Corporate Finance Theory

Lecture 15

Risking Other People's Money (2)
DeMarzo et al. (2014)

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Intended outcomes for the day:

1. **To finish deriving** the optimal contract

2. **To analyze** how making contracts more complete (conditioning on state of nature) affects efficiency/project selection

3. **To relate** DeMarzo et al's proposal of how to implement such a contract to the ideas in the article "Why Your Boss is Overpaid" from Forbes.

Review from last time

DeMarzo et al. consider a setting with a **conflict of interest** between investors/owner and a manager.

Manager can be hired to implement a project

The manager requires incentives to:

1. **Select appropriate level of risk** (project selection)
2. **Honestly report** positive cash flows

1. Relates to risk shifting, asset substitution

2. Can relate to "diligence", or even related to effort.

Key point: moral hazard in project selection interacts with moral hazard in reporting cash flows.

Owner with initial assets A

Manager chooses:

safe project

risky project

Cash flow (safe)

1 with probability μ
0 with probability 1- μ

Cash flow (risky)

1 with probability μ + ρ
0 with probability 1-(μ + ρ + δ)
-D with probability δ

Manager can honestly report positive cash flows or divert funds.

-Diverting funds gives private benefit $\lambda < 1$.

If diverted, owner gets **reported** cash flow

safe project

Reported cash flow (safe)

0 with probability μ
0 with probability $1 - \mu$

risky project

Reported cash flow (risky)

0 with probability $\mu + \rho$
0 with probability $1-(\mu + \rho + \delta)$
$-D$ with probability δ

w(0): wage of failure
w(1): wage for success
w(-D): wage for "disaster", which by limited liability, the owner should set equal to 0.

Owner offers incentive contract

$$\varphi = (w(0), w(1), w(-D)=0)$$

specifying payment based on **reported** cash flow

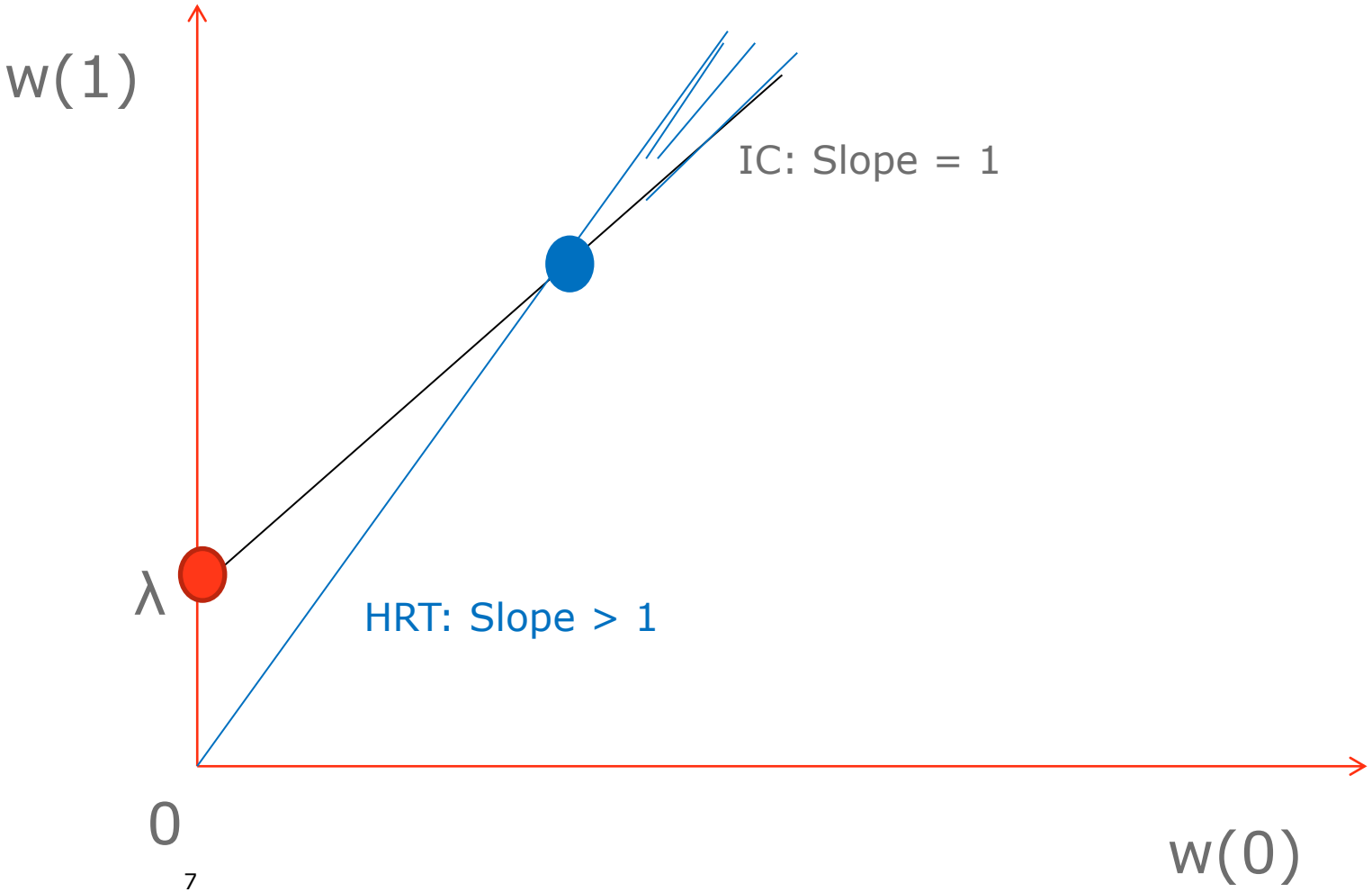
Payments are non negative (**limited liability**)

We assume: owner will only employ manager if expected reported cash flow minus expected payment is strictly positive.

The Optimal Contract

Black line: IC (honest reporting) binds

Blue line: Risk-taking constraint (project choice) binds



The Optimal Contract

Just compare expected cash flows under the safe and the risk project

The safe project is **efficient**: $\delta D - \rho > 0$

Implement the risky project? **(0, λ)** i.e

-Expected payment: $\rho\lambda + \mu\lambda$

Risky: w(0) = 0, w(1) = lambda
Probability of success: (rho + mu).
That gives expected wage payment to the manger (lambda)*(rho +mu))

Implement the safe project? **($(\frac{\rho}{\delta})\lambda$, $(\frac{\rho}{\delta})\lambda+\lambda$)**

-Expected payment : $(\frac{\rho}{\delta})\lambda + \mu\lambda > \rho\lambda + \mu\lambda$

Safe:
Probability of success: mu
Expected wage payment of the LHS of the inequity here on the slide.

The safe project is **more expensive to implement**:

$$(\tfrac{\rho}{\delta})\lambda + \mu\lambda - (\rho\lambda + \mu\lambda) = \lambda\rho\left(\tfrac{1-\delta}{\delta}\right) > 0$$

Hence: implement risky project if and only if

$$\lambda\rho\left(\frac{1-\delta}{\delta}\right) > \delta D - \rho$$

Profit risky: Expected cash flow, risky - Expected wage payment, risky

Profit safe. Expected cash flow, safe - Expected wage payment, safe.

Suppose the probability of disaster goes down. LHS will increase (as delta gets smaller). RHS will decrease. That makes it look like, a low probability of disaster, makes it more attractive to implement the risky project.

A little bit different: keep delta*D constant. That is the expected loss under the risky project associated with disaster.

Now, let's increase D, but decrease delta. That means: disaster becomes more severe, but less likely to occur. Expected cash flow from the risky project is unchanged.

RHS above is unchanged. But the LHS increases. When delta is small, disaster is unlikely. That means that under the risky project, the manager is less likely to get a wage of zero (which is what happens when disaster occurs). This makes it more attractive for the manager to choose "risky".

Therefore, the owner must compensate the manager more, under the safe project, to convince them to implement it (rather than the risky one).

Assume: $g(0) > 0$, $g(1) > 0$.

Solution: Contract on State of Nature

State is "good" (prob 1- δ) or "bad" (prob δ)

Use shorthand g^0, g^1. **Question: write g^0, g^1 as functions of μ, ρ, δ, to get same probabilities of cash flows as on the previous slides**

	Safe	Risky
Good	1 with probability g^0 0 with probability $1-g^0$ -D with probability 0	1 with probability g^0+g^1 0 with probability $1-g^0-g^1$ -D with probability 0
Bad	1 with probability 0 0 with probability 1 -D with probability 0	1 with probability 0 0 with probability 0 -D with probability 1

Solution: Contract on State of Nature

That is, in the earlier slides, the unconditional probability of a positive cash flow under the safe project was mu. Now, on this slide, the corresponding probability depends somwhere on g0 and on the probability of the good or bad state

That is write down expressions for g^0, g^1, such that:

-under the safe project, the prob. of cash flow 1 is equal to μ;

-under the risky project, the prob. of cash flow 1 is equal to μ + ρ, and the prob. 0 is equal 1 – (μ + ρ + δ).

Write down an expression for g0 (in terms of for example mu and other parameters) required to give the same probability (mu) of positive cash flow as on the previous slides.

	Safe	**Risky**
Good	1 with probability g^0 0 with probability $1-g^0$ -D with probability 0	1 with probability g^0+g^1 0 with probability $1-g^0-g^1$ -D with probability 0
Bad	1 with probability 0 0 with probability 1 -D with probability 0	1 with probability 0 0 with probability 0 -D with probability 1

Cash flow 1 (safe) $= \mu$ (Lecture 14).

Now, cash flow 1 (safe) $= (1-\delta)\, g_0 + \delta \cdot 0$

$\Rightarrow \mu = (1-\delta) g_0 = (1-\delta) g_0$

$\Leftrightarrow \boxed{g_0 = \frac{\mu}{1-\delta}}$

Prob. success, risky project: $\mu + \rho = (1-\delta)(g_0 + g_1) + \delta \cdot 0$

$\Rightarrow \boxed{g_1 = \frac{\rho}{1-\delta}}$

Solution: Contract on State of Nature

State is ”good” (prob 1- δ) or ”bad” (prob δ)

Solution: $g^0 = \mu/(1-\delta)$. $g^1 = \rho/(1-\delta)$.

	Safe	**Risky**
Good	1 with probability g^0 0 with probability $1-g^0$ -D with probability 0	1 with probability g^0+g^1 0 with probability $1-g^0-g^1$ -D with probability 0
Bad	1 with probability 0 0 with probability 1 -D with probability 0	1 with probability 0 0 with probability 0 -D with probability 1

Solution: Contract on State of Nature

Contract consists of:
w(1,g)
w(0,g)
w(0,b)
w(-D,b) = 0

Suppose compensation can depend on both **reported cash flows** and the **state**

	Safe	**Risky**
Good	1 -> w(1,g) 0 -> w(0,g) -D ->	1 -> w(1,g) 0 -> w(0,g) -D ->
Bad	1 -> 0 -> w(0,b) -D ->	1 -> 0 -> -D -> w(-D,b)

Solution: Contract on State of Nature

Please concentrate on what values for w(0,g) and w(0,b) the owner should include in the contract. Should the owner pay the manager when they report a cash flow of zero? Should the amount the owner pays the manager for a cash flow of zero be larger in the good state or the bad state?

Question: under the optimal contract, whatshould be the values of w(1,g), w(0,g), w(0,b), w(-D,b)? Which of these should be strictly positive, and which should be zero? Focus on intuition.

Discuss (max 10 minutes); vote in the poll.

	Safe	Risky
Good	1 -> w(1,g) 0 -> w(0,g) -D ->	1 -> w(1,g) 0 -> w(0,g) -D ->
Bad	1 -> 0 -> w(0,b) -D ->	1 -> 0 -> -D -> w(-D,b)

Poll: Contract on State of Nature

Under the optimal contract, where the owner can contract both on reported cash flows and the state of nature, we have:

1. $w(1,g) = 0,\ w(0,g) > 0, w(0,b) > 0, w(-D,b) = 0$
2. $w(1,g) > 0,\ w(0,g) > 0, w(0,b) > 0, w(-D,b) = 0$
3. $w(1,g) > 0,\ w(0,g) = 0, w(0,b) > 0, w(-D,b) = 0$
4. $w(1,g) > 0,\ w(0,g) > 0, w(0,b) = 0, w(-D,b) > 0$
5. $w(1,g) > 0,\ w(0,g) = 0, w(0,b) = 0, w(-D,b) = 0$

Answer 3. is most popular and is also correct!

Go to socrative.com, room 897458, and vote for what you think is the best answer

Don't reward report of 0 when it is a "negative" outcome (i.e. in the good state). Makes it relatively cheap to provide incentives for honest reporting.

Reward report of 0 only when it is a "positive" outcome (i.e. in the bad state). Provides incentives to choose safe project.

	Safe	**Risky**
Good	1 -> w(1,g) = λ 0 -> w(0,g) = 0 -D ->	1 -> w(1,g) = λ 0 -> w(0,g) = 0 -D ->
Bad	1 -> 0 -> w(0,b) > 0 -D ->	1 -> 0 -> -D -> w(-D,b) = 0

Owner will always get the manager to implement safe project
Manager gets same expected payment as for risky project

Assume for now, the manager gets the same expected payment under the owner-preferred contract that implements the safe project, and the one that implements the risky project.

Then, the owner would like to implement the safe project because it is more efficient (and now, unlike in lecture 14, the expected wage payments are equal to those under the risky project).

	Safe	**Risky**
Good	1 -> w(1,g) = λ 0 -> w(0,g) = 0 -D ->	1 -> w(1,g) = λ 0 -> w(0,g) = 0 -D ->
Bad	1 -> 0 -> w(0,b) > 0 -D ->	1 -> 0 -> -D -> w(-D,b) = 0

Manager incentives for risk taking:

Manager expected wage under the safe project

$= (1-\delta) g^0 \lambda + \delta \cdot 1 \cdot$ w(o,b)

What you can do, is increase w(0,b) just enough so that the expression for manager payoff under the safe project equals exactly that under the risky project

Manager expected wage under the risky project:

$= (1-\delta)(g^0 + g^1)\lambda + \delta \cdot 0$

$= (1-\delta)(\mu+\rho)\lambda$

$= (\mu+\rho)\lambda$

Application of state-contingent contract

1. **Allowing for more complete contracts can increase efficiency**: condition on the bad state ("disaster" state)
2. Implementation: during good times, offer manager out-of-money put options on firms in same industry
3. High payoff when these firms face disaster
4. Caveat: only valid when manager's firm stays afloat
5. Effectively rewards intermediate outcome (solvency, cash flow of zero) in disaster state.

Question

DeMarzo et al. suggest that firms could implement the optimal state-contingent contract by offering managers out-of-money put options on firms in the same industry, which can only be paid if the managers' firm stays solvent.

Question: what (if any) is the connection between this proposal and the ideas in the article "Why Your Boss is Overpaid" from Forbes?

Please take a few minutes to think about this question, and discuss with your neighbours.

Discussion

”Why Your Boss is Overpaid” talks about tournament incentives – relative performance evaluation

Reward not for being good, but for being better than your rivals

Relative performance may sometimes provide more useful information than absolute performance

Protect people from risks they cannot control

This is what DeMarzo et al. suggest:

reward a firm with options that become valuable if and only if others fail (and the firm itself stays afloat)

Dynamic Model

In the lectures, we have looked at the static model of DeMarzo et al. (2014)

The authors also consider a dynamic model in continuous time

Technically much more complicated!

We will take a brief, informal look, and touch on what extra insights the dynamic model generates.

Main ingredients:

-Cash flow stream is stochastic (Brownian motion).

-At each point in time, agent chooses (i) whether to truthfully report cash that is generated or to divert, (ii) safe or risky project

-Drift given by μ (safe project) or $\mu + \rho$ (risky project)

-Possible disaster outcome (Poisson process). Leads to project liquidation, if project was risky when disaster arrives

Dynamic Model (continued)

The principal would like the agent to choose the low-risk project and to report cash flows truthfully.

Similar tradeoff as in the static model:

-providing the agent **with incentives for truthful reporting** is costly

-must reward agent for high reports, but this **affects incentives for risk**

New element in dynamic model:

-**Extra insight:** agent's incentive to choose risky project depends on his continuation payoff (forward-looking)

-if continuation payoff is relatively low under safe project (say close to zero), then agent prefers to switch to risky project.

-Why? With low continuation payoff, the agent suffers little if disaster occurs and leads to project liquidation

Intended outcomes revisited

1. **To finish** deriving the optimal contract.

The optimal contract may implement the inefficient, risky project, because implementing the safe project is more costly; in particular when the probability of disaster is very low but the impact of disaster is very severe.

2. To analyze how making contracts more complete (conditioning on state of nature) affects efficiency/project selection

Reward positive cash flow in good state, zero cash flow in bad state. Provide incentives for project selection without affecting incentives for truthful reporting.

3.To relate DeMarzo et al's proposal of how to implement such a contract to the ideas in the article "Why Your Boss is Overpaid" from Forbes.

Offering incentives based on relative performance can make sense, in particular in situations where relative performance provides more useful information than absolute performance.

For next time

Take at first look at Fahn et al. (2019)

Think about the following question:

What is the key market friction by which debt levels affect firm value in their setting?

Be ready to share your thoughts next time!