a}_I).$$

(e). Focus on the bid side. We now look for a mixed strategy for U such that it is optimal for I to play a mixed strategy for $\bar{b}_I$ over the interval $[0, 1/2]$.

Denote U's strategy by $\sigma_U(b) = \mathbb{P}(b_U < b)$ for $b \in [0, 1/2]$. Recall that for it to be optimal for I to mix between two values of $\bar{b}_I$, he must be indifferent between these two value, i.e. they must yield the same expected payoff. Hence, for I to mix over $\bar{b}_I$ in $[0, 1/2]$, a necessary condition is that $\mathbb{E}[\overline{\Pi}_I]$ is constant for $\bar{b}_I$ in $[0, 1/2]$.

Suppose $\sigma_U(0) = y > 0$ and $\sigma_U(1/2) = 1$.[1] Find $\sigma_U(b)$ such that $\mathbb{E}[\overline{\Pi}_I]$ is constant for $\bar{b}_I$ in $[0, 1/2]$.

(f). Still, focus on the bid side. Notice that given $\underline{b}_I = 0$, then U's expected profits conditional on b_U and conditional on an incoming sell order is

$$\mathbb{E}[\Pi_U | \text{sell order}] = \frac{1}{2}(0 - b_U) + \frac{1}{2}\mathbb{P}(\bar{b}_I < b_U)(1 - b_U).$$

In equilibrium this will be equal to zero.

Suppose I's strategy when $V = \overline{V}$ is such that $\overline{\sigma}_I(b) = \mathbb{P}(\bar{b}_I < b)$ for $b \in [0, 1/2]$. Find a strategy for I with $\overline{\sigma}_I(0) = 0$ and $\overline{\sigma}_I(1/2) = 1$, such that U obtains zero profits for all $b_U \in [0, 1/2]$.

(g). Finally, argue that the strategies you have found constitute an equilibrium on the bid side.

(h). Suppose the equilibrium in (g) is played. Answer the following questions:

- Does the informed market maker reveal his information?

- Suppose the model has two periods and the market makers observe the period-1 prices before they set period-2 prices. Suppose an analyst observes only the realized prices and **not** the offered bid/ask prices. Can she use the period-1 price to predict the period-2 price? (Give an intuitive answer, you do not need to set the model up.)

- Do any of the market makers earn positive expected profits?

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[1]Notice, this implies that U's strategy has a mass point at 0.

Problem 3

On the next pages, you will find an article from The Guardian on stock market volatility in the beginning of 2016. Summarize the issues raised in the article, then analyze the issues using theory learned in the course. Evaluate the theory and give your opinion as to whether it explains well the observed events. Do you agree with the conclusions of the author about the state of the world economy? You are welcome to bring in theories and models from outside the course, if these seem to better explain the events.

theguardian

What volatile markets say about the world economy
Anatole Kaletsky

A process known as 'reflexivity' is a powerful force in financial markets, especially during periods of instability or crisis

Monday 1 February 2016 11.07 GMT

J anuary is usually expected to be a good month for stock markets, with new money gushing into investment funds, while tax-related selling abates at the end of the year. Although the data on investment returns in the United States actually show that January profits have historically been on only slightly better than the monthly norm, the widespread belief in a bullish "January effect" has made the weakness of stock markets around the world this year all the more shocking.

But the pessimists have a point, even if they sometimes overstate the January magic. According to statisticians at Reuters, this year started with Wall Street's biggest first-week fall in more than a century, and the 8% monthly decline in the MSCI world index made January's performance worse than 96% of the months on record. So, just how worried about the world economy should we be?

Three fears now seem to be influencing market psychology: China, oil and the fear of a US or global recession.

China is surely a big enough problem to throw the world economy and equity markets off the rails for the rest of this decade. We saw this in the first four days of the year, when the sudden fall in the Chinese stock market triggered January's global financial mayhem. But the Chinese stock market is of little consequence for the rest of the world. The real fear is that the Chinese authorities will either act aggressively to devalue the renminbi or, more likely, lose control of it through accidental mismanagement, resulting in devastating capital flight.

Such a scenario seemed quite plausible for a few weeks last summer, and it reemerged as a threat in the first two weeks of this year. By the end of January, however, market sentiment had moved back in favour of stability in China. This calm could be disrupted again if China's foreign-exchange reserves show another huge monthly loss, and the authorities' efforts to manage an orderly economic slowdown will remain the biggest source of legitimate concern for financial markets for many years ahead. But, judging by market behaviour in the second half of January, the fear about China has subsided, at least for now.

That cannot be said about the market's second great worry: collapsing oil prices. From

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the moment investors stopped panicking about China, in the second week of January, stock markets around the world started falling (and occasionally rebounding) in lockstep with the price of oil. Unlike the reasonable concern about China, market sentiment seems simply to have gotten the relationship between oil and the world economy wrong. In anything but the very short term, the correlation between oil prices and stock markets should be negative, not positive – and will almost certainly turn out that way in the years ahead.

When oil prices plunge by 10% daily, this is obviously disruptive in the short term: credit spreads in resources and related sectors explode, and leveraged investors are forced into asset fire sales to meet margin calls. Fortunately, market panic now seems to be subsiding, as oil prices reach the lower part of the $25-50 trading range that always seemed appropriate in today's political and economic conditions. Now that oil prices are stabilising at a reasonable long-term level, the world economy and non-commodity businesses should benefit. Low oil prices increase real incomes, stimulate spending on non-resource goods and services, and boost profits for energy using businesses.

Yet, despite these obvious benefits, most investors now seem to believe that falling oil prices point to a collapse in economic activity, which brings us to the third fear haunting financial markets this winter: a recession in the global economy or the US. Past experience suggests that oil prices are not a useful leading indicator of economic activity. In fact, if oil-price movements have any relevance at all in economic forecasting, it is as a contrary indicator.

Every global recession since 1970 has been preceded by a big increase in oil prices, while almost every decline greater than 30% has been followed by accelerating growth and higher equity prices. The widespread view that plunging oil prices augur recession is a clear case of the belief that this time is different – a belief that typically takes hold in financial markets at the peaks and troughs of boom-bust cycles.

Finally, what about the falling stock market itself as an indicator of recession risks? One could quote the great economist Paul Samuelson, who famously quipped in the 1960s that the stock market had "predicted nine of the last five recessions". There is, however, a less reassuring answer. While markets are often wrong in predicting economic events, financial expectations can sometimes influence those events. As a result, reality can sometimes be forced to converge towards market expectations, not vice versa.

This process, known as "reflexivity," is a powerful force in financial markets, especially during periods of instability or crisis. To the extent that reflexivity works through consumer and business confidence, it should not be a problem now, because the oil price collapse is a powerful antidote to the stock-market decline. Consumers are gaining more from cheap oil than they are losing from falling stock prices, so the net effect of recent financial turmoil on consumption should be positive – and stronger consumption should feed through to business revenues.

A greater worry is the workings of reflexivity within the financial system itself. Bankruptcies among small energy-sector companies, which are of limited economic importance themselves, are creating pressures in global banking and reducing the availability of credit to healthy businesses and households that would otherwise be beneficiaries of cheaper oil. Fears of a Chinese devaluation that has not happened (and

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probably never will) are having the same chilling effect on credit in emerging markets. Meanwhile, banking regulators are continuing to tighten lending standards, even though economic conditions suggest they should be easing up.

In short, nothing about the condition of the world economy suggests that a major slowdown or recession is inevitable or even likely. But a lethal combination of self-fulfilling expectations and policy errors could cause economic reality to bend to the dismal mood prevailing in financial markets.

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