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MT–**DP.** 2002/15

SUPPORT AND INTERFERENCE:

VENTURE FINANCING WITH MULTIPLE TASKS

IBOLYA SCHINDELE

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Hungarian Academy of Sciences

Budapest

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Support and Interference: Venture Financing with Multiple Tasks

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SUPPORT AND INTERFERENCE:

VENTURE FINANCING WITH MULTIPLE TASKS

IBOLYA SCHINDELE

Abstract

The paper focuses on the financing possibilities for capital constrained entrepreneurs when venture financiers perform two tasks, monitoring and advice. We model advice as effort that results in an increase in the probability of success. In turn, we consider monitoring as an activity exerted to control entrepreneurial project choice, which results in an increase in the returns in the less successful state. Thus entrepreneurs favor advice and dislike monitoring. Through the financial claim offered, an entrepreneur can affect the financier's effort exertion on the two tasks. The primary result is that highly capital constrained entrepreneurs can get financing only with intense monitoring and limited advice. The optimal financial claim resembles to a convertible debt contract. Entrepreneurs endowed with more self-financing can restrain the level of monitoring, thus induce more advice, and can offer an equity contract. The results may shed light on contracting practices observed in the venture capital industry, namely the unusual negative correlation between control and cash-flow rights and the use of a variety of securities.

TANÁCSADÁS ÉS KONTROLL: VÁLLAKOZÁS-FINANSZÍROZÁS BEFEKTETŐI FELADATOKKAL

SCHINDELE IBOLYA

Összefoglaló

A cikk a tőkeszegény vállakozók finanszírozhatóságát elemzi. A fő feltevés az, hogy a befektető a pénzforrás biztosítása mellett, tanácsadói és ellenőrző funkciókat is ellát. A modellben a tanácsadói tevékenység növeli a projekt jövőbeli sikeres lezárásának valószínűségét. Az ellenőrző funkció lehetővé teszi a vállakozó üzleti tevékenységének kontrollálását, ami növelheti a végső hozamot a projekt sikertelen lezárása esetén. A vállalkozó szempontjából, a tanácsadás értékes, viszont az ellenőrzés nem kívánatos. Az általa felajánlott finanszírozási forma (értékpapír-típus) segítségével, a vállalkozó képes befolyásolni a befektetői tevékenység intenzitását a két funkciót illetően. Eredményeink szerint, erősen tőkeszegény vállakozók korlátolt mértékben kapnak befektetői segítséget és csak nagyfokú kontroll mellett finanszírozhatók. A vállalkozó által felajánlott értékpapír ez esetben (részvényre) átváltható hitel. Több saját tőkeerővel rendelkező vállakozók esetében az ellenőrzés korlátozott mértékű lesz, míg a tanácsadás hangsúlyos szerepet kap. Az optimális finanszírozási forma ilyen vállakozók számára a részvény. Ezen eredmények elméleti alapot nyújtanak számos, a kockázati tőkebefektetők es vállakozók viszonyában megfigyelt szerződéskötési sajátosságot illetően. Nevezetesen, igazolják a cash-flow és kontroll jogusoltságok közötti szokatlan negatív összefüggést és rámutatnak arra, hogy a kockázati tőkebefektetők és vállakozók számára optimális a többféle értékpapírtípus használata (ez utóbbi új eredmény az elméleti irodalomban).

Support and Interference: Venture Financing with Multiple Tasks

Ibolya Schindele*

Draft: November, 2002

Abstract

The paper focuses on the financing possibilities for capital constrained entrepreneurs when venture financiers perform two tasks, monitoring and advice. We model advice as effort that results in an increase in the probability of success. In turn, we consider monitoring as an activity exerted to control entrepreneurial project choice, which results in an increase in the returns in the less successful state. Thus entrepreneurs favor advice and dislike monitoring. Through the financial claim offered, an entrepreneur can affect the financier's effort exertion on the two tasks. The primary result is that highly capital constrained entrepreneurs can get financing only with intense monitoring and limited advice. The optimal financial claim resembles to a convertible debt contract. Entrepreneurs endowed with more self-financing can restrain the level of monitoring, thus induce more advice, and can offer an equity contract. The results may shed light on contracting practices observed in the venture capital industry, namely the unusual negative correlation between control and cash-flow rights and the use of a variety of securities.

Keywords: Financial Contracting, Venture Capital, Moral Hazard

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1 Introduction

This paper focuses on the roles of venture capitalists as advisors and monitors to entrepreneurial projects. In addition to their financing role, venture investors actively participate in entrepreneurial projects and thus fulfil different roles than traditional financiers such as banks. In the literature, both the advising and monitoring roles received substantial attention. Although the importance of both activities have been emphasized, the interrelation between the two roles has been relatively unexplored[1]. This paper is a first attempt to propose a clear distinction between the tasks of advising and monitoring and to account for both activities at the same time.

Our analysis identifies a conflicting nature of advice versus monitoring. Advice is congruent, while monitoring is dissonant with respect to entrepreneurial interests. We show that the financier's incentives for advice are in line with, while those for monitoring differ from entrepreneurial incentives. The financier has thus two tasks with conflicting incentives. Through the financial contract offered, an entrepreneur seeks a balance to promote both advice and monitoring. While the entrepreneur prefers advice, monitoring is needed to increase the chance for getting financing when the financier is subject to entrepreneurial moral hazard. In equilibrium, capital constrained entrepreneurs are extensively monitored and receive limited support. They are restricted, by the need for financing, to offer less risky, convertible securities or debt. More capital rich entrepreneurs are able to restrain monitoring and stimulate investor's advice by issuing more convex claims, such as equity.

There exists ample evidence that venture investors accomplish both advising and monitoring activities. Focusing on the professionalization of Silicon Valley start-ups, Hellmann and Puri (2002) find that venture capitalists play both supportive and controlling roles in building up human resource policies at small entrepreneurial ventures. Sapienza, Manigart and Vermeir (1996) analyze the involvement of venture financiers in their portfolio companies, distinguishing between support and governance. Kaplan and Stromberg (2002) also define the two activities as different: they associate monitoring with interference in human resource policies at entrepreneurial firms [2].

In the theoretical literature, most papers focus on the advising task, emphasizing the double-sided nature of the moral hazard problem involved in the relationship (Casamatta (2000), Inderst and Muller (2002), Repullo and Suarez (1999), and Schmidt (2000)). The advising activity is modelled as effort exertion by the investor, which leads to an increase in the probability of success. Our definition of advice is equivalent. Dessi (2002) discusses the monitoring role of venture investors and points out the interest in collusion with the entrepreneur.

[1] To our knowledge, the only exception is Cestone (2001).

[2] Apart from the empirical results, anecdotal evidence also supports the view that venture financiers both help entrepreneurs and intervene in their actions. They play important roles in recruiting personnel, establishing business strategies, or marketing new products. At the same time, they often substitute the original founders with new outside managers, which is a concern of many start-up entrepreneurs seeking for financing.

Here, the monitoring activity indirectly increases the success probability, by reducing the opportunity cost of exerting effort for the entrepreneur. Several papers associate monitoring or intervention in entrepreneurial actions with the right to substitute the original founder with a professional manager (Chan, Siegel, and Thakor (1990), Hellmann (1998)) in order to realign the preferences of the desision maker with those of the investors. Our definition of monitoring is consistent with this approach. We consider both support (advising) and interference (monitoring). We show that the two tasks may require different incentives: stimulating the monitoring activity may decrease the intensity of advice. When the entrepreneur also needs appropriate incentives, capital constraints may limit the possibility for inducing the investor's effort exertion on advice.

We study the contracting problem of an entrepreneur seeking financing for an uncertain project. Active participation of an investor in the project increases value and therefore the chance for getting financing. We associate advice with effort exertion to increase the mean of the outcome distribution. In turn, we consider monitoring as the investor's means to influence entrepreneurial project choice. The price of interference is a loss in the entrepreneur's private benefits. The entrepreneur prefers high effort on advice and no monitoring, since the first increases while the latter decreases her expected utility. We show that the financier's incentives for effort exertion on the two tasks will depend on the size of the entrepreneur's initial capital endowment and thus the extent of the entrepreneurial moral hazard problem. When capital constraints are severe, in order to get financing the entrepreneur is forced to choose a cash-flow allocation that results in intense monitoring and low advice. As a result, she obtains low expected returns. When her initial capital endowment exceeds a certain level, she is able to limit monitoring and increase advice. Thus the entrepreneur faces a trade-off between the terms of financing and the effort on his favored task, advice.

The intuition lies in the definition of the two tasks. Advising increases value by raising the chance for high returns, which decreases the probability of the less successful state. Interference increases the return in the liquidation stage and thereby reduces risk. As a consequence, advising lowers the ex-ante value of monitoring. In turn, monitoring reduces the need for the intensive provision of advice. Since the entrepreneur wants high advising and low monitoring, she needs to provide the investor a high share in the success state returns and a low share in the liquidation proceeds. The allocation of more liquidation value to the financier however facilitates financing, for it increases the ex-ante value of the project. As a result, when the entrepreneur is capital constrained, monitoring will be intensive and advice will get lower attention, which reduces the entrepreneur's expected returns. Only if the entrepreneur has sufficient self-financing, can she afford to induce advice and restrain monitoring.[3]

[3]Monitoring in our model is disliked by the entrepreneur because it reduces her private benefits as well as her expected returns. The existence of positive private benefits is, however, not a necessary condition to obtain our results. The implications of the model arise as a consequence of the interrelation of effort on advice and monitoring, in the presence of

Our paper is closest in spirit to Cestone (2001), the only paper in the literature, to our knowledge, which accounts for both support and interference by venture investors. In that paper, venture capitalists exercise more control when holding risky claims, which is beneficial but may hinder entrepreneurial initiative. Thus a trade-off arises between control and cash-flow rights. To keep the entrepreneur motivated, investors should have formal control only when the riskiness of their claim is limited. Our results have the same implication although for different reasons. Since monitoring requires having control, we obtain the following equilibrium. When the entrepreneur is more capital constrained, she offers a less risky (convertible) security and allocates control to the investor. When financing constraints are less severe, the financier holds an equity claim and has no control rights.

The paper clearly relates to the literature on multitask moral hazard analysis. In Holmstrom and Milgrom (1991), agents performing two tasks have an effort allocation problem because their time and attention is limited. Although, incentives for tasks do not conflict, a substitution of effort may occur because performance on one task is hardly observable and thus not measurable. Our work is more in line with Dewatripont and Tirole (1999), where a direct incentive conflict between tasks arises. Justifying the existence of advocates in organizations, they show that efficient information production requires tasks with conflicting incentives to be allocated to different interest groups. While different in focus, our approach is similar: we model an incentive conflict between the tasks accomplished by venture capitalists, advising and monitoring. In this context, the entrepreneur has a favored task: advice. In order to obtain financing, however, she needs to incentivize monitoring as well, which in turn decreases the investor's effort exertion on advice.

Predictions from our model may provide an explanation for some observed features of venture financing agreements, namely the unusual pattern of cash-flow and control rights and the diversity of securities venture financiers tend to use. Evidence suggests that venture financing contracts often allocate the holders of less risky claims a variety of control rights, while owners of risky securities are given limited or no control (Cumming (2002), Kaplan and Stromberg (2002)). Assuming that the monitoring activity requires having control, our model suggests that in equilibrium, convertible and straight debt may be offered together with control rights, while riskier claims are issued with no control. Moreover, the model provides theoretical grounds for the use of a variety of securities in venture financing (for empirical evidence see Bascha and Walz (2001), Cumming (2000) and (2002), Kaplan and Stromberg (2002)). Specifically, it offers a testable implication: the convexity of the investor's financial claim depends on the extent of entrepreneurial moral hazard and capital constraints. In the presence of moral hazard, a capital constrained entrepreneur needs to issue a less risky claim which stimulates monitoring and limits effort exertion on advice. Only entrepreneurs endowed with sufficient capital can issue more convex securities, thereby inducing advice and restraining intervention by

entrepreneurial moral hazard and capital constraints.

the investor.

The setup of the paper is as follows. The next section describes the model, emphasizing the distinction between the financier's two tasks. Section 3 assumes effort is contractible and describes the first best effort levels on advice and monitoring. Section 4 addresses information problems: it assumes non-contractible effort and characterizes incentive compatible cash-flow allocations. Section 5 summarizes the results and concludes.

2 The model

The economy consists of two types of agents: entrepreneurs and venture capitalists[4]. Entrepreneurs have unit mass and are uniformly distributed in terms of their capital endowment I_e over the interval $[0, I]$. Each entrepreneur is endowed with a project idea which requires an investment I. The model has two dates, t=0,1. At t=0 investment in some projects occurs and actions are taken, and at t=1 the state of the world is realized. Three types of states can arise: a state of successful termination providing a high return H, a medium state with a low return L ($H > L > 0$), and total failure with 0 revenues. Project returns are observable and verifiable in all states. All agents are assumed to be risk-neutral and entrepreneurs are protected by limited liability.

We distinguish between two projects: ambitious (riskier) and commercial (less risky). The primary difference is that the less risky project provides a positive liquidation value L in the failure state, while the risky one brings zero revenues in case of unsuccessful termination. However, the entrepreneur obtains private benefit (knowledge, prestige, or reputation) from a risky project. Since verifiable returns in the success state are equal to H for both projects, an investor would always prefer to realize the less risky one[5].

2.1 Entrepreneurs

The contracting parties face substantial uncertainty concerning the final state of nature. They may however influence project outcome by undertaking privately costly actions. If an entrepreneur incurs a cost of exerting effort C, the probability of the most successful state is $p_H \in [0, 1]$, and with probability $1 - p_H$, the outcome will be either L or 0 (it depends on the type of the project). If the entrepreneur avoids exerting costly effort, the probability of success becomes $p_L < p_H$, $p_L \in [0, 1]$. When entrepreneurial effort is not observable, a situation of moral hazard arises for potential financiers.

When the ambitious project is carried out the entrepreneur obtains private benefits of size $B > 0$. The entrepreneur's preferences over the two projects

[4] Outside, uninformed investors may also be considered as potential providers of financial resources. In this model, however, we assume that venture investors are the sole source of finance. In practice, uninformed investors do not participate in start-up projects, especially not in the early stage when venture investors play a necessary role.

[5] Note that agents are risk-neutral. The reason for an investor to prefer the less risky realization is that it results in a higher average return.

depend on the relative size of her private benefits and cash-flows in the medium state. When private benefits are sufficiently large ($B > (1 - p_H) L$), the entrepreneur will always prefer the risky realization.

We can interpret the choice between two projects as taking either a "scientific" (risky) or a "commercial" (less risky) approach in project realization. Venture financiers, focusing on innovation, tend to finance entrepreneurs with a research-oriented attitude. An innovative entrepreneur may favor a "scientific approach" which gives her opportunity for substantial experimentation and thus learning. The experience she gains may provide her benefits in the form of scientific reputation or knowledge, which can be used in new projects. This approach can however be too costly to a financial investor as it produces no returns in case of failure. This seems to be a natural way of formalizing the conflict of interests between venture investors and entrepreneurs concerning project realization, which often results in the substitution of original founder entrepreneurs with new professional managers, an issue addressed by several empirical and theoretical papers in the venture capital literature (for example Chan, Siegel, and Thakor (1993), Hellmann (1998), Hellmann and Puri (2002)).

2.2 Venture Financiers

Venture capitalists are the only source of finance in this model. Besides providing financial resources, they actively participate in entrepreneurial projects through performing monitoring and advising activities. Exerting costly effort $e_a \in [0, 1]$, a venture financier increases the probability of success by $e_a \tau$, $0 < \tau < 1$, so that τ measures the efficiency of advice. Monitoring involves supervising entrepreneurial choices to ensure that the less risky ("commercial") project prevails.In this case, even an unsuccessful termination brings a positive liquidation return L. The monitoring effort $e_m \in [0, 1]$ by the financier raises, with probability e_m, the low-state outcome from 0 to L. Monitoring represents the investor's effort to direct the project towards a less-risky realization. Thus advising, increases the mean of the outcome distribution while monitoring, works along both the first and second order stochastic dominance dimensions as it increases the mean and decreases variance at the same time.

Effort costs are $\frac{e_a^2}{2K}$ and $\frac{e_m^2}{2K}$ for advice and monitoring, respectively. We assume that K and τ are sufficiently small:

$$KH < 1 \tag{A1}$$

$$\tau < 1 - p_H \tag{A2}$$

Assumption (A1) is intuitive: the cost of advice and monitoring is sufficiently high in the sense that receiving all cash flows would not provide sufficient incentives for the financier to exert maximum effort on both tasks even if success occurs with probability 1. Assumption (A2) ensures the role for monitoring: the investor is not able to eliminate the possibility of unsuccessful termination, even if the entrepreneur works and maximum effort is exerted on the advising task ($1 - p_H - \tau > 0$). In other words, the efficiency of advice τ is sufficiently

low thus project outcome is uncertain even when both parties exert maximum effort.[6]

We make the following assumptions about the project. On the condition that the entrepreneur works, the project is valuable even if the financier exerts no effort.

$$p_H H - I + B - C > 0 \tag{A3}$$

When the entrepreneur does not work, the project is not worthwhile to realize, even if the venture financier exerts maximum effort on both tasks. The entrepreneur's effort is thus indispensable for external financing to be worthwhile.

$$(p_L + \tau) H + (1 - p_L - \tau) L - I + B - C - \frac{1}{K} < 0 \tag{A4}$$

3 First-best contract

In this section, we assume that effort is observable and verifiable, thus contractible. Under this assumption, the allocation of profits does not matter for the provision of incentives for either of the parties as direct compensation contracts ensure first-best effort levels.

We consider three different situations. First, we examine the case of a passive financier who neither helps the entrepreneur through the provision of advice nor engages in monitoring. Second, we study only the monitoring task, when the financier is able to interfere in the entrepreneur's project choice. Finally, we consider an investor active in both advising and monitoring. In all three situations the first-best contract maximizes the joint surplus of the parties including the entrepreneur's private benefits.

When the financier is passive, the value of the project depends exclusively on whether the entrepreneur exerts effort. When effort is contractible, the only requirement for a contract is to ensure the entrepreneur's and the investor's participation. Note that since there is no monitoring, the risky realization is always chosen and the entrepreneur earns his private benefits with probability one.

With a one-task monitor, the expected value of the project depends on the entrepreneur's effort choice (works or shirks) and the level of monitoring e_m. The contract defines the first best effort on monitoring e_m^{FB} and ensures the participation of both parties. Intense monitoring is welfare increasing as long as private benefits are sufficiently low. In particular, we can define two threshold levels of the size of entrepreneurial private benefits: $\widehat{B} = (1 - p_H) L - \frac{1}{K}$ and $\widehat{\widehat{B}} = (1 - p_H) L$. The result follows.

[6] In practice, monitoring and advising costs are indeed high at projects aiming at the development of brand-new products or new innovative technologies: to be able to contribute, the financier needs to acquire sufficient expertise in specific, research intensive sectors. Also, venture financed projects are highly uncertain: a high percentage of entrepreneurial projects end up liquidation.

Proposition 1 *When the financier is active in one-task (monitoring), and private benefits are such that*
a, $B \leqslant \widehat{B}$*, monitoring should be at its maximum level* $e_m^{FB} = 1$*,*
b, $\widehat{B} \leqslant B < \widehat{\widehat{B}}$*, the first best monitoring effort is positive:* $e_m^{FB} = K\left[\left(1 - p_H\right) L - B\right]$*,* $0 < e_m^{FB} < 1$*,*
c, $B \geqslant \widehat{\widehat{B}}$ *monitoring does not add to the value of the project, thus* $e_m^{FB} = 0$*.*

Proof. see Appendix. ■

The result suggests that the first best effort on monitoring depends on the size of private benefits relative to the value of liquidation proceeds. If private benefits are substantial, the entrepreneur should be allowed to carry on with the risky realization. Otherwise, there should be positive monitoring, which increases the chance that the less risky project is chosen. Below a small threshold of the level of private benefits, monitoring should be at its maximum, which brings along the less risky realization with probability 1.

In the case of a multitask financier, the relative value of private benefits and liquidation returns determines which activity is the more valuable task. When entrepreneurial private benefits are high, advice is more valuable than intervention. In particular, we can define three (endogenous) thresholds:

$B^* = \left(1 - p_H\right) L - \frac{H}{LK}$;

$B^{**} = \left(1 - p_H\right) L - \frac{1}{K} - K\tau^2 L\left(H - L\right)$;

$B^{***} = \left(1 - p_H\right) L - K\tau^2 H.$

Obviously, $B^* < B^{**} < B^{***}$, given assumptions (A1) and (A2). The following result can be stated:

Proposition 2 *When the financier is active in both tasks, and private benefits are such that*
a, $B \leqslant B^*$*, then* $\left\{e_a^{FB} = 0, e_m^{FB} = 1\right\}$*,*
b, $B^* < B \leqslant B^{**}$*, first-best effort levels are* $\left\{e_a^{FB} = K\tau\left(H - L\right), e_m^{FB} = 1\right\}$*,*
c, $B^{**} < B < B^{***}$*, first-best effort on both advice and monitoring is positive* $\left\{e_a^{FB} = K\tau\frac{H + KL(B - L(1 - p_H))}{1 - K^2\tau^2 L^2}, e_m^{FB} = K\frac{L\left(1 - p_H - K\tau^2 H\right) - B}{1 - K^2\tau^2 L^2}\right\}$*,*
d, $B \geqslant B^{***}$*, then* $\left\{e_a^{FB} = K\tau H, e_m^{FB} = 0\right\}$*.*

Proof. see Appendix. ■

The intuition for the results in Propositions (1) and (2) is as follows. Monitoring has two opposite effects on the welfare from the project. On one hand, it increases welfare through ensuring a positive liquidation value L. On the other hand, it reduces entrepreneurial utility because it takes away private benefits by pushing the entrepreneur towards the less risky project. The first best level of monitoring thus depends on the relative size of the two variables.

In what follows, we rule out the less interesting case when the entrepreneur strictly values the monitoring activity. We assume that entrepreneurial private benefits are large, thus monitoring decreases entrepreneurial welfare:

$$B > (1 - p_H)\, L \tag{A5}$$

When assumption (A5) holds, the first best effort on monitoring is zero $\left(e_m^{FB} = 0\right)$ while advice is positive $\left(e_a^{FB} = K\tau H > 0\right)$.

4 Non-verifiable Effort Choices

We now assume that effort exertion is not verifiable. Under this assumption, the allocation of cash-flow rights becomes crucial in the provision of incentives, and the financial contract between the parties must define incentive compatible cash-flow allocations.

We consider again different types of investor. First, we look at the benchmark case of a pure financier, exerting no effort. Then, we analyze the case of a one-task monitor and last, we consider a multitask financier who provides both support and monitors entrepreneurial decision making.

4.1 Passive financier

When the investor carries out neither monitoring nor advising, the only information problem is entrepreneurial moral hazard. An appropriate contract allocates sufficient cash-flows in the success state to the entrepreneur, such that she exerts positive effort and thereby raises the probability of success from p_L to p_H. In this case the entrepreneur's decision making can not be controlled, therefore she chooses the risky project (i.e. liquidation returns are 0) and earns her private benefits with probability 1.

The ability to finance the project externally is determined by the extent to which the entrepreneur is capital constrained. We define the minimum entrepreneurial capital contribution necessary for financing by a passive financier as
$\left(\mathbf{I}_e^{\min}\right)^{passive} = I - p_H \left(H - \frac{C}{p_H - p_L}\right)$.
H_e denotes the entrepreneur's share in the success state outcome realization. Now we state the result.

Proposition 3 *a, If* $I_e < \left(\mathbf{I}_e^{\min}\right)^{passive}$*, the project can not be financed with a passive financier.*

b, If $I_e \geqslant \left(\mathbf{I}_e^{\min}\right)^{passive}$*, external financing can occur and the contract allocates cash-flow rights to the entrepreneur such that* $H_e \geqslant \frac{C}{p_H - p_L}$.

Proof. see Appendix. ■

The result arises as a consequence of the classical problem of financing a capital constrained entrepreneur under moral hazard (e.g. in Tirole (2001)).

Since the entrepreneur's actions influence project outcome, the entrepreneur needs to be allocated a sufficient proportion of project returns to be interested in choosing the appropriate (costly) action. This however limits the investor's share in the returns thus the possibility for his participation to the contract. The entrepreneur needs to contribute a sufficient proportion of the investment outlay to be able to offer a contract that allows her to be induced to take the right action and that allows the investor to break even.

4.2 Active financier

4.2.1 One-task financier: monitoring

When the financier is active in monitoring only, the probability of the success state is determined by the entrepreneur alone. By her choice of the financing conract, the entrepreneur can influence the intensity of monitoring. When the investor has a claim on all liquidation proceeds, he will exert maximum effort to ensure a less risky project. In general, effort on monitoring is increasing in the financier's share in the liquidation returns, which we denote by L_f:

$$e_m = K\left(1 - p_H\right) L_f$$

On the other hand, the allocation of liquidation proceeds also affects the threshold entrepreneurial capital contribution necessary for external financing. The following result is intuitive:

Lemma 4 *The minimum capital the entrepreneur needs to contribute to ensure financing $I_e^{\min}$ is decreasing in L_f.*

Proof. see Appendix. ■

Therefore, allocating a large part of the liquidation proceeds L has two opposite effects on the entrepreneur. First, it decreases her expected welfare, for it increases the level of monitoring. However, it also lowers the minimum amount of capital she needs to provide to ensure external financing. The second effect may be advantageous when the entrepreneur is highly capital constrained.

As a consequence of this trade-off, if the entrepreneur has sufficient capital, she will restrain the level of monitoring by offering a contract that rewards the financier only in the high outcome realization. The contract thus resembles to an equity contract. When the entrepreneur is capital constrained, she is forced, in order to obtain external financing, to allocate a large part of the liquidation proceeds to the financier and to stimulate his monitoring activity and ease the possibility for financing. In this case, the financial contract rewards the financier both in the high and the low outcome states. Such an allocation can be implemented through a (convertible) debt contract.

We define here the entrepreneur's minimum capital contribution necessary for financing the project with a one-task monitor:

$\left(\mathbf{I}_e^{\min}\right)^{one-task} = \left(\mathbf{I}_e^{\min}\right)^{passive} - \frac{1}{2}K\left(1 - p_H\right)^2 L^2$, where $\left(\mathbf{I}_e^{\min}\right)^{passive}$ is the minimum capital the entrepreneur has to provide when she contracts with a

passive financier. H_e and H_f denote the entrepreneur's and the monitor's cash-flows in the success state. L_e and L_f represent the allocation of liquidation proceeds. Now we state the result.

Proposition 5 *a, If* $I_e < \left(\mathbf{I}_e^{\min}\right)^{one-task}$ *the project will not receive external financing by a one-task monitor.*

b, If $\left(\mathbf{I}_e^{\min}\right)^{one-task} \leqslant I_e < \left(\mathbf{I}_e^{\min}\right)^{passive}$, *external financing can occur, and the contract offered by the entrepreneur resembles to a (convertible) debt contract:* $\left\{H_f \leqslant H - \left(\frac{C}{p_H - p_L} + e_m\left(L - L_f\right)\right), 0 < L_f \leqslant L\right\}$.
Equilibrium monitoring is positive: $e_m = K\left(1 - p_H\right) L_f$.

c, If $I_e \geqslant \left(\mathbf{I}_e^{\min}\right)^{passive}$, *the entrepreneur offers an equity contract such that* $\left\{H_f \leqslant H - \frac{C}{p_H - p_L}, L_f = 0\right\}$.
Equilibrium monitoring effort is zero: $e_m = 0$.

Proof. see Appendix. ■

Notice that if the financier is entitled to some liquidation proceeds ($L_f > 0$), monitoring will always be more intense than in the first-best case $\left(e_m > e_m^{FB} = 0\right)$. The first-best contract forces the monitor to choose a level of intervention such that the parties' joint surplus is maximized, therefore entrepreneurial private benefits matter. Here, however, the monitor maximizes his own expected profits: he sacrifices the entrepreneur's private benefits to raise the expected value of the project.

The positive aspect of monitoring is that it eases the possibility for financing for highly capital constrained entrepreneurs, compared to the passive investor's case: $\left(\mathbf{I}_e^{\min}\right)^{one-task} < \left(\mathbf{I}_e^{\min}\right)^{passive}$. This result is in accordance with Dessi (2002) and Holmstrom and Tirole (1997). Both suggest that costly monitoring by an intermediary may increase the possibilities for financing for entrepreneurs whose capital is insufficient to commit to an appropriate action choice in the presence of moral hazard. Monitoring in those models reduces the opportunity cost of choosing the appropriate project, thereby decreases the extent of moral hazard and eases the condition for financing. Here, the monitoring activity reduces the probability of choosing a project which is preferred by the entrepreneur and disliked by the investor. This definition allows us to show a link between the extent of entrepreneurial moral hazard and the form of the monitor's financial claim: the more capital constrained the entrepreneur, the more likely that the financier owns a debt-like contract. Only entrepreneurs with capital exceeding a certain threshold can get financing by issuing an equity claim.

4.2.2 Multitask financier: advice and monitoring

The results summarized in Proposition (5) assume that the financier intervenes in the entrepreneur's project choice and may thereby ensure positive liquidation returns in the low outcome state. In the context of venture financing, it is

more appropriate, however, to assume that the investor carries out other, supporting activities as well, which are more valuable for the entrepreneur. Under this scenario, the moral hazard problem becomes two-sided: the entrepreneur likes receiving support since that increases her expected welfare. Therefore, she wants to provide the financier incentives to exert the high effort on the advising activity. The following discussion assumes the investor carries out both activities, advice and monitoring.

The two activities have conflicting incentives: they affect returns in different states of nature. The support activity increases expected returns in the success state while monitoring creates value for a less successful state. If the outcome is success, effort on monitoring is ex-post inefficient. If no success occurred, the support activity would not add value ex-post. Ex-ante however both tasks matter because of the uncertainty concerning the future state of nature.

How realistic is the assumption that venture investors carry out different types of activities and that their activities have conflicting incentives? One may argue that venture capitalists do not differ from other large investors who engage in monitoring their investee firms. Certainly, venture investors do need to carry out monitoring in order to control the entrepreneur's activity. However, several results in the empirical corporate finance literature suggest that venture investors have additional value increasing roles besides disciplining the entrepreneur (Hellmann and Puri (2002), Kaplan and Stromberg (2002), Sapienza, Manigart and Vermeir (1996)). Along the lines of these results, our distinction between advice and monitoring is based on the assumption that advice is congruent, while monitoring is dissonant with entrepreneurial interests. Accordingly, advising incentives are in line with entrepreneurial incentives, while incentives for monitoring differ. This is reflected by the following result:

Lemma 6 *a, The allocation of substantial success state cash-flows to the multitask financier enhances advice and decreases effort on monitoring.*
b, The allocation of liquidation returns to the multitask financier increases the intensity of monitoring and lowers effort exertion on advice.

Proof. see Appendix. ■

Therefore, inducing one task decreases effort exertion on and value added by the other activity. The intuition lies in the characteristic features of the two tasks. Incentives for advice stimulate the investor to exert effort in order to increase the chance for success, thus reduce the probability of the less successful state. This lowers the value of monitoring. At the same time, the provision of liquidation returns induces the investor's value creation for the less successful state, which decreases project risk and thus the need for advice. The possibilities for financing and the type of the financial contract are determined by the extent to which the entrepreneur is capital constrained. Let's define here two (endogenous) levels of the size of the entrepreneur's initial capital endowment I_e:

$$\left(\mathbf{I}_e^{\min}\right)^{multitask^{**}} = \left(\mathbf{I}_e^{\min}\right)^{passive} - \tfrac{1}{2}K\tau^2\left(H_f^{\max}\right)^2$$

$\left(\mathbf{I}_e^{\min}\right)^{multitask^*} = \left(\mathbf{I}_e^{\min}\right)^{passive} - e_a\tau\left(H_f^{\max}\right) - \frac{e_m^2}{2K} + \frac{e_a^2}{2K}$

where

$H_f^{\max} = \left(H - \frac{C}{p_H - p_L}\right)$, $e_a = K\tau\frac{H_f^{\max} - KL^2(1-p_H)}{1-K^2\tau^2L^2}$, $e_m = KL\frac{1-p_H-K\tau^2H_f^{\max}}{1-K^2\tau^2L^2}$,

and $\left(\mathbf{I}_e^{\min}\right)^{passive}$ is the entrepreneur's minimum capital endowment necessary to finance the project with a passive financier. The following result arises.

Proposition 7 *a, If* $I_e < \left(\mathbf{I}_e^{\min}\right)^{multitask^*}$, *the project can not be financed.*

b, If $\left(\mathbf{I}_e^{\min}\right)^{multitask^*} \leqslant I_e < \left(\mathbf{I}_e^{\min}\right)^{multitask^{**}}$, *external financing can occur and the contract offered by the entrepreneur resembles to a (convertible) debt contract:*
$\left\{H_f \leqslant H - \left(\frac{C}{p_H - p_L} + e_m\left(L - L_f\right)\right), 0 < L_f \leqslant L\right\}$.
Equilibrium effort on both monitoring and advice is positive:
$\left\{e_a = K\tau\frac{H_f - KL_f^2(1-p_H)}{1-K^2\tau^2L_f^2}, e_m = KL_f\frac{1-p_H-K\tau^2H_f}{1-K^2\tau^2L_f^2}\right\}$.

c, If $I_e \geqslant \left(\mathbf{I}_e^{\min}\right)^{multitask^{**}}$, *financing can occur, and the contract offered by the entrepreneur resembles to an equity contract:*
$\left\{H_f \leqslant H - \frac{C}{p_H - p_L}, L_f = 0\right\}$.
Equilibrium effort on monitoring is zero, while effort on advice is positive (and higher than in case b): $\{e_a = K\tau H_f, e_m = 0\}$.

Proof. see Appendix. ■

The intuition for this result is as follows. The entrepreneur favors the advising task and dislikes monitoring. This is because advice increases her expected returns by enhancing success, while monitoring reduces her ex-ante surplus by decreasing the chance of getting private benefits. However, as we showed for the case of contracting with a one-task monitor, intense monitoring may be advantageous for the entrepreneur when she is capital constrained. Similarly to the case in section 4.2.1, the entrepreneur faces a trade-off between the extent of monitoring and the possibility for financing. Since the allocation of returns also affects the level of advice (for incentives for the two tasks conflict), the trade-off is more complex in this case. Here, the entrepreneur has a trade-off between receiving support and financing from, and being monitored by the investor. She may receive better terms of financing at the price of loosing the value of her private benefits and getting less support for the project. When being capital constrained, the entrepreneur offers a large proportion of the low state proceeds to the investor ($L_f \cong L, L_e \cong 0$), which induces monitoring and lowers effort on advice and, as a consequence, decreases her expected returns. If her initial capital endowment exceeds a minimum level, she will allocate a smaller share in the liquidation returns to the investor ($L_f < L, L_e > 0$), which results in less intervention, higher effort on advice[7], and increased entrepreneurial utility.

[7] When L_e increases, the change in advice is not obvious. On one hand, an increase in L_e

When the entrepreneur's capital endowment exceeds a certain threshold, the investor receives a sufficiently convex claim, which brings along zero monitoring and positive advice.

Notice that, given assumption (A5), the advising activity will always be carried out at less than first-best intensity: $e_a < e_a^{FB} = K\tau H$. The reason for this is that first-best effort on advice aims at maximizing the parties' joint surplus, while here the financier exerts effort only to an extent determined by his cash-flow incentives. The conclusion concerning monitoring is the opposite. Monitoring is always higher than or equal to its first-best level: $e_m > e_m^{FB} = 0$. Under non-verifiable effort, the financier ignores the value of private benefits and carries out monitoring such that his profits are maximized. Only if the entrepreneur is sufficiently endowed with own capital, is she able to constrain the monitoring effort to its first-best zero intensity.

However, our findings are not based on the assumption that entrepreneurial private benefits are large. Assumption (A5) is not a necessary condition to derive our results: propositions (5) and (7) hold for any level of the private benefits. The tension between entrepreneurial moral hazard and investor's participation is sufficient to derive the above discussed implications, given that the financier carries out two tasks with conflicting incentives as described in Section 2. Assumption (A5) concerns an extreme case, making explicit the entrepreneur's preference for maximum advice and least possible monitoring, but it affects only the first best outcome (see Section 3).

Comparative Statics An implication of the result in Proposition (7) is that more capital constrained entrepreneurs, who can not receive financing from a passive investor, would be able to finance their projects with a multitask financier.

Corollary 8 *When the entrepreneur contracts with a multitask financier, the minimum amount of capital she needs to contribute to ensure financing is lower than when she contracts with a passive investor:*

$$\left(\mathbf{I}_e^{\min}\right)^{multitask^*} < \left(\mathbf{I}_e^{\min}\right)^{multitask^{**}} < \left(\mathbf{I}_e^{\min}\right)^{passive}$$

Proof. This result is a consequence of Proposition (7). ■

The intuition for corollary (8) relates to the tension between entrepreneurial moral hazard and the possibility for financing. Because the chance for success depends on (costly) effort exertion by the entrepreneur, the latter needs to own a sufficiently high proportion of the cash-flows to be interested in working. This however limits the proceeds that the investor can obtain and thus the amount

decreases the investor's incentives to monitor, and given the inter-relation of the two activities it increases advice. On the other hand, an increase in L_e decreases the monitor's success state returns, and thereby the incentives for advice. This latter effect is because the appropriate provision of incentives requires that the entrepreneur has a higher share in the success returns when she owns more of the liquidation proceeds. Since $L_e = L - L_f$, the result in Lemma (6) implies that the first effect outweighs the second, thus advice increases as a result of an increase in L_e.

of capital he is willing to contribute. The participation of an active investor (one-task or multitask financier) may ease this tension. The monitoring and advising activities, when appropriately incentivized, increase ex-ante project value, thus allow the parties to share higher expected profits and, as a result, ease the condition for the investor's participation.

Our model also provides predictions concerning the method of financing for different types of projects.

Corollary 9 *For projects with sufficient up-side potential, it is always easier to get financing from a multitask financier: if* $\frac{H}{L} > \frac{1-p_H}{\tau} + \frac{C}{L(p_H-p_L)}$ *then* $\left(\mathbf{I}_e^{\min}\right)^{multitask^*} < \left(\mathbf{I}_e^{\min}\right)^{multitask^{**}} < \left(\mathbf{I}_e^{\min}\right)^{one-task}$.

Proof. see Appendix. ■

Note that $\left(\mathbf{I}_e^{\min}\right)^{multitask^*}$ denotes the minimum amount of entrepreneurial capital contribution required to finance the project with a multitask financier performing maximum monitoring. In turn, $\left(\mathbf{I}_e^{\min}\right)^{multitask^{**}}$ represents the amount of necessary entrepreneurial capital, when the project is financed with an equity contract and thus zero monitoring. When she contracts with a one-task financier, the entrepreneur needs to contribute more capital even if she allows for maximum monitoring: $\left(\mathbf{I}_e^{\min}\right)^{multitask^{**}} < \left(\mathbf{I}_e^{\min}\right)^{one-task}$. Thus, given sufficient up-side potential, projects that will not be financed by a one-task monitor, are eligible for financing by a financier who, besides the monitoring activity, carries out the advising task as well. This result may give some intuition why riskier projects tend to be financed by (multitask) venture financiers, while banks (one-task financiers) seem more willing to provide capital for projects with less uncertain cash-flow claims.

4.2.3 Multitask financier: sequential effort choices

In this section, we briefly discuss whether the results generated in Section (4.2.2) are robust to alternative formulations of the basic model. In particular, we describe the equilibrium outcome under the assumption of sequential effort choices by the financier with interim information arrival concerning the value of the project.

Let's consider the following variant of the model described in Section (2). There are two periods. After the first (early) stage, an interim signal arrives concerning the project's profitability. The signal is verifiable and can be high or low. If it is high, project outcome is H at the end of the second (expansion) stage (success occurs with probability 1). If the interim signal is low, success occurs with probability γ, $0 \leqslant \gamma \leqslant 1$, and the project is unsuccessful with probability $1-\gamma$. If no success occurs, project outcome is L or 0 depending on whether the commercial or scientific project prevails.

The probability of a high first period signal depends on joint effort exertion by the entrepreneur and the financier. If the entrepreneur works and the financier exerts advising effort e_a, a high (low) signal arrives with probability

$p_H + e_a\tau$ (with probability $1 - p_H - e_a\tau$). When the entrepreneur avoids incurring the cost of effort C, the probability of high and low signals will be $p_L + e_a\tau$ and $1-p_L-e_a\tau$, respectively. This model formulation captures a highly realistic scenario in which monitoring is required only in case of a low interim signal.

When, success occurs with positive probability after the arrival of a low interim signal ($\gamma > 0$), equilibrium effort exertion on both advice and monitoring is lower than in the more general simultaneous effort case (analyzed in Section (4.2.2)). As a result, the possibility for financing also hardens, in the sense that the entrepreneur has to contribute a higher amount to the investment outlay in order to obtain financing. As γ decreases, effort exertion on both tasks becomes more intense. Accordingly, the possibilities for financing expand. When ($\gamma = 0$), the results coincide with those in Proposition (7). The intuition for this case is the following. The positive probability of success given the low interim signal, $\gamma > 0$, eliminates the need for intensive monitoring in the second period. Thus effort on monitoring is less intense than in the simultaneous effort case. Effort on advice also decreases because, when $\gamma > 0$, unit advising raises the chance for success to a larger extent than under the scenario with simultaneous tasks. Thus the provision of advice becomes more effective, which lowers the amount of effort provided in equilibrium.

The assumption of sequential effort choices does not bring new insights: if success is not very likely on the condition that a low interim state occurs, the equilibrium is close to the one described in Proposition (7).

4.3 Discussion: venture capital contracting practices

Predictions from the above analysis may shed light on certain features of venture capital agreements, recently identified by several empirical studies. The foregoing discussion details these implications.

Evidence suggests that in venture financing contracts, investors' cash-flow and control rights follow an unusual joint pattern: holders of less risky securities are allocated more, while owners of risky claims tend to have less control. In their extensive study of venture financing contracts in the United States, Kaplan and Stromberg (2000) find that when venture investors have voting control, they are likely to hold a convertible security. Moreover, the evidence indicates that entrepreneurs' cash flow rights are positively correlated with the extent of investors' control. In an analysis of about 200 venture capital deals in Europe, Cumming (2002) offers further evidence that convertible securities are associated with more control (in the form of veto and other rights), while equity contracts typically involve few control rights.

Despite the surprising evidence there is, to our knowledge, only one paper in the literature that has addressed this issue. The result in Cestone (2001) suggests that venture investors should be given control only when the riskiness of their cash-flow claim is limited. This is because investors holding risky claims may interfere in entrepreneurial decision making, which negatively affects incentives. Our model has the same implication but the reasoning is different. Assume that monitoring requires the investor to have control rights. Then,

the results summarized in proposition (7) imply that capital constrained entrepreneurs will allocate control to the investor and offer a less risky (convertible) security. As a consequence, equilibrium effort on monitoring (advice) will be high (low). Entrepreneurs with a capital endowment of sufficient size are able to issue an equity claim and retain control, which ensures that the investor is active only on the advising task. In the model by Cestone, support and interference are assumed to be positively related: the control allocation is the means to prevent extensive monitoring when there is a need for advice. Further, the direct cross effects of effort exertion on the two tasks are not modelled. In our setup, the opposite can be obtained: the intensive provision of advice limits effort exertion on monitoring. Moreover, we explicitly model the interrelation between monitoring and advice. As a consequence, in this model, interference lowers not only entrepreneurial initiative, but also effort on advice. Incentives for advising still require the allocation of risky claims to the investor, but in our context this will decrease the extent of interference.

The other implication concerns the form of the financial contract. Although a number of theories predict that convertible debt or preferred equity are the unique optimal securities to finance start-up entrepreneurs (Berglof (1994), Dessi (2002), Cornelli and Yosha (2002), Repullo and Suarez (1999), Schmidt (2000)), the empirical literature has not come yet to an unanimous conclusion concerning the form of the financial contract venture capitalists use. Evidence provided by Kaplan and Stromberg (2001) shows that in the United States convertible preferred equity is the most frequently used security but not the only financing means. Sometimes, (multiple classes of) common stocks are also issued[8]. Evidence from other countries indicates a somewhat larger variety in the forms of financing. In Canada and Germany, common equity seems to be the most frequently used security but straight and convertible debt, preferred equity, warrants, and combinations of these instruments are also possible means of financing (see evidence for Canada in Cumming (2000), and for Germany in Bascha and Walz (2001)). Cumming (2002) offers similar evidence for a group of venture funds from ten European countries. Our analysis may provide an explanation for these observations. The main insight is that the financier's contribution to the project in terms of advice and monitoring depends on the incentives embedded in the financial contract he owns. The entrepreneur can incentivize advice and limit monitoring when she is sufficiently endowed with capital. When there are severe capital constraints, however, it becomes difficult to overcome entrepreneurial moral hazard: the more capital constrained an entrepreneur, the less she can commit to take the required costly action. As a result, the higher (lower) the equilibrium effort exertion on monitoring (advice) and, accordingly, the less convex the security the financier holds. Therefore, more capital constrained ventures will be financed by a convertible security or straight debt and will be monitored extensively (and offered less professional support). Only entrepreneurs with sufficient self-financing can afford to issue

[8] Different classes of common stock refer to different allocations of control and cash flow rights attached to the securities.

equity and get substantial support (along with less intense monitoring).

5 Conclusion

This paper offers a theory for the roles of venture investors as advisors and monitors to entrepreneurial projects. Our most important finding is that financiers' activities such as advice and monitoring increase value even when the unit cost of performing these tasks is high. When entrepreneurs are wealth constrained, the financing of projects occurs more frequently by multitask investors than by passive (uninformed) or traditional (one-task) financiers, such as banks.

We model a situation in which an entrepreneur favors advice and dislikes monitoring, since the first increases, while the second decreases her expected utility. The positive aspect of monitoring is that it facilitates financing. A capital constrained entrepreneur may need to incentivize both tasks. The form of the financial contract offered and the financier's effort exertion on the two tasks depend on the size of the entrepreneur's initial capital endowment and thus the extent of the entrepreneurial moral hazard problem. When her capital contribution to the project is below a certain treshold, the entrepreneur will offer a (convertible) debt contract. As a result, cash-flow incentives will induce intense monitoring and low effort on the advising task. If her initial capital endowment is more substantial, the entrepreneur is able to increase her ex-ante utility by offering a return allocation which increases effort on advice and limits the extension of interference. This allocation can be implemented through an equity contract. Thus in equilibrium, only entrepreneurs with sufficient self-financing will receive substantial help. When capital constraints are severe, entrepreneurs will be extensively monitored.

Our results explain recent evidence on the forms of finance in venture contracts, namely, the use of a variety of securities including common equity and straight debt (Bascha and Walz (2001), Cumming (2000a) and (2002), Kaplan and Stromberg (2002). Moreover, they provide theoretical grounds for the unusual joint pattern of cash-flow and control rights observed in venture financing agreements (Cumming (2002), Kaplan and Stromberg (2002)). Since monitoring requires the investor to have control, the model suggests that in equilibrium cash-flow and control rights are negatively related.

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6 Appendix

Proof of Proposition 1

The first best contract between the entrepreneur and a one-task financier defines the monitoring effort $e_m^{FB} \in [0,1]$ that maximizes the sum of the parties' expected utilities from the project and establishes a cash flow and investment allocation $\{H_e, H_f, L_e, L_f, I_e, I_f\}$ such that both the entrepreneur and the investor participate to the contract. H_e and L_e represent the entrepreneur's, while H_f and L_f the financier's cash flows in the high and low outcome states. I_e and I_f denote the investment contribution by the entrepreneur and the financier, respectively. The first-best monitoring effort can be written as:

$$e_m^{FB} = \underset{0 \leqslant e_m \leqslant 1}{\arg\max} \left\{ p_H H + e_m (1 - p_H) L + (1 - e_m) B - C - \frac{e_m^2}{2K} - I \right\} \quad (1)$$

$$e_m^{FB} = K \left[(1 - p_H) L - B \right] \quad (2)$$

Given the constraint $0 \leqslant e_m \leqslant 1$, the solution in (2) applies only for certain parameter values. Let's define the following two threshold levels of entrepreneurial private benefits: $\widehat{B} = (1 - p_H) L - \frac{1}{K}$ and $\widehat{\widehat{B}} = (1 - p_H) L$.
Now, we can state the result:

a, If $B \leqslant \widehat{B}$, then $e_m^{FB} = 1$ (the constraint $e_m \leqslant 1$ binds).

b, If $\widehat{B} \leqslant B < \widehat{\widehat{B}}$, monitoring increases project value, its first best level is positive: $e_m^{FB} = K \left[(1 - p_H) L - B \right] > 0$ (none of the constraints are binding: $1 > e_m^{FB} > 0$).

c, If $B \geqslant \widehat{\widehat{B}}$ monitoring does not add to the value of the project, thus $e_m^{FB} = 0$ (the constraint $0 \leqslant e_m$ binds).

Financing occurs whenever the contract $\left\{ e_m^{FB}, H_e, H_f, L_e, L_f, I_e, I_f \right\}$ satisfies the following conditions:

$$p_H H_e + e_m^{FB} (1 - p_H) L_e + \left(1 - e_m^{FB}\right) B - C \geqslant I_e \quad (3)$$

$$p_H H_f + e_m^{FB} (1 - p_H) L_f - \frac{\left(e_m^{FB}\right)^2}{2K} \geqslant I_f \quad (4)$$

$$L_e \geqslant 0 \quad (5)$$

$$H = H_f + H_e \quad (6)$$

$$L = L_f + L_e \quad (7)$$

$$I = I_f + I_e \quad (8)$$

The first two constraints represent participation conditions for the entrepreneur and the investor, respectively. Condition (5) is the entrepreneur's limited liability constraint. Equalities (6)-(8) are feasibility conditions.

Proof of Proposition 2

When the financier exerts two types of effort, the first-best contract defines the surplus maximizing effort levels $\left\{e_a^{FB}, e_m^{FB}\right\}$, $e_a^{FB} e_m^{FB} \in [0,1]$ and an allocation $\{H_e, H_f, L_e, L_f, I_e, I_f\}$ that induces both parties to participate. Optimal effort exertion on the two tasks depends on the parties joint expected utility.

$$e_m^{FB} = \underset{0 \leqslant e_m \leqslant 1}{\arg\max} \left\{ (p_H + e_a\tau) H + e_m (1 - p_H - e_a\tau) L + (1 - e_m) B - C - \frac{e_a^2 + e_m^2}{2K} - I \right\}$$

$$e_a^{FB} = \underset{0 \leqslant e_a \leqslant 1}{\arg\max} \left\{ (p_H + e_a\tau) H + e_m (1 - p_H - e_a\tau) L + (1 - e_m) B - C - \frac{e_a^2 + e_m^2}{2K} - I \right\}$$

The solutions for e_a^{FB} and e_m^{FB} follow:

$$e_m^{FB} = K \frac{L\left(1 - p_H - K\tau^2 H\right) - B}{1 - K^2\tau^2 L^2} \tag{9}$$

$$e_a^{FB} = K\tau \frac{H + KL\left(B - L\left(1 - p_H\right)\right)}{1 - K^2\tau^2 L^2} \tag{10}$$

Given the constraints $0 \leqslant e_a^{FB} \leqslant 1$, $0 \leqslant e_m^{FB} \leqslant 1$, expressions (9) and (10) provide a solution only for a certain range of the parameter values. In particular, we can define the following thresholds of the level of entrepreneurial private benefits B:

$B^* = (1 - p_H) L - \frac{H}{LK}$;
$B^{**} = (1 - p_H) L - \frac{1}{K} - K\tau^2 L (H - L)$;
$B^{***} = (1 - p_H) L - K\tau^2 H$.

We summarize the solution to the problem as follows:
a, When $B \leqslant B^*$, then $\left\{e_a^{FB} = 0, e_m^{FB} = 1\right\}$ (the constraints $e_a^{FB} \leqslant 1$ and $0 \leqslant e_m^{FB}$ are binding).

b, When private benefits are such that $B^* < B \leqslant B^{**}$, the solution is $\left\{e_a^{FB} = K\tau (H - L), e_m^{FB} = 1\right\}$ (the condition $0 < e_a^{FB} < 1$ is satisfied and the constraint $e_m^{FB} \leqslant 1$ binds).

c, When the size of entrepreneurial benefits is higher, i.e. $B^{**} < B < B^{***}$, the above solution applies $\left\{ e_a^{FB} = K\tau \frac{H + KL(B - L(1-p_H))}{1 - K^2\tau^2 L^2}, e_m^{FB} = K \frac{L\left(1 - p_H - K\tau^2 H\right) - B}{1 - K^2\tau^2 L^2} \right\}$ (none of the constraints bind: $0 < e_a^{FB} < 1$ and $0 < e_m^{FB} < 1$).

d, If $B \geqslant B^{***}$, the solution will be $\left\{e_a^{FB} = K\tau H, e_m^{FB} = 0\right\}$ ($0 < e_a^{FB} < 1$ and the constraint $0 \leqslant e_m^{FB}$ binds).

Feasibility of the solution requires that the contract $\left\{e_a^{FB}, e_m^{FB}, H_e, H_f, L_e, L_f, I_e, I_f\right\}$ satisfies the following conditions:

$$\left(p_H + e_a^{FB}\tau\right) H_e + e_m^{FB} \left(1 - p_H - e_a^{FB}\tau\right) L_e + \left(1 - e_m^{FB}\right) B - C \geqslant I_e \tag{11}$$

$$\left(p_H + e_a^{FB}\tau\right) H_f + e_m^{FB}\left(1 - p_H - e_a^{FB}\tau\right) L_f - \frac{\left(e_a^{FB}\right)^2 + \left(e_m^{FB}\right)^2}{2K} \geqslant I - I_e \tag{12}$$

$$\begin{aligned} L_e &\geqslant 0 && (13)\\ H &= H_f + H_e && (14)\\ L &= L_f + L_e && (15)\\ I &= I_f + I_e && (16) \end{aligned}$$

Inequalities (11) and (12) are participation conditions for the entrepreneur and the financier, condition (13) is the entrepreneur's limited liability constraint, while equalities (14)-(16) are feasibility conditions.

Proof of Proposition 3

When she contracts with a passive financier, the entrepreneur proposes an incentive compatible allocation $\{H_e, H_f, L_e, L_f, I_e, I_f\}$ that provides sufficient incentives for the investor to participate in the financing. We can write the entrepreneur's problem as follows:

$$\max_{H_e} p_H H_e + B \tag{17}$$

subject to

$$\begin{aligned} H_e &\geqslant \frac{C}{p_H - p_L} && (18)\\ p_H H_f &\geqslant I_f && (19)\\ H &= H_f + H_e && (20)\\ I &= I_f + I_e && (21) \end{aligned}$$

Condition (18) is the entrepreneur's incentive compatibility, while (19) represents the financier's participation condition. Equations (20) and (21) are feasibility constraints. The entrepreneur's incentive compatibility condition (18) sets a lower bound on H_e :

$$H_e \geqslant H_e^{\min} = \frac{C}{p_H - p_L} \tag{22}$$

This condition, together with the investor's participation constraint (19) and equations (20) and (21), imply the condition for financing.

$$I_e \geqslant \left(\mathbf{I}_e^{\min}\right)^{passive} = I - p_H\left(H - \frac{C}{p_H - p_L}\right) \tag{23}$$

$\left(\mathbf{I}_e^{\min}\right)^{passive}$ denotes the minimum amount of capital the entrepreneur needs to contribute to the project to ensure financing by a passive financier. When

$I_e < \left(\mathbf{I}_e^{\min}\right)^{passive}$, the project can not be funded. When $I_e \geqslant \left(\mathbf{I}_e^{\min}\right)^{passive}$ financing occurs, and the optimal cash-flow allocation satisfies (22).

Proof of Lemma 4

To prove the result (that I_e is decreasing in L_f), we have to consider the entrepreneur's problem when contracting with a one-task financier. The entrepreneur offers a contract $\{H_e, H_f, L_e, L_f, I_e, I_f\}$ with an incentive compatible cash-flow allocation such that participation of the financier is also induced. The entrepreneur's problem can be specified as follows:

$$\max_{e_m, H_e, L_e} p_H H_e + (1 - p_H)\, e_m L_e + (1 - e_m)\, B - C - I_e \tag{24}$$

subject to

$$\begin{aligned}
H_e &\geqslant \frac{C}{p_H - p_L} + e_m L_e && (25)\\
L_e &\geqslant 0 && (26)\\
e_m &= \arg\max \left\{ p_H H_f + e_m\,(1 - p_H)\, L_f - \frac{e_m^2}{2K} - I_f \right\} && (27)\\
I_f &\leqslant p_H H_f + e_m\,(1 - p_H)\, L_f - \frac{e_m^2}{2K} && (28)\\
H &= H_f + H_e && (29)\\
L &= L_f + L_e && (30)\\
I &= I_f + I_e && (31)
\end{aligned}$$

The first constraint is the entrepreneur's incentive compatibility and the second is his limited liability condition. Equation (27) represents the investor's incentive compatible effort choice, while the constraint (28) ensures his participation. Equations (29),(30), and (31) are feasibility conditions. To find an expression for I_e, we set upper bounds on H_f and L_f using the constraints (25), (26) and equations (29),(30).

$$\begin{aligned}
H_f &\leqslant H_f^{\max} = H - \left[\frac{C}{p_H - p_L} - e_m L_e\right]\\
L_f &\leqslant L_f^{\max} = L - L_e
\end{aligned}$$

Using these results, and condition (31), we can express the financier's participation constraint in terms of the entrepreneur's capital contribution I_e:

$$I_e \geqslant I_e^{\min} = I - p_H \left(H - \frac{C}{p_H - p_L} - e_m L_e\right) - e_m\,(1 - p_H)\,(L - L_e) + \frac{e_m^2}{2K}$$

Using (27) and (30), we rewrite the above condition as:

$$\begin{aligned}
I_e &\geqslant I_e^{\min} = I - p_H \left(H - \frac{C}{p_H - p_L} - e_m L_e\right) - \frac{e_m^2}{2K} && (32)\\
\text{where } e_m &= K\,(1 - p_H)\,(L - L_e) && (33)
\end{aligned}$$

Through setting L_e the entrepreneur may influence the investor's participation. The result of a change in L_e on $I_e^{\min}$ is given by the total derivative $\frac{dI_e^{\min}}{dL_e}$.

$$\begin{aligned}\frac{dI_e^{\min}}{dL_e} &= \frac{\partial I_e^{\min}}{\partial e_m}\frac{de_m}{dL_e} + \frac{\partial I_e^{\min}}{\partial L_e} = \\ &= K\left(1-p_H\right)^2\left(L-L_e\right) + p_H K\left(1-p_H\right)\left(L-2L_e\right) \\ &= K\left(1-p_H\right)\left[L-\left(1-p_H\right)L_e\right] > 0\end{aligned}$$

Since $L_f = L - L_e$, $\frac{dI_e^{\min}}{dL_f} < 0$. Thus setting L_f high, the entrepreneur eases the condition for financing.

Proof of Proposition 5

When the entrepreneur contracts with a one-task financier, the contract $\{H_e, H_f, L_e, L_f, I_e, I_f\}$ is a solution to the problem defined by equations (24)-(31). The effort level on monitoring can be expressed from the financier's incentive compatibility condition (27).

$$e_m = K\left(1-p_H\right)\left(L-L_e\right)$$

The financing condition is given in (32). We know from the result in Lemma (4) that, when the entrepreneur is capital constrained, she may induce monitoring by offering a contract such that $L_e = 0$ and $L_f = L$, and thereby ease the condition for financing. In this scenario, the financier's monitoring effort is the highest possible.

$$e_m^{\max} = K\left(1-p_H\right)L$$

The condition for financing (32) becomes as follows:

$$I_e \geqslant \left(\mathbf{I}_e^{\min}\right)^{one-task} = \left(\mathbf{I}_e^{\min}\right)^{passive} - \frac{1}{2}K\left(1-p_H\right)^2 L^2 \tag{34}$$

where $\left(\mathbf{I}_e^{\min}\right)^{passive}$ is the entrepreneur's minimum capital contribution necessary for financing the project with a passive financier.

If condition (34) is not satisfied, the project can not be financed.

When $I_e = \left(\mathbf{I}_e^{\min}\right)^{one-task}$, the project can be financed with a one-task monitor in a way that the financier's effort on monitoring is at the maximum ($e_m = e_m^{\max} = K\left(1-p_H\right)L$), and the value of entrepreneurial private benefits is at its minimum. In this case, the financial contract will provide all liquidation returns to the investor $\left\{H_e = \frac{C}{p_H - p_L}, H_f = H - H_e, L_e = 0, L_f = L\right\}$.

When the entrepreneur has more than the minimum amount of capital $I_e > \left(\mathbf{I}_e^{\min}\right)^{one-task}$, she may choose $L_e > 0$. It follows that monitoring will be less

intense: $e_m = K(1-p_H)(L-L_e)$, which increases the entrepreneur's expected returns. Accordingly, the financial contract will change its form: $\left\{H_e = \left(\frac{C}{p_H - p_L} + K(1-p_H) L_f L_e\right), H_f = H - H_e, L_e > 0, L_f = L - L_e\right\}$.

Proof of Lemma 6

To prove the result in Lemma (6), we express effort on advice and monitoring as functions of the financier's cash flow rights (H_f, L_f). From the financier's profit maximization, we write the effort levels as follows.

$$e_m = \underset{0 \leqslant e_m \leqslant 1}{\arg\max} \left\{ (p_H + e_a\tau) H_f + e_m (1 - p_H - e_a\tau) L_f - \frac{e_m^2 + e_a^2}{2K} - I_f \right\} \quad (35)$$

$$e_a = \underset{0 \leqslant e_a \leqslant 1}{\arg\max} \left\{ (p_H + e_a\tau) H_f + e_m (1 - p_H - e_a\tau) L_f - \frac{e_m^2 + e_a^2}{2K} - I_f \right\} \quad (36)$$

The first order conditions and a unique solution follow:

$$e_a = K\tau(H_f - e_m L_f) \quad (37)$$
$$e_m = K L_f (1 - p_H - e_a\tau) \quad (38)$$

$$e_a = K\tau \frac{H_f - K L_f^2 (1 - p_H)}{1 - K^2\tau^2 L_f^2} \quad (39)$$
$$e_m = K L_f \frac{1 - p_H - K\tau^2 H_f}{1 - K^2\tau^2 L_f^2} \quad (40)$$

When $L_f > 0$ and $H_f \geqslant L_f$, the above expressions satisfy the conditions $0 < e_a < 1$, $0 < e_m < 1$, given assumptions (A1)-(A2) hold. The solution to the equation system (38)-(37) is the following:

a, When $L_f = 0$ and $0 < H_f < H$, then $\{e_a = K\tau H_f, e_m = 0\}$. The condition $0 < e_a < 1$ is satisfied and the constraint $e_m \geqslant 0$ is binding.

b, When $L_f > 0$, and $0 < H_f < H$, the above solution applies $\left\{e_a = K\tau \frac{H_f - K L_f^2 (1-p_H)}{1 - K^2\tau^2 L_f^2}, e_m = K L_f \frac{1 - p_H - K\tau^2 H_f}{1 - K^2\tau^2 L_f^2}\right\}$ and none of the constraints bind ($0 < e_a < 1$ and $0 < e_m < 1$).

Let's consider the case *b*. The result can be proved by calculating first derivatives of the expressions (39) and (40) with respect to H_f and L_f. Given assumptions

(A1) and (A2), the following inequalities hold:

$$\begin{aligned}
\frac{de_a}{dH_f} &= \frac{\tau K}{1-K^2\tau^2L_f^2} > 0 \\
\frac{de_m}{dH_f} &= -\frac{K^2\tau^2L_f}{1-K^2\tau^2L_f^2} < 0 \\
\frac{\partial e_a}{\partial L_f} &= -\frac{2K^2\tau L_f\left[1-p_H-K\tau^2H_f\right]}{\left[1-K^2\tau^2L_f^2\right]^2} < 0 \\
\frac{\partial e_m}{\partial L_f} &= \frac{K\left(1+L_f^2K^2\tau^3\right)\left[1-p_H-K\tau^2H_f\right]}{\left[1-K^2\tau^2L_f^2\right]^2} > 0
\end{aligned}$$

This proves the result.

Proof of Proposition 7

To prove the results in Proposition (7), we consider the entrepreneur's problem when contracting with a multitask financier. The entrepreneur offers a contract $\{H_e, H_f, L_e, L_f, I_e, I_f\}$ with an incentive compatible cash-flow allocation such that the financier's participation condition is satisfied. The entrepreneur's problem can be written as follows:

$$\max_{e_m, H_e, L_e} \left(p_H + e_a\tau\right) H_e + e_m\left(1-p_H-e_a\tau\right) L_e + \left(1-e_m\right) B - C - I_e \quad (41)$$

subject to

$$\begin{aligned}
H_e &\geqslant \frac{C}{p_H-p_L} + e_mL_e && (42)\\
L_e &\geqslant 0 && (43)
\end{aligned}$$

$$e_a = \underset{0\leqslant e_a\leqslant 1}{\arg\max}\left\{\left(p_H+e_a\tau\right)H_f + e_m\left(1-p_H-e_a\tau\right)L_f - \frac{e_m^2+e_a^2}{2K} - I_f\right\} \quad (44)$$

$$e_m = \underset{0\leqslant e_m\leqslant 1}{\arg\max}\left\{\left(p_H+e_a\tau\right)H_f + e_m\left(1-p_H-e_a\tau\right)L_f - \frac{e_m^2+e_a^2}{2K} - I_f\right\} \quad (45)$$

$$\begin{aligned}
I_f &\geqslant \left(p_H+e_a\tau\right)H_f + e_m\left(1-p_H-e_a\tau\right)L_f - \frac{e_m^2+e_a^2}{2K} && (46)\\
H &= H_f + H_e && (47)\\
L &= L_f + L_e && (48)\\
I &= I_f + I_e && (49)
\end{aligned}$$

The first constraint is the entrepreneur's incentive compatibility and the second is his limited liability condition. Equations (44) and (45) represent the investor's incentive compatible effort choices, while the constraint (46) ensures his participation. Equations (47),(48), and (49) are feasibility conditions. To express the condition for financing (46) in terms of I_e, first we set upper bounds on H_f and L_f using the constraints (42), (43) and equations (47),(48).

$$\begin{aligned} H_f &\leqslant H - H_e^{\min} = H - \frac{C}{p_H - p_L} \\ L_f &\leqslant L - L_e^{\min} = L \end{aligned}$$

Using these results, and condition (31), we can express the condition for financing in terms of the entrepreneur's capital contribution I_e:

$$I_e \geqslant I_e^{\min} = I - (p_H + e_a\tau)\left(H - \frac{C}{p_H - p_L}\right) - e_m\left(1 - p_H - e_a\tau\right)L + \frac{e_m^2 + e_a^2}{2K}$$

This inequality can be rewritten using expression (38).

$$I_e \geqslant I_e^{\min} = I - (p_H + e_a\tau)\left(H - \frac{C}{p_H - p_L}\right) - \frac{e_m^2}{2K} + \frac{e_a^2}{2K} \tag{50}$$

The financier's equilibrium effort choices $\{e_a, e_m\}$ depend on the contracted cash-flow allocation $\{H_e, H_f, L_e, L_f, I_e, I_f\}$.

a, When cash flows are such that $(L_f = 0, H > H_f > 0)$ (corresponds to case a in the proof of Lemma (6)), equilibrium monitoring is zero, and there is positive effort on advice $\{e_a = K\tau H_f, e_m = 0\}$. The financing condition in this scenario is as follows:

$$I_e \geqslant I_e^{\min} = I - p_H H_f - \frac{1}{2}K\tau^2 H_f^2 \tag{51}$$

The maximum returns the investor can obtain, given the entrepreneur's incentive compatibility condition (42), are $H_f^{\max} = \left(H - \frac{C}{p_H - p_L}\right)$. Thus the condition for financing becomes:

$$I_e \geqslant \left(\mathbf{I}_e^{\min}\right)^{multitask^{**}} = \left(\mathbf{I}_e^{\min}\right)^{passive} - \frac{1}{2}K\tau^2\left(H - \frac{C}{p_H - p_L}\right)^2 \tag{52}$$

where $\left(\mathbf{I}_e^{\min}\right)^{passive}$ is the entrepreneur's minimum capital contribution necessary for financing the project with a passive financier given by expression (23).

b, If the cash-flow allocation is such that $(L > L_f > 0, H > H_f > 0)$, equilibrium effort choices both on advice and monitoring will be positive: $\left\{e_a = K\tau\frac{H_f - K\tau L_f^2(1-p_H)}{1-K^2\tau^3 L_f^2}, e_m = KL_f\frac{1-p_H-K\tau^2 H_f}{1-K^2\tau^3 L_f^2}\right\}$. The maximum returns available for the investor are $L_f^{\max} = L$, $H_f^{\max} = \left(H - \frac{C}{p_H - p_L}\right)$ in the high and low states, respectively. The condition for financing turns out to be:

$$I_e \geqslant \left(\mathbf{I}_e^{\min}\right)^{multitask^*} = \left(\mathbf{I}_e^{\min}\right)^{passive} - e_a\tau\left(H - \frac{C}{p_H - p_L}\right) - \frac{e_m^2}{2K} + \frac{e_a^2}{2K} \tag{53}$$

where $\left\{e_a = K\tau\frac{H_f^{\max} - K\tau L^2(1-p_H)}{1-K^2\tau^3L^2}, e_m = KL\frac{1-p_H-K\tau^2H_f^{\max}}{1-K^2\tau^3L^2}, H_f^{\max} = \left(H - \frac{C}{p_H-p_L}\right)\right\}$.
Now we carry out the last part of the proof. We show that the project can be financed with zero monitoring (case a), only if the entrepreneur holds a sufficient amount of capital. We claim that monitoring eases the condition for financing in the sense that the following inequality holds.

$$\left(\mathbf{I}_e^{\min}\right)^{multitask^*} < \left(\mathbf{I}_e^{\min}\right)^{multitask^{**}} \tag{54}$$

To prove this statement, we rewrite (54) using the results in (52) and (53).

$$-e_a\tau\left(H_f^{\max}\right) - \frac{e_m^2}{2K} + \frac{e_a^2}{2K} < -\frac{1}{2}K\tau^2\left(H_f^{\max}\right)^2 \tag{55}$$

where $\left\{e_a = K\tau\frac{H_f^{\max} - KL^2(1-p_H)}{1-K^2\tau^2L^2}, e_m = KL\frac{1-p_H-K\tau^2H_f^{\max}}{1-K^2\tau^2L^2}, H_f^{\max} = \left(H - \frac{C}{p_H-p_L}\right)\right\}$.
(55) is equivalent to the following condition:

$$e_m^2 > \left(e_a - K\tau H_f^{\max}\right)^2$$

After some transformation of the right hand side expression, the inequality becomes:

$$e_m^2 > \left(K\tau L\right)^2 e_m^2$$

which holds by assumption (since $\left(K\tau^2 L\right)^2 < 1$). This completes the proof.

Proof of Corollary 9

To prove the statement in Corollary (9), we compare expressions in (34), (52), and (53). In the proof of Proposition (7), we showed that $\left(\mathbf{I}_e^{\min}\right)^{multitask^*} < \left(\mathbf{I}_e^{\min}\right)^{multitask^{**}}$. Furthermore, $\left(\mathbf{I}_e^{\min}\right)^{multitask^{**}} < \left(\mathbf{I}_e^{\min}\right)^{one-task}$ is satisfied when the following inequality holds:

$$-\frac{1}{2}K\tau^2\left(H - \frac{C}{p_H - p_L}\right)^2 < -\frac{1}{2}K\left(1-p_H\right)^2L^2 \tag{56}$$

(56) implies a condition on the riskiness of the project $\left(\frac{H}{L}\right)$:

$$\frac{H}{L} > \frac{1-p_H}{\tau} + \frac{C}{L\left(p_H - p_L\right)}$$

This inequality shows that when the project has a sufficient up-side potential, contracting with a multi-task financier increases the possibilities for financing more than contracting with a one-task monitor. This completes the proof.