Corporate Finance Theory - Solution Guide to Resit Exam (Winter 2016-2017)

1. 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 answer, but please do not include any explicit calculations.

(a) Summarize the main role played by bankruptcy costs in Banal-Estanol et al. (2013). If bankruptcy costs are zero, what will this imply about the optimal choice of financing regime (i.e. joint versus separate)?

Solution: The presence of strictly positive bankruptcy costs (or default costs) is what drives the choice between separate and joint financing in Banal-Estanol et al. (2013). In their setting, a firm borrows from creditors to finance a project, and captures the project's full net present value (in expected terms). This is because credit markets are competitive so that creditors break even on average. It follows that the firm will choose the financing regime that minimizes expected bankruptcy costs, because doing so maximizes the project's net present value. If there were no costs associated with bankruptcy (i.e. bankruptcy costs of zero), then the firm would be indifferent between joint and separate financing. This would be the case regardless of whether joint financing led to coinsurance or risk contamination, so regardless of which regime led to a higher probability of bankruptcy. When bankruptcy costs are zero, the fact that bankruptcy may occur ex post has no impact on the project's ex ante net present value, and hence no impact on the firm's expected profits.

(b) Describe the reason why, in Almeida et al. (2011), some firms are able to successfully borrow to meet a liquidity shock, but others are not. Discuss how this compares to the reason why some firms borrow more than others in Malenko and Malenko (2015).

Solution: Firms in Almeida et al. (2011) differ in terms of their initial wealth, which can be high or low. Both types of firms can approach creditors: potentially to borrow enough to start a project, and also to inject extra funds (and see the project through to completion) if a liquidity shock hits. However, creditors realize the firm must receive a sufficiently high payoff in the case of project success, so give the firm an incentive to work rather than shirk. This moral hazard problem limits the amount that firms can credibly promise to repay, and thus sets an upper bound on the amount that creditors are willing to lend. The moral hazard problem is equally severe for firms with high or low wealth. However, since low-wealth firms need to borrow more to meet the liquidity shock, the result may be a situation where high-wealth firms borrow to meet the shock and low-wealth firms do not.

Malenko and Malenko (2015) also show that some firms may borrow more than others, and there is also an issue of moral hazard in their setting. However, the key point there is that the moral hazard problem is more severe for some firms then for others. Specifically, for a sponsor that offers higher operational benefits, and is sufficiently patient, there is little problem; such a sponsor will take on higher debt, at a *lower interest rate, than a stand-alone target, because creditors realize the sponsor has no incentive to divert cash. In contrast, the moral hazard problem is equally severe for all firms in Almeida et al. (2011), but firms have different funding needs.*

(c) Consider the framework of Povel and Singh (2010), where multiple bidders bid against one another to acquire a target. Will bidders benefit from stapled finance being offered as part of this takeover contest? Explain intuitively why this is, or is not, the case.

Solution: From an ex post perspective, a weak bidder may benefit from the offer of stapled finance if it happens to win the takeover contest. The bidder can then take out the stapled finance loan, and avoid repayment by defaulting if it discovers that the target is actually of little value. More generally, the fact that the contest winner has the option to take out this loan cannot reduce his payoff, and may strictly increase his payoff. However, the offer of a stapled finance loan also affects bidding behavior. Weak bidders realize that they now have more to gain from winning the contest, which makes them bid more aggressively. This effect drives up the acquisition price so much that it increases seller profits, even though the seller must compensate the investment bank for the expected losses associated with offering the loan. The result is that, from an ex ante perspective, the offer of stapled finance leaves bidders worse off, because it increases the intensity of competition in the takeover contest.

2. Problem 2

This question is based on the static framework of DeMarzo et al. (2014), with two differences. First, whereas DeMarzo et al. (2014) consider a single firm, with one owner, one manager, and a safe/risky project, we allow for multiple firms (each with one owner, one manager, and a safe/risky project). We also allow wage payments to each manager to depend on both the cash flows he reports, as well as on the cash flows reported by managers in the other firms. Second, we assume that the state of the world ('Good' or 'Disaster') is unobservable. This implies that the wage a manager receives can only depend on cash flow reports, but not directly on the state.

Important: the set-up is very similar to Problem 2 in the Corporate Finance Theory Exam of December 2016. The first difference relates to a manager's payoff after choosing to divert cash, which I will point out explicitly in the problem description. The second difference is that the contract $\mathbb{W}$ you are asked to consider is slightly more general than in the December Exam. You are most welcome to review the December 2016 Exam and solution guide.

The text that follows provides a detailed description of the problem. Keep in mind that, if we set $N = 1$, then this problem description would correspond to the static model of DeMarzo et al. (2014), except that wage payments cannot be conditioned on the realized state. When answering this question, you are expected to explicitly work with, and manipulate, the relevant mathematical expressions.

Consider a setting with $N \geq 1$ firms, and where the state of the world θ is either 'Good' ($\theta = G$) or

'Disaster' ($\theta = D$). Each firm $i \in \{1, 2, \dots, N\}$ consists of an owner and a manager (both with subscript i). Neither of them observe the state of the world, but they hold the following prior beliefs: $\mathbb{P}(\theta = G) = 1 - \delta$, and $\mathbb{P}(\theta = D) = \delta$, with $0 < \delta < 1$.

The timing of the game is as followed. First, the state of the world is realized. Second, in each firm i, owner i offers a contract $w_i(r_1, \dots, r_N)$ to manager i. This contract specifies the wage w_i the manager will later receive, conditional on the cash flow he reports, r_i, and the cash flows reported by other managers, $(r_1, \dots, r_{i-1}, r_{i+1}, \dots r_N)$ (more details below). Third, manager i observes this contract and chooses a project $p_i \in \{S, R\}$, where S stands for 'Safe' and R stands for 'Risky'. Fourth, the cash flow of this project is realized, which we denote by $Y_i(p_i, \theta)$. Fifth, manager i observes the cash flow $Y_i(p_i, \theta)$ and sends a public report about it, r_i. Sixth, owner i observes the set of reports from all N managers, $(r_1, \dots, r_N)$, and pays manager i the wage $w_i(r_1, \dots, r_N)$ specified under the contract. Finally, payoffs are realized and the game ends.

The realized cash flow $Y_i(p_i, \theta)$ can take on one of three values: 1, 0, and $-D < 0$. The probability of these different values depends both on the project $p_i \in \{S, R\}$ chosen by manager i, and on the state $\theta \in \{G, D\}$, in the following way:

Safe Project, Good State:

- $\mathbb{P}(Y_i = 1 | p_i = S, \theta = G) = \frac{\mu}{1-\delta}$
- $\mathbb{P}(Y_i = 0 | p_i = S, \theta = G) = 1 - \frac{\mu}{1-\delta}$
- $\mathbb{P}(Y_i = -D | p_i = S, \theta = G) = 0$

Safe Project, Disaster State:

- $\mathbb{P}(Y_i = 1 | p_i = S, \theta = D) = 0$
- $\mathbb{P}(Y_i = 0 | p_i = S, \theta = D) = 1$
- $\mathbb{P}(Y_i = -D | p_i = S, \theta = D) = 0$

Risky Project, Good State:

- $\mathbb{P}(Y_i = 1 | p_i = R, \theta = G) = \frac{\mu+\rho}{1-\delta}$
- $\mathbb{P}(Y_i = 0 | p_i = R, \theta = G) = 1 - \left(\frac{\mu+\rho}{1-\delta}\right)$
- $\mathbb{P}(Y_i = -D | p_i = R, \theta = G) = 0$

Risky Project, Disaster State:

- $\mathbb{P}(Y_i = 1 | p_i = R, \theta = D) = 0$

- $\mathbb{P}(Y_i = 0 | p_i = R, \theta = D) = 0$
- $\mathbb{P}(Y_i = -D | p_i = R, \theta = D) = 1$

where $0 < \mu < 1 - \delta$, and $0 < \rho < 1 - \delta - \mu$. Conditional on the state and project selection, the realized cash flow for manager i is independent of the realized cash flows of the other managers.

We will assume that manager i must truthfully report the realized cash flow if it is 0 or $-D$, i.e. $r_i = Y_i$ whenever $Y_i \in \{0, -D\}$. However, if the realized cash flow is 1, then manager i can choose to truthfully report, $r_i = Y_i = 1$, or to instead report $r_i = 0$ and divert cash. The manager's private benefit from diverting cash is λ, where $0 < \lambda < 1$.

Payoffs are as follows. If manager i reports truthfully, then his payoff is equal to the wage he receives: $\pi_i^M = w(r_1, \ldots, r_N | r_i = Y_i)$. If manager i does not report truthfully, then his payoff is $w_i(r_1, \ldots, r_N | r_i = 0) + \lambda$ i.e. the wage he receives, plus the private benefit of diverting cash **(Aside: this assumption differs from that taken in the Corporate Finance Theory December 16 Exam. There, we assumed that the payoff from diverting cash was simply $\pi_i^M = \lambda$.)** The payoff to owner i is equal to the cash flow reported by manager i, minus the wage paid: $\pi_i^O = r_i - w_i(r_1, \ldots, r_N)$. The manager is protected by limited liability, so that wages must be non-negative: $w_i(r_1, \ldots, r_N) \geq 0$, for any vector of reports $(r_1, \ldots, r_N)$. You can also assume that the condition $\delta D - \rho > 0$ holds.

In terms of contracts, we now concentrate on the incentives of the owner and manager in a specific firm i. Suppose that owner i and manager i both expect that managers in all $N-1$ other firms will choose the safe project and truthfully report cash flows. Moreover, suppose that owner i offers manager i the following contract, which we will call 'contract $\mathbb{W}$' : $w_i(r_1, \ldots, r_N) = \lambda + x$ if $r_i = 1$; $w_i(r_1, \ldots, r_N) = w > 0$ if $r_1 = \ldots = r_N = 0$; and $w_i(r_1, \ldots, r_N) = 0$ otherwise. That is, if manager i reports a cash flow of 1, then he will receive a wage of $\lambda + x$, no matter what. But if manager i reports a cash flow of 0, then his wage will depend on the other managers' reports. Specifically, manager i will receives a wage of w if all other managers also report zero cash flow, and a wage of 0 if at least one manager $j \neq i$ reports a cash flow of 1. Owner i specifies the exact values of x and w when offering the contract; our notation reflects the fact that w can be set at any positive value.

(a) Suppose that all managers choose the safe project. Write down manager i's incentive-compatibility constraint for truthful reporting. That is, what mathematical condition must x and w satisfy to give manager i an incentive to truthfully report cash flows, under contract $\mathbb{W}$? Comment on whether an increase in either x or w makes this constraint easier or harder to satisfy, and explain why.

Solution: Suppose that $r_i = 1$. If manager i reports truthfully, then he receives a wage of $\lambda + x$ with probability 1. If he diverts cash, then he receives a private benefit of λ, along with a wage of w if all $N-1$ other managers, $j \neq i$, report $r_j = 0$. Assuming that other managers report truthfully, this probability is equal to $(1 - \frac{\mu}{1-\delta})^{N-1}$. Thus, the incentive-compatibility constraint for truthful reporting *can be written as*

$$\lambda + x \geq \lambda + w(1 - \frac{\mu}{1-\delta})^{N-1},$$

or equivalently

$$x \geq w(1 - \frac{\mu}{1-\delta})^{N-1}. \tag{1}$$

An increase in x makes this constraint easier to satisfy, and an increase in w makes it more difficult to satisfy. The intuition is that x is paid to the manager for sure if he reports a positive cash flow, and is never paid to the manager if he diverts cash. Thus, an increase in x makes truthful reporting more attractive. In contrast, w is paid to the manager with positive probability if he diverts cash, and is never paid to the manager if he reports a positive cash flow. Thus, an increase in w makes diverting cash more attractive.

(b) Suppose that all managers other than i choose the safe project. Write down the low-risk-taking constraint for manager i. That is, what mathematical condition must x and w satisfy to give manager i an incentive to choose the safe project, under contract $\mathbb{W}$? Comment on whether an increase in either x or in w makes this constraint easier or harder to satisfy, and explain why.

Solution: To calculate manager i's expected payoff from choosing the safe project, given truthful reporting, follow the same steps as in question 2(d) of the Corporate Finance Theory Exam of December 2016, but where manager i now receives $\lambda + x$, rather than λ, if $r_i = 1$. Thus:

$$\pi_i^M(S) = \delta w + (1-\delta)\left[(\lambda + x)\frac{\mu}{1-\delta} + w\left(1 - \frac{\mu}{1-\delta}\right)^N\right].$$

Similarly, to calculate manager i's expected payoff from choosing the risky project, given truthful reporting, follow the same steps as in question 2(e) of the December 2016 exam, but where manager i now receives $\lambda + x$, rather than λ, if $r_i = 1$. Thus:

$$\pi_i^M(R) = (1-\delta)\left[(\lambda + x)\left(\frac{\mu+\rho}{1-\delta}\right) + w\left(1 - \frac{\mu}{1-\delta}\right)^{N-1}\left(1 - \left(\frac{\mu+\rho}{1-\delta}\right)\right)\right]$$

The low-risk-taking constraint is $\pi_i^M(S) \geq \pi_i^M(R)$, and can be rewritten as

$$w \geq \frac{(\lambda + x)\rho}{\delta + \rho\left(1 - \frac{\mu}{1-\delta}\right)^{N-1}}. \tag{2}$$

An increase in w makes this constraint easier to satisfy, and an increase in x make this constraint more difficult to satisfy. The intuition is that w is paid to the manager with higher probability under the safe project than under the risky project (since the intermediate outcome $r_i = 0$ is more likely under the safe project). Thus, an increase in w makes choosing the safe project more attractive. In contrast, x is paid to the manager with higher probability under the risky project than under the safe project (since more extreme outcomes, including $r_i = 1$, are more likely under the risky project). Thus, an increase in x makes choosing the risky project more attractive.

(c) Suppose that owner i wants to use contract $\mathbb{W}$ to implement the safe project and induce truthful reporting, but wants to minimize expected wage payments to the manager while doing so. What values of x and w should the owner set? That is, derive the optimal values of x and w (conditional on implementing the safe project and inducing the manager to truthfully report) from the owner's perspective.

Solution: Owner i should set $x = x^*$ and $w = w^*$ such that (x^*, w^*) make both constraints (1) and (2) bind. Manager i then has an incentive to choose the safe project and report truthfully. Moreover, any $(x', w') \neq (x^*, w^*)$ that provides manager i with the same incentives would involve $x' > x^*$ and $w' > w^*$, leading to higher expected wage payments. Hence, direct substitution and simplification shows that the optimal x and w are:

$$x^* = \lambda\frac{\rho}{\delta}(1 - \frac{\mu}{1-\delta})^{N-1},$$
$$w^* = \lambda\frac{\rho}{\delta}.$$

(d) Now suppose that the number of firms is large, i.e. take the limit as N goes to infinity. What do the optimal values of x and w, derived in part c, tend to in this limit? Compare expected wage payments in the limit, under contract $\mathbb{W}$ with these optimal values, to expected wage payments from Problem 2 of the Corporate Finance Theory Exam December 2016, and from Proposition 3 of DeMarzo et al. (2014), both of which were $(\mu + \rho)\lambda$. Explain any similarities or differences.

Solution: Taking the limit yields $x^* = 0$ and $w^* = \lambda\frac{\rho}{\delta}$. In the limit, this contract is identical to the limiting contract from Problem 2 of the December 2016 exam. Thus, expected wage payments must again be $(\mu+\rho)\lambda$. The intuition as to why expected wage payments are the same in the limit is that the manager has little incentive to divert cash when N is large. He realizes that he is very likely to receive a wage of zero if he diverts cash, since it is very likely that at least one manager will report a cash flow of zero. Thus, in the limit, the owner can induce truthful reporting by offering the same contract as in the December 2016 exam (i.e. set $x = 0$), where we effectively assumed that truthful reporting was not an issue.

3. Problem 3

Choose a real-world case of a merger or acquisition that we did not explicitly examine in the course, but that relates to at least some theoretical ideas we considered during the semester. (*To find such a case, you can search e.g. in magazines, newspapers, Bloomberg.com, etc.)* Argue which article from the course can shed the most light into this real-world case, and explain why. Comment on whether the key modelling assumptions in this article are plausible for this particular case.

Solution: Answers here will differ depending on which real-word case is chosen.