Solution guide: Corporate Finance Theory Exam, December 2020 - January 2021.

Please answer all questions. Answers must be submitted in English.

You may discuss the questions with your fellow students, but you must write up your own individual answers to all questions.

Exam scripts may be checked for plagiarism. Note, in particular, that copy paste of each others' answers, or changing only a few words in sentences, etc. constitutes plagiarism.

Problem 1

Write 1 to 2 paragraphs for each of the following subquestions. You are welcome to use a limited number of mathematical symbols in your answers, but please do not include any explicit calculations. Focus on providing intuition.

a. Explain why debt levels affect firm value in Fahn et. al (2019), commenting on the firm's relationship both with workers and creditors.

Solution: Relevant points can include:

- *Fahn et al. (2019) show that taking on high debt can sometimes reduce firm value.*
- *With high debt, the firm may induce the worker to exert low effort. Part of the resulting costs, generated by a possible shock that can destroy firm capital, are then borne by creditors, who are not repaid in full. This is the case both in a static and a repeated setting.*
- *Relatedly, in a repeated setting, high debt can also make it more difficult for the firm to honour its promises to workers. The firm can promise a bonus for high effort, but then use its discretion to refuse to pay. The worker may then punish the firm by exerting*

low effort in subsequent periods, but given high debt, some of these costs are effectively passed on to creditors.

b. Discuss what the analysis of Bayar and Chemmanuar (2013) suggests about the relationship between the proportion of high-quality firms in the economy and the amount of IPO activity.

Solution: Relevant points can include:

- *The proportion of high-quality firms in the economy can be represented by the prior belief that quality is high.*
- *Bayar and Chemmanur (2013) derive a mixed strategy equilibrium where high-quality firms choose IPO for sure, and where low quality firms choose IPO with a probability that is increasing in the prior. Thus, the larger the proportion of high-quality firms, the more IPO activity.*
- *Intuitively, a large proportion of high-quality firms, in a setting where high-quality firms all choose IPO, directly gives more IPO activity, and also results in IPO being a stronger signal of firm quality. Low-quality firms are then more tempted to choose IPO as well, to take advantage of the high share price, resulting in even more IPOs.*

c. Describe how the conflict of interest between the activist investor and the Board affects the quality of communication in Levit (2019). Briefly comment on whether results in this article would change, if we instead assumed that interests were fully aligned.

Solution: Relevant points can include:

- *The conflict of interest between the activist and the Board, captured by the Board's bias* $\beta > 0$ *towards the status quo, hinders effective communication.*
- *The activist can send the Board a message about the value of making a change, using cheap talk, but will only do so if the Board sometimes follows its recommendation.*
- *The activist would recommend a change whenever this maximizes shareholder value, i.e. in some situations where the Board prefers the status quo. As a result, the Board*

may refuse to follow the activist's recommendation, in which case communication breaks down.

- *If interests were fully aligned, then communication would always be possible in equilibrium. The activist would inform the Board about whether a change or the status quo would be best for shareholders; the Board would always follow the activist's recommendation, regardless of whether the activist has the ability to carry out a public campaign.*

Problem 2

In this question, you are asked to work with the model of Banal-Estañol et al. (2013) with independent, binary returns. In this model, a firm has two identical projects, i and j. To carry out each project, the firm must pay an investment cost of 1. Each project then succeeds with probability p and fails with probability $1-p$. Success yields a cash flow of r_H whereas failure yields a cash flow of r_L, where $r_H > 1 > r_L$ and $pr_H + (1-p)r_L > 1$. Cash flow realizations are independent across the two projects.

The firm must raise the investment costs of 1 per project by borrowing from risk-neutral creditors. The risk free rate is normalized to zero. Creditors are willing to lend at an interest rate that allows them to break even on average. The firm also chooses between separate and joint financing, which differ in the following way.

Under separate financing, creditors who finance a project only have a claim on the cash flows of that particular project. If these cash flows are too low to repay them in full, then these creditors receive a fraction γ of these cash flows; the remaining fraction $1-\gamma$ of the project's cash flow is lost to default costs. Under joint financing, all creditors have a claim on the cash flows of both projects. If the total cash flow from both projects is too low to repay all creditors in full, then creditors receive a fraction $1-\gamma$ of the total cash flow, and the remaining fraction $1-\gamma$ is lost to default costs.

Please attempt all subparts of this problem, even if there are some subparts that you are unable to answer.

a. Show when it is feasible for the firm to use separate financing. That is, derive a condition such that the firm is able to carry out the projects using separate financing if and only if this condition holds.

Solution: The condition is $\frac{1-\gamma(1-p)r_L}{p} \leq r_H$. *See Banal-Estañol et al. (2013) p.3151.*

b. For the rest of this problem, you can assume that the condition you derived in part a is violated, so that separate financing is not feasible. Show that the firm will carry out the projects using joint financing if and only if the following condition holds

$$\left[\frac{1-(1-p)^2\gamma r_L}{1-(1-p)^2}\right] \leq \frac{r_H + r_L}{2}. \tag{1}$$

Solution: joint financing with coinsurance is feasible if and only if condition (1) holds. See Banal-Estañol et al. (2013) p.3152. For completeness, notice that joint financing with risk-contamination is feasible if and only if

$$\frac{1-\gamma(1-p)(pr_H + r_L)}{p^2} \leq r_H,$$

but this condition is stricter than $\frac{1-\gamma(1-p)r_L}{p} \leq r_H$ *from part a, which we assume is violated (see Lecture 9).*

For the rest of this problem, you can assume that condition (1) holds. We also adjust the model of Banal-Estañol et al. (2013) by assuming that the firm has two workers: worker i for project i and worker j for project j. The probability of success of a particular project depends on whether the worker in question exerts effort. Specifically, if worker i exerts effort, then project i succeeds with probability p and and fails with probability $1-p$. If worker i does not exert effort, then project i fails for sure. The same applies for worker j and project j. Any worker who exerts effort incurs a private cost of $B > 0$.

Suppose furthermore that the firm signs a contract with each worker, specifying a payment $r \geq 0$ to the worker if that worker's project succeeds, and zero if it fails. The firm can commit ex ante to the value of r, and chooses r optimally so as to maximize expected profits.

c. What is the worker incentive constraint in this setting? That is, write down a condition such that a worker has an incentive to exert effort if and only if this condition holds.

Solution: The worker incentive constraint is $pr - B \geq 0$. The left-hand side is a worker's expected payoff from exerting effort, which is equal to the expected payment from the firm, pr, minus the cost of effort, B. The right-hand side is a worker's expected payoff from not exerting effort, which is just zero, because then the worker receives no payment and incurs no effort cost.

d. Using your answer in part c, show that the firm can only carry out the projects using joint financing if the following conditions holds:

$$\left[\frac{1-(1-p)^2\gamma r_L}{1-(1-p)^2}\right] \leq \frac{r_H + r_L - B/p}{2}. \tag{2}$$

Briefly comment on why this condition depends on B.

Solution: if the firm did not have to pay workers to incentive high effort, then the relevant condition would be

$$r_m^* \equiv \left[\frac{1-(1-p)^2\gamma r_L}{1-(1-p)^2}\right] \leq \frac{r_H + r_L}{2}$$

as described in part b. The total amount promised to creditors under joint financing with coinsurance, $2r_m^*$, should not exceed the total cash flow when one project succeeds and the other project fails, $r_H + r_L$. But now, the firm needs to meet the worker incentive constraint, since otherwise the projects would fail for sure, and the resulting cash flows would not cover the investment costs, $r_L < 1$. It does so by setting $r = B/p$, which leaves only $r_H + r_L - B/p$ to repay creditors when only one project succeeds. Thus, the relevant constraint for joint financing (with coinsurance) to be feasible is $2r_m^* \leq r_H + r_L - B/p$, i.e. condition (2). The larger the value of B, the greater the moral hazard problem, so the more the firm must compensate workers for project success to incentive effort. As a result, a larger value of B makes condition (2) more difficult to satisfy, because it leaves the firm with less cash to repay to creditors.

e. Suppose that condition (2) is violated. Discuss informally whether or not the firm might nevertheless be able to carry out the projects using joint financing if it used relative performance evaluation: where a worker whose project succeeds is paid more if the other worker's project fails. *Extra:* if you would like, you can also consider joint performance evaluation, where a worker whose project succeeds is paid more if the other worker's project also succeeds. *Note: you are encouraged to refer to condition (2) in your discussion, but you are not expected to derive an explicit expression for the optimal contract.*

Solution: To satisfy a worker's incentive constraint under relative performance evaluation, the worker should receive more than B/p if only her project succeeds, and less than B/p if both projects succeed. Compared to the above analysis, this would tighten condition (2), so that joint financing would still be infeasible. In contrast, under joint performance evaluation, the worker should receive less than B/p if only her project succeeds, and more than B/p if both projects succeed. This would loosen condition (2), and potentially help the firm meet its debt obligations when exactly one project succeeds, by reducing its wage bill in this setting. For completeness: to derive the optimal contract, we would also have to verify that the firm can meet its debt obligations when both projects succeed, even after paying the high wage bill specified under joint performance evaluation.

Problem 3

Please seek out and find a news story, describing a case that relates to some of the ideas from the course.

Discuss to what extent the main points from the news story relate to the different academic articles we have seen throughout the semester (approximately 2-3 pages). In particular, comment on both of the following:

- Which theoretical results from the articles can (or cannot) shed light on the news story?
- Which of the key modelling assumptions behind these theoretical results are realistic, when applied to this real-life situation?

Note: you are not expected to relate the news story to every single academic article we have seen. Rather, you should select a few articles from the course which you believe are most relevant for the news story you have chosen. Moreover, your answer should include a link to, or a copy of, the news story in question.

Solution: answers will differ depending on the news story chosen. A satisfactory answer must address both parts of the question, relating to the theoretical results and also to the modelling assumptions.