Written Exam at the Department of Economics Summer 2021

Macroeconomic Risk Management
Final Exam

From July 26 10 AM to July 27 10 AM, 2021

Answers only in English.

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

This exam question consists of 4 pages in total

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

- Use the ideas or thoughts of others without making use of source referencing, so it may appear to be your own idea or your thoughts

- 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.

1 (20 points, not more than 150 words) Answer true, false, or uncertain. Justify your answer.

In the last year the price of real estate in Denmark has increased by about 15%, and the share of people that think that real estate is the best investment increased from 70 to 80%. This change in beliefs should be of no concern to policymakers as people who purchase real estate are naturally optimistic about their investment decision.

2 (20 points, not more than 150 words) Answer true, false, or uncertain. Justify your answer.

When a group of countries write risk sharing agreements using markets on indexes of aggregates of individual risks, those countries with more persistent income shocks will tend to take short positions and pay insurance premium.

3 (20 points, not more than 150 words) Answer true, false, or uncertain. Justify your answer.

A developed currency derivatives market allows countries to let their currencies depreciate when turmoil in global capital markets leads to a reversal in capital flows. This is mainly due to domestic banks being able to borrow in international capital markets and lend in domestic currency while hedging their currency risk.

4 (100 points) Consider the following version of Geanakoplos (2010). There is one consumption good, two dates, and a continuum of risk neutral traders that have resources at date 0, and consume at date 1. There are two assets in the economy, a risky one (or market) with unit supply and state contingent payoffs, and a riskless one. There are two states of the world, "up" and "down". The riskless rate is $R_f \geq 1$. The market return, $\tilde{r}$, is u in the up state and d in the down state, where $u > R_f > d$.

Traders' beliefs about the probability of state "up" are uniformly distributed over $[0, 1]$. Trader with type $\pi \in [0, 1]$ believes probability of u is π.

Each type starts with exogenous net worth W_0. Assume that every financial contract that is written is fully collateralized (e.g. if a trader borrows to purchase a unit of the risky asset the contractual repayment cannot be higher than d).

a) Assume that there is a borrowing constraint such that traders cannot borrow more than ϕ (if $\phi = 0$, then no borrowing is allowed). Characterize the identity of the marginal trader and equilibrium prices in terms of R_f, u, d, and ϕ. Show that both are increasing functions of ϕ. Interpret.

b) Now assume that there are no borrowing constraints and that traders are also allowed to short sell the market (again using fully collateralized contracts). Characterize the identity of the marginal trader and equilibrium prices. Explain why there is one marginal trader and not two, one for the longs and another for the shorts. What is the effect on the market price of allowing for short sales? Explain.

Note that for the rest of the problem you do not need previous results. For the rest of the problem assume traders have log utility. They invest x in the market and $W_0 - x$ in the riskless asset. Assume there are no borrowing, nor short-selling, constraints.

c) Show that the optimal choice of x is

$$x = W_0 R_f \frac{\pi(u - R_f) + (1 - \pi)(d - R_f)}{(u - R_f)(R_f - d)}.$$

d) You don't know what the investor thinks π is. But suppose that in equilibrium the investor's wealth is fully invested in the market. Find the expected excess return on the market (i.e. the expected return over the risk free return) in terms of R_f, u, and d. *HINT:* Your answer should not involve π.

e) Write down an expression for the risk-neutral probability of an up-move (the risk neutral probability is the probality under which risky asset prices can be written as $p = E^*[\tilde{r}]/R_f = (\pi_u^* u + \pi_d^* d)/R_f$, with $\pi_u^* + \pi_d^* = 1$), and show that the risk-neutral expectation of the return on the market is R_f. Find the risk-neutral variance of the return on the market in terms of u, d, and R_f, simplifying your answer as much as possible.

f) Briefly outline how, in principle, you could calculate the expected excess return on the market from asset prices even if you do *not* directly observe u and d. [*If you can't find the risk-neutral variance explicitly, you can still get partial credit by outlining the rest of the answer.*]

5 (50 points) NOTE: You can find the data in Absalon, and basic code files that you might need to modify to carry out this excercise. To do this excercise you need to use your **exam number** to select some variables and/or their order. Please report your exam number at the beginning. Also upload the code file(s) you used to find the required estimates with your exam.

Suppose you are an expert in Macroeconomic Risk management. You are asked to evaluate tail risk events related to Morgan Stanley and are given market data for this.

a) Estimate the 97% value at risk (VaR) for market returns of Morgan Stanley and for the financial system for the period for which you are given data.

b) Use quantile regression to estimate the 97% ΔCoVaR of Morgan Stanley conditional on the financial system. Estimate the 97% ΔCoVaR of the financial system conditional on Morgan Stanley. Why are these different estimates? What do they measure?

c) To estimate the 97% weekly conditional exposure ΔCoVaR of Morgan Stanley use the macroeconomic state variables for which you are given data for the time period:

1. market return

2. real estate sector return

3. change in three-month yield

4. change in slope of yield curve

5. equity volatility

6. TED spread

7. credit spread

Use all these macroeconomic variables except the one corresponding to your exam number, modulo 7 (e.g. you should not use market return if your exam number is 1, 8, 15,..., you should not use TED spread if your exam number is 5, 12, 19,..., etc.). Estimate the 97% conditional exposure ΔCoVaR of Morgan Stanley for the first week of year 2001. Also estimate the 97% conditional exposure ΔCoVaR of Morgan Stanley for a counterfactual week in which your six macroeconomic variables are one standard deviation in a "crisis" state relative to their sample means (below mean for variables 1, 2, 3, and above mean for variables 4, 5, 6, 7). What can you use this counterfactual for? Explain.

d) Use quantile regression to estimate ΔCoVaR$^{(i|j)}$ for Morgan Stanley and Bank of America at the q = 97% level. If your exam number is odd, take i=Morgan Stanley and j=Bank of America, if your exam number is even, take i=Bank of America and j=Morgan Stanley. How should we interpret this number?

e) Explain the difference between conditional ΔCoVaR and forward ΔCoVaR. Why is the former generally pro-cyclical, while the latter is counter-cyclical? Why can't you estimate forward ΔCoVaR with the documents that we provided you for the exam?

6 (50 points, not more than 700 words) Your expertise and evaluation of Morgan Stanley did not go unnoticed. You are called by the IMF to give your opinion on a proposal they are working on. They want to give member countries incentives to take more countercyclical measures that prepare them to better withstand sudden stops and term of trade shocks. Having heard of the CoVaR methodology they applied it to data of members' yields on sovereign debt using the EMBI index (measured by JP Morgan) for the "system". They found some interesting results, and are considering using the forward ΔCoVaR to charge a premium on countries seeking liquidity assistance, with the objective that they will "behave" in boom periods to avoid being charged a higher rate in a crisis. Being a conservative bureaucracy they want to check with you what are the pros and cons of using this methodology for their purpuse (of course they give you the right incentives and tell you would not work for them beyond this evaluation). Please provide them your candid assessment in between 500 and 700 words. This might include, in no more than 250 words, an evaluation of the proposal's objective.