Moral Hazard Reduction in Entrepreneurial Financing An application to Profit and Loss Sharing Contracts

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Moral Hazard Reduction in Entrepreneurial Financing An appliaction to Profit and Loss Sharing Contracts ☆

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Abstract

In profit and loss sharing contracts, profits are shared according to a specific ratio while losses are shared according to each partner contribution ration in the project's capital. We aim to reduce entrepreneurial effort shirking in a profit and loss sharing contract involving a VC and an entrepreneur. We use a game theoretic approach and try to find the profit-sharing ratio that would reduce the moral hazard risk of effort shirking. The game theoretic approach allows for the development of a profit-sharing ratio span of negotiation that fulfil both the incentive and participative constraints of the PLS participants

Keywords: Finance, Optimal contracts, Moral hazards, Profit and loss sharing contracts, Span of Negotiation.

☆MusharakaHcont is a form of profit and loss sharing contracts

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1. Introduction

The role of VC as a financier for start-ups is increasing. yet the innovative nature of those start-ups carries a great element of failure risk Bergemann and Hege (1998). The main comparative advantage of VCs over other financing mechanisms such as debt or angel financing is their expertise. This can help entrepreneur in improving the strategies and the performance of their work.
Despite this advantage, VC are suffering from asymmetric information in the formal of moral; hazards. For example, problems can arise between entrepreneurs and VC after a project is being undertaken.
To mitigate against this problem, it is suggested that decision making power should be balanced by having each party controlling decisions at each stage of the project life. Aghion and Bolton (1992) ,Dewatripont and Tirole (1994) Dewatripont and Tirole (1994),Dessein (2002)

Other forms of dealing with moral hazards urges VC to dictate a rate of return Mason and Harrison (2002), Manigart et al. (2002). In our case the profit sharing is negotiated rather than dictated by the VC.
There are also external risks faced by VCs Kaplan and Strömberg (2004). For example, demand for newly launched products, extent of market competition, as well as how financial markets are perceived can affect VCs entry and exit stages.
When it comes to tackling the issue of demand, we allow for a flexibility in the project return. Also, the competition problem is reflected indirectly in the demand function.
We build a model based on a profit and sharing contract. Profits for each participant is determined by expected profits and not based on a fixed profit or percentage of investment. Also, losses are shared based on each participant share of capital, rather than a fixed loss. This is different form standard VC contracts where a VC can demand higher part in the case of loss, or even claim the totality of the residual value of the project.
We try to reduce moral hazards in the form of effort shirking. However there is no model that can eliminate it , we ca only reduce it Elitzur and Gavious (2003).
Our paper proceeds as follows: In section 2 we present the model. In section 3 we provide the methodology. Sction 4 presents a discussion of the results. Section 5 , concludes with possible further extensions.

2. The model

We aim to reduce entrepreneurial effort shirking in a profit and loss sharing contract involving a VC and an entrepreneur. The entrepreneur is endowed with an initial wealth and requires additional funding. The entrepreneur can exercise a hight or low level of effort e_i: $i \in \{l, h\}$. Both levels can determine the level of success of the project which can yield a stochastic return R:

$$E(R|e_i) = \int_0^R Rf(R|e_i)dR \tag{1}$$

where R_e , VC are the share of the project output of the entrepreneur and the VC respectively: R_v such that R = R_e+ R_v . the projcets can take two stockastic values $\overline{R} \geq I$ and lower values $0 \leq \underline{R} \leq I$ suc that:

$$E(\overline{R}|e_i) = \int_I^R Rf(R|e_i)dR \tag{2}$$

and

$$E(\underline{R}|e_i) = \int_0^I Rf(R|e_i)dR \tag{3}$$

Because the output under high effort is assumed to be higher than that under low effort , we conclude that the cumulative density function based on high effort on e_h first-order stochastically dominates the cdf based on low effort on e_l:

$$F(R|e_h) \leq F(R|e_l) \text{ for all R} \in [\underline{R}, \overline{R}]$$

and therfore the exected return under the high effort is greater than that under low effort. i.e.

$$E(R|e_h) = \int_0^R Rf(R|e_h)dR > E(R|e_l) = \int_0^R Rf(R|e_l)dR \tag{4}$$

The Vc has a reservation utility of Uv = 0 while the entrepreneur has a reservation utility of U$\geq$ 0

3. Methodology

We have a one period game where the entrepreneur and the VC have a contractual agreement (x; I, α, β=x)

Where :

- X = Capital contribution of Vc
- I = Project capital
- β : VC share of loss
- α : VC share of profit

The specific terms of the PLS contracts dictates that the losses cannot exceed each participant's percentage share in the capital of the firm.

In exercising a effort the entrepreneur endures a disutility $D(e_i) : i \in \{l, h\}$ depending on the effort levlsuch that $D(e_l) > D(e_h)$. this means that the entrepreneurs endures a higher disutility if he/she exercises a higher effort.

the expected cash flows for each participant are given as:

$$E(\overline{R}_v) = \alpha E(\overline{R}); E(\overline{R}_e) = (1 - \alpha)E(\overline{R}) \tag{5}$$

In order to find the optimal sharing ration of profit, we will construct the model under two cases: 1)Observable effort and 2) unobservable effort.

4. Results

4.1. 1) Observable effort case

since effort is observed by the Vc, the entrepreneur is committed to perform a high effort and cannot deviate from such commitment. Therfore the VC would assign a sharing ratio that would make the entrepreneur just break even. Formally:

$$\min_{R_m(R)} \int_I^R \overline{R}_m f(R|e_h)dR + \int_0^I \underline{R}_m f(R|e_h)dR$$

S.t

$$\int_I^R \overline{R}_m f(R|e_h)dR + \int_0^I \underline{R}_m f(R|e_h)dR - D(e_h) \geq U$$

Taking the First order derivative with respect to $\overline{R}_m$ and applying lagrange multiplier λ. we get:

$$-\int_I^R f(R|e_h)dR + \lambda \int_I^R f(R|e_h)dR = 0$$

this gives

$$\lambda = 1 \tag{6}$$

we can then conclude that the participation constraint can be set to equality:

$$\int_I^R \overline{R}_m f(R|e_h)dR + \int_0^I \underline{R}_m f(R|e_h)dR - D(e_h) = U \tag{7}$$

Given that the sharing ratios are fixed in advance, we cannot change them in the due course of the project. Therefore we can safely replace $\overline{R}_e$ by $(1-\alpha)\ \overline{R}$ and $\underline{R}_m$ by $(1-\beta)\ \underline{R}$

Equation 3, then becomes:

So we can reset equation 3 and taking off the fixed ratios from the integrals:

$$(1-\alpha)\int_I^R \overline{R} f(R|e_h)dR + (1-\beta)\int_0^I \underline{R} f(R|e_h)dR - D(e_h) = U \tag{8}$$

The profit-sharing ratio can then be given as:

$$\alpha = 1 - \frac{U + D(e_h) - (1-\beta)\displaystyle\int_0^I \underline{R} f(R|e_h)dR}{\displaystyle\int_I^R \overline{R} f(R|e_h)dR} \tag{9}$$

or in a shorthand formula:

$$\alpha = 1 - \frac{U + D(e_h) - (1-\beta)E(\underline{R}|e_h)}{E(\overline{R}|e_h)} \tag{10}$$

4.2. The unobservable effort case

The VC suffers moral hazards as he/she cannot observe the effort of the entrepreneur. to assess this problem , the VC establishes two kinds of probabilities:

- Entrepreneur's type probability θ_h: This the probability that the entrepreneur would exercise a high effort
- Performance probability: probability of project success given an effort level

Due to this asymmetric information case, the Vc is in an informational disadvantage while the entrepreneur is in informational advantage and can extract a private benefit if he/she performs a low effort.

The contract need to take into consideration those specific constraints of the unobservable effort case:

- Participation constraints PCF and PCM: where both participants (Financier Manger) are at least breaking even.
- Incentive compatibility constraints ICM: where only the manager is Offred a profit-sharing ratio that will encourage him to exert high effort rather than shirking.

Therefore the objective of the VC is to maximise his return while taking into consideration the Participation constraints and Incentive compatibility constraints Formally:

$$\max_{R} \int_0^1 \theta_i g(\theta_i) d\theta_i \int_0^R R_f f(R|e_i) dR \tag{11}$$

subject to constraints:

$$PCF : \int_0^1 \theta_i g(\theta_h) d\theta_i \int_0^R R_f f(R|e_i) dR \geq \beta I \tag{12}$$

$$PCM : \int_I^R \overline{R}_m f(R|e_h) dR + \int_0^I \underline{R}_m f(R|e_h) dR - D(e_h) \geq U \tag{13}$$

$$ICM : \int_I^R \overline{R}_m f(R|e_h) dR + \int_0^I \underline{R}_m f(R|e_h) dR - D(e_h) \geq \int_I^R \overline{R}_m f(R|e_l) dR + \int_0^I \underline{R}_m f(R|e_l) dR - D(e \tag{14}$$

The Vc sharing ratio α can be solved using the technique of game theory. We identify the minimum acceptable ratio α_{pce} for the entrepreneur to break even:

$\int_I^R \overline{R}_m f(R|e_h)dR + \int_0^I \underline{R}_m f(R|e_h)dR - D(e_h) \geq U$ Replacing $\overline{R}_m$ by $(1-\alpha)\overline{R}$ and $\underline{R}_m$ by $(1-\beta)\underline{R}$. We get:

$$\alpha \leq 1 - \frac{U + D(e_h) - (1-\beta)\int_0^I \underline{R} f(R|e_h)dR}{\int_I^R \overline{R} f(R|e_h)dR} \tag{15}$$

Or in a shorthand formula

$$\alpha \leq \alpha_{pcm} = 1 - \frac{U + D(e_h) - (1-\beta)E(\underline{R}|e_h)}{E(\overline{R}|e_h)} \tag{16}$$

We then identify the ratio α_{ice} to incentivize the entrepreneur to exercise a higher effort.

$$(1-\alpha)E(\overline{R}|e_h)+(1-\beta)E(\underline{R}|e_h)-D(e_h) \geq (1-\alpha)E(\overline{R}|e_l)+(1-\beta)E(\underline{R}|e_l)-D(e_h)+S \tag{17}$$

α then become :

$$\alpha_{inc} \leq 1 - \frac{S + \Delta D - (1-\beta)\Delta\underline{R})}{\Delta\overline{R}} \tag{18}$$

where: $\Delta D = D(e_h) - D(e_l); \Delta\underline{R} = E(\underline{R}|e_h) - E(\underline{R}|e_l); \Delta\overline{R} = E(\overline{R}|e_h) - E(\overline{R}|e_l)$

Therfore we must have

$$\alpha \leq \min\{\alpha_{ice}; \alpha_{pce}\} \tag{19}$$

in order for α to fulfil the incentive and participation constraints of the entrepreneur

From the Vc point of view, he/ she is in comparative disadvantage and therefore his/her main aim is to break even. the sharing ratioα_{pcf} that would allow the financier to just break even can be formulated as:

$$\int_0^1 \theta_h g(\theta_h)d\theta_h[\int_0^I \underline{R}_f f(R|e_h)dR \int_I^R \overline{R}_f f(R|e_h)$$
$$+(1 - \int_0^1 \theta_h g(\theta_h)d\theta_h)[\int_0^I \underline{R}_f f(R|e_l)dR \int_I^R \overline{R}_f f(R|e_l) \geq \beta I$$

Where $\int_0^1 \theta_h g(\theta_h) d\theta_h$ is the expected probability $E(\theta)$ that the entrepreneur is going to excercise a high effort.

Formalizing the integrals using expected values and replacing $\overline{R}_f$ by $\alpha\overline{R}$ and $\underline{R}_f$ by $\beta\underline{R}$. we get:

$$E(\theta_h)[\beta E(\underline{R}|e_h) + \alpha E(\overline{R}|e_h]) + (1 - E(\theta_h)[\beta E(\underline{R}|e_l) + \alpha E(\overline{R}|e_l]) \geq \beta I$$

Solving for α we get:

$$\alpha \geq \alpha_{pcf} = \frac{B[I - \theta_h \Delta\underline{R} - E(\underline{R}|e_l)}{\theta_h \Delta\overline{R} + E(\overline{R}|e_l)} \tag{20}$$

Finally , we need to establish a span of negotiation over the profit sharing ratio. α has to lie down between two values α_{pcv} and $\min\{\alpha_{inc}; \alpha_{epc}\}$. or Formally:

$$\alpha_{pcf} \leq \alpha \leq \min\{\alpha_{icm}; \alpha_{pcm}\} \tag{21}$$

We can then formulate a span of negotiation of the profit-sharing ratio

$$\min\{\alpha_{icm}; \alpha_{pcm}\} - \alpha_{pcf} \tag{22}$$

5. Conclusion

We have tried to reduce Moral Hazards (entrepreneurial effort shirking) in a PLS contract. low effort in this context can lead to a higher probability of the project's failure. We used game theory techniques under both observable effort (symmetric information) and unobservable effort (asymmetric case). We have managed to establish a span of negotiation around the profit-sharing ratio. This case allows for more flexibility in the negotiation rather than having the profit-sharing ratio dictated by the VC. This span of negation satisfies both the incentive as well as the participation constraints of both parties.

This model can be extended using agent-based simulation. the later will help calculating optimal profit sharing under different users customised setting.

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