Written Exam at the Department of Economics winter 2019-20

# Corporate Finance and Incentives

Final Exam

December 20, 2019

(3-hour closed book exam)

Answers only in English.

**This exam question consists of 4 pages in total**

**Falling ill during the exam**
If you fall ill during an examination at Peter Bangs Vej, you must:

- contact an invigilator who will show you how to register and submit a blank exam paper.
- leave the examination.
- contact your GP and submit a medical report to the Faculty of Social Sciences no later than five (5) days from the date of the exam.

**Be careful not to cheat at exams!**
You cheat at an exam, if during the exam, you:

- Make use of exam aids that are not allowed
- Communicate with or otherwise receive help from other people
- 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
- Or if you otherwise violate the rules that apply to the exam

The exam consists of 4 problems. All problems must be solved. The approximate weight in the final grade of each problem is stated. A problem can consist of different sub-questions that do not necessarily have equal weight. Please provide intermediate calculations.

# Problem 1 (Asset pricing 25%)

Four assets $i = 1, \ldots, 4$ are traded today at prices $p^T = (87, 10.5, 57, 39)$. They deliver cash flow at a future date when the economy will be in one of four possible states $j = 1, \ldots, 4$. Cash flows are listed in matrix $V$, where the $i$'th row represents asset $i$, while columns correspond to states:

$$V = \begin{bmatrix} 105 & 82 & 85 & 99 \\ 4 & 7 & 12 & 20 \\ 67 & 75 & 46 & 51 \\ 19 & 65 & 23 & 57 \end{bmatrix}.$$

1) Find a vector $d$ that solves $p = Vd$.

2) Do the prices of the four assets permit arbitrage?

3) Find the risk-free interest rate between now and the future date, and find the market's implicit risk-neutral probability distribution over the four states.

4) Consider a fifth asset with cash flows $V_5 = (8, 15, 3, 19)$, also traded today. Find a price for this fifth asset using the above results.

5) Find a portfolio of the first four assets which replicates the cash flows of the fifth asset.

# Problem 2 (Corporate finance 25%)

A firm lives for one year in a risky world. It initially invests $I = 85$ in a project which will terminate one year from now, paying out cash at that time. The world will be in one of three states, $L$, $M$ or $H$. The project delivers cash 30 in state $L$, 60 in state $M$, and 150 in state $H$. Risk-neutral pricing assigns probability 15% to state $L$, 35% to state $M$, and 50% to state $H$. The safe interest rate is 0%.

The firm will be financed by equity and debt. The firm is considering whether to promise either 40 or 70 to creditors. In states where the firm has promised more than the project delivers, the firm will default, and creditors can recover 80% of the cash delivered by the project. In such states, the remaining 20% is lost in default costs, and equity holders receive nothing.

In state $H$, the firm must pay corporate profit tax. From 150, it can deduct the initial investment $I$ as well as the interest payment to creditors, before paying 28% of its gain to tax collectors. Investors pay no personal taxes.

1) Suppose the debt promise is 40. Compute the present value $D_{40}$ of debt, and the interest payment $40 - D_{40}$.

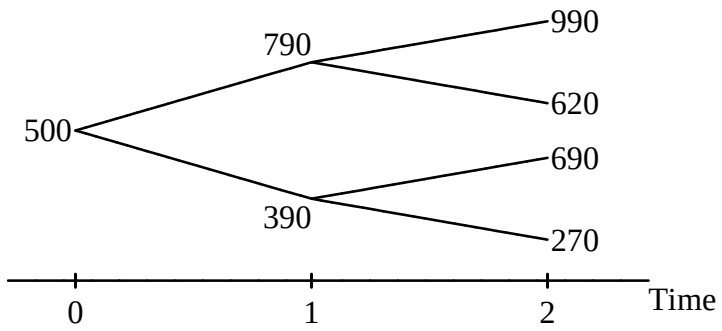
2) Keeping the promise at 40, compute the present value $E_{40}$ of equity, and the present value $V_{40}$ of the firm.

3) Suppose the debt promise is 70. Repeat the two steps above to compute the corresponding values $D_{70}$, $E_{70}$ and $V_{70}$.

4) Which debt level should the firm choose, 40 or 70? Briefly explain the intuition behind your result.

## Problem 3 (Options 25%)

A non-dividend paying stock currently costs 500. In the next two periods its market price can evolve as shown in the tree below. The constant risk free rate is 0.15% per time period.




1) Compute the risk-neutral probabilities for each branch in the tree.

2) Consider two European put options expiring at time 2. Their respective strike prices are 680 and 700. Compute the market values (i.e., premiums) $P$ at time 0 for both options.

3) For both nodes at time 1, and for both put options, decompose the value of the option into its intrinsic value and its time value.

4) If one of these European put options would have negative time value in some node at time 1, what would you conclude about a corresponding American put option?

# Problem 4 (Various themes 25%)

1) Discuss the following claim: "When you have the option of deciding when to invest, it is usually optimal to invest only when the NPV is substantially greater than zero."

2) Discuss the following information from the perspective of asset pricing. Reuters reported on November 28, 2019: "Asset manager BlackRock has gone defensive in Asia's stock market, favouring sectors such as telecoms, as it braces for slower economic growth next year, the company said in a report on 2020 Asia investment views on Tuesday." In its outlook for Asian stocks, Reuters reports, BlackRock sees "slower global growth, lower returns in 2020, and the U.S. presidential election to be a key uncertainty alongside trade, geopolitics." Commenting on the present, BlackRock says "markets are not priced for an economic setback." BlackRock has "significantly decreased exposure to the financial sector where vulnerabilities would be most evident if the global economy downshifts meaningfully." BlackRock expects "stronger U.S. dollar as growth slows and investors seek refuge in safe havens." Hence, it has "trimmed overweight equity positions in markets such as India and Indonesia which rely heavily on U.S. dollar debt. Favours those less reliant such as Taiwan and Thailand." At the same time, BlackRock regards "Asian bonds attractive for global investors." According to Wikipedia, BlackRock is one of the world's largest asset managers with $6.84 trillion in assets under management as of August 2019.

3) Define the debt overhang problem, and briefly explain the idea behind it.