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Abstract

We argue that the process whereby a venture capital syndicate is formed is characterized by two-sided asymmetric information, as the profitability signals held by different VCs are non-verifiable and manipulable. We analyze how an appropriate design of the syndicating VCs' cash-flow rights can induce them to truthfully reveal their signals to each other. We then study how the incentive costs of syndication and the shape of financial claims vary with the VCs' levels of expertise in evaluating entrepreneurial projects.

Key words

Venture capital, syndication deals, asymmetric information.

Resumen

En este documento de trabajo analizamos el proceso de formación de un sindicato de empresas de capital riesgo. Este proceso presenta un problema de *doble asimetría de información,* por el hecho de que las señales de rentabilidad de los diferentes inversores no son verificables y pueden ser manipuladas. Estudiamos cómo una estructura adecuada del sindicato puede inducir a los inversores a comunicar a sus *partners* del sindicato la información privada de la que disponen. Analizamos también cómo los costes de agencia del proceso de sindicato y la estructura de los derechos financieros puedan variar con el nivel de experiencia de los inversores en la evaluación de proyectos empresariales.

Palabras clave

Capital de riesgo, contratos de sindicato, información asimétrica.

The Design of Syndicates in Venture Capital

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C O N T E N T S

1. Introduction

A common feature of venture capital finance is that investments are often syndicated, that is, two or more venture capitalists participate in the financing of a project. Typically, the first (lead) venture capitalist to come in contact with the start-up performs his own evaluation of the project but then seeks another venture capitalist's opinion. This may happen at the first investment round (seed stage) or when continuation investments are considered. It is understood that the late venture capitalist provides an additional screening of the project, participates in the (first or subsequent round of) financing and is then entitled to part of the control and cash-flow rights over the venture. In many syndication deals, early and late joining VCs hold different financial claims: while the lead VC typically holds convertible preferred stock, late VCs often hold *participating* convertible preferred stock and have senior rights in case of liquidation [1].

One may wonder why venture capitalists syndicate in the first place. According to the selection hypothesis (Lerner, 1994), syndication is a way for the lead VC to obtain a second assessment of the project and thus improve the selection process for risky ventures. The value-added hypothesis (Amit, Antweiler and Brander, 2002) stresses instead the ability of VCs to create value by providing advice and bringing business connections once the project has been funded. In this respect, different VCs may bring in different and complementary skills, thus making syndication desirable. Finally, VCs may pursue syndication simply to share risks, or to overcome capital constraints when the financing needs of the venture are large. Probably, more than one rationale lies behind most syndication decisions [2].

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1. Participating convertible preferred equity is a very peculiar security whose holder is entitled to a debt-like claim *plus* an equity claim prior to conversion, but loses the entire debt claim upon conversion (Lerner, 1999). Conversion is automatic and contingent on successful events like IPO; if conversion was not forced, the investor would never want to convert spontaneously in that he loses any right to a preferred dividend (Hellmann, 2004).

2. Which rationale is most important in practice is largely an empirical question. Amit, Antweiler and Brander (2002) provide evidence that the first three motives matter, while capital constraints are unlikely to explain the wide extent of syndication observed in the VC industry. Lockett and Wright (2001) find that the motives for syndicating a deal vary according to the investment stage of the deal.

In this paper we focus on the first rationale for syndication, namely the need for a second expert evaluation to improve the selection process of entrepreneurial ideas. We argue that various incentive issues arise in a VC syndicate due to the non-verifiability and manipulability of private signals. Consider first the second VC's information gathering process. The lead VC (*VC*1) cannot observe whether his potential syndication partner (*VC*2) acquires information or not, hence *VC*2 must be given incentives to gather her signal. Furthermore, as the signal is soft information (i) *VC*2 may not report the signal truthfully to *VC*1 if she has observed one; (ii) *VC*2 may report a signal even if she has not observed anything. A further incentive issue arises from the fact that the lead venture capitalist's signal is also manipulable. *VC*1 may be tempted to provide a false assessment of the project and propose a syndication contract to *VC*2 even in case she has bad news. Hence, *VC*2 will fear that she is buying an overpriced claim, unless the syndication contract ensures that *VC*1's report is truthful. In this paper we study how an appropriate design of cash-flow rights can induce the syndicating VCs to truthfully reveal their signals to each other via their decision as to whether co-finance the project.

We then investigate how the incentive costs of syndication vary with the VCs' levels of expertise, in order to address a question which is central to VC syndication, namely how lead VCs choose their syndication partners. We first ask whether lead VCs should always syndicate their investments with the most experienced firms. In the benchmark case where *VC*1's signal is public, we find that syndicating with a more experienced venture capitalist is always more valuable to the lead VC, in that a second signal of better precision significantly improves the investment selection process and can be obtained at no extra incentive cost from *VC*2. This is in line with previous results on the formation of venture capital syndicates (see Casamatta and Haritchabalet, 2003). However, we show that when the lead VC also holds a manipulable signal, the incentive costs of syndication (namely, *VC*2's rent) may become very large as *VC*2's expertise increases. Indeed, we find examples where the gains from syndication are maximized if the syndication partner is *not too experienced.* We also address the related question of *who syndicates with whom.* We solve our model numerically and in all our examples we find that the optimal level of *VC*2's expertise is increasing in *VC*1's expertise. This confirms the prediction found in symmetric information frameworks (Casamatta and Haritchabalet, 2003) that *experienced venture capitalists should syndicate with experienced venture capitalists,* and is in line with existing empirical evidence (Lerner, 1994).

Our paper contributes to the theoretical literature on venture capital finance. Many papers in this literature have analyzed the design of venture capital deals in the presence of multiple incentive problems. Yet, the focus so far has been mostly on the incentive issues arising in the relationship between the *entrepreneur* and the venture capitalist (Casamatta, 2003; Schmitdt, 2003; Repullo and Suárez, 2004; Dessi, 2005; Cestone, 2005). To our knowledge, little work has been done on the incentive problems arising *within a venture capital syndicate*. Casamatta and Haritchabalet (2003) provide an analysis of syndication deals in a model where VCs perform independent evaluations of an investment project, yet their signals are public. In their model, the cost of syndication stems from the possibility that the second expert might "steal" the investment opportunity after evaluating it, which obliges the first VC to write a co-ownership contract with the partner. The decision of whether to syndicate thus trades off the benefit from relying on a second VC's assessment with the cost of sharing rents with the syndication partner. In our model, the private signals gathered by the venture capitalists evaluating a project are non-verifiable and manipulable. The cost of syndication stems from the incentive problems arising in this context.

Our paper is also closely related to the literature on experts' incentives. Gromb and Martimort (2003) analyze the incentive issues arising when a principal hires experts for gathering two independent signals about a project. They show that a principal can reduce the incentive costs of delegated expertise by relying on two experts and using one expert's report to cross-check the other's. Our model differs in that one expert (the lead VC) holding a private signal about a project *hires* a second expert (the late VC) to perform a second assessment of the project. The second expert must be motivated to gather her signal; both experts must have incentives to report their signals truthfully to each other. In such a setting, $VC1$ is an informed principal, whose contract offer conveys information to the agent, and at the same time motivates the agent to gather and report information. Also in contrast to Gromb and Martimort, where transfers paid to agents may come out of the principal's pocket, in our model payments to experts come out of the project's returns. This imposes an extra *budget-balance* constraint on our problem; though our second agent (venture capitalist) can supply funds to the project and thus does not necessarily benefit from limited liability ex ante. We believe that this is a more appropriate framework within which to analyse our particular problem of interest: the choice of syndicate partner and the structure of VCs' claims in a syndicate.

2. The Basic Model

IN the following, we will set up a highly stylised model of the venture capital syndication process, which, will allow us to focus on the particular issue in which we are interested. We consider that an incumbent (or lead) venture capitalist, whom we shall call $VC1$, has already made an initial investment in a firm and is considering whether to inject a further amount of cash I to continue the firm or else to close the firm. For simplicity, we assume that the incumbent VC initially owns all the cash flow rights to the project, but may sell some of these claims to a second venture capitalist in a syndication deal if they go ahead with a further round of financing [3]. The amount of financing required to continue the project I is commonly known to (potential) financiers, but the project's final returns R are uncertain and may turn out to be high H, or low L, with $0 < L < I < H$. The *a priori* probability of success is $q \equiv \Pr(H)$, while $1 - q = \Pr(L)$. We assume that the risk that the project fails and yields only L is sufficiently high that providing funds I to the project in the absence of further information about the firm's prospects is unprofitable [4]:

$$qH + (1 - q)L - I < 0$$

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3. Clearly, this is not a literal description of the situation in most venture capital deals, for at least two reasons. First, usually the entrepreneur (founder, management team, angel investors) will hold some (common) equity. A simple way to incorporate this consideration into our model would be to interpret $VC1$ as being a composite of all of the incumbent claimants. This interpretation is not completely perfect as it is likely that incumbent claimants differ in their ability to inject cash into the firm in later rounds. But if (for example) the entrepreneur is wealth-constrained and cannot inject more cash, one can just consider that the returns R and L in the model are net of any payments that must be made to the entrepreneur in the two states. Second, rather than early venture capitalists *selling* existing equity to venture capitalists which join later, typically the firm will *issue* more equity. Evidently, if it were not for the existence of incumbent claimants other than early-stage venture capitalists just noted who will also be diluted by the issue of new claims, these two operations would be mathematically equivalent.

4. We make this assumption in order that it is always worthwhile to collect information if the project is to be continued. If this assumption did not hold, there would still be a benefit to collecting information if the value of avoiding projects which are likely to be unprofitable was large enough relative to the cost of collecting information, which will hold provided the project is sufficiently risky. We believe that the insights that would arise from this case would be similar, but the constraints would be more complicated.

Information structure and VC expertise

We assume that through his initial funding of the project, $VC1$ receives some *private* information about the likely returns of the project. The quality of such information depends on $VC1$'s expertise. In particular, $VC1$ has a binary signal s_1 about returns, $s_1 \in \{\underline{s_1}, \overline{s_1}\}$, of precision $\theta_1 \in (\frac{1}{2}; 1]$, defined as $\theta_1 = (\overline{s}_1/H) = \Pr(\underline{s_1}/L)$. The probability of receiving a high signal $\overline{s_1}$ when the project is profitable increases with $VC1$'s expertise θ_1. Given his signal, $VC1$ updates his belief about the project's probability of success. We denote with $q(\overline{s}_1)$ the probability of success conditional on $VC1$ receiving a good signal:

$$q(\overline{s}_1) = \frac{q\theta_1}{q\theta_1 + (1-q)(1-\theta_1)}$$

We define $p(s_1)$ as the unconditional probability that signal s_1 is observed by $VC1$. For instance, $p(\overline{s}_1) = q\theta_1 + (1-q)(1-\theta_1)$.

After receiving the signal s_1, $VC1$ may (i) reject the project, (ii) finance the project alone, or (iii) ask for a second expert's opinion. We assume that even after conditioning upon $s_1 = \overline{s}_1$, the project's NPV is negative:

$$q\theta_1 (H-I) + (1-q)(1-\theta_1)(L-I) < 0 \qquad (2.1)$$

which implies that $VC1$ never undertakes the project alone. This assumption will simplify our analysis. One can view the assumption as restricting attention to projects which are not too profitable in expectation (these highly profitable projects $VC1$ might prefer to undertake alone). Rearranging the constraint, we can see that, for a given a priori profitability, it imposes an upper bound on $VC1$'s expertise, since otherwise he could always be sufficiently confident that projects about which he had received a good signal would succeed:

$$\theta_1 < \frac{(1-q)(I-L)}{(1-q)(I-L) + q(H-I)} \equiv \overline{\theta}_1$$

where clearly $\overline{\theta}_1 < 1$.

After receiving a good signal, $VC1$ will then ask a second venture capitalist, $VC2$, to evaluate the project, and to participate in the financing if the project is funded. The investment cost and the final returns are shared according to a syndication contract that $VC1$ offers to $VC2$. The second VC is an outsider to the project, hence he has to make an (unobservable) information gathering effort at private cost ψ, to collect a signal $s_2 \in \{\underline{s}_2, \overline{s}_2\}$ with precision $\theta_2 \in (\frac{1}{2}; 1]$, defined as $\theta_2 = \Pr(\overline{s}_2/H) = \Pr(\underline{s}_2/L)$. The two signals s_1 and s_2 are independent conditional on the project outcome, and are *soft information*, i.e., they cannot be observed by other parties. *VC*1 and *VC*2's levels of expertise in evaluating projects, θ_1 and θ_2, can in principle be different.

If *VC*1 is able to obtain *VC*2's opinion, he then updates his prior about the likelihood of success, which becomes $q(s_1, s_2)$. For instance, if *VC*1 learns that both signals are good:

$$q(\overline{s}_1, \overline{s}_2) = \frac{q\theta_1\theta_2}{q\theta_1\theta_2 + (1-q)(1-\theta_1)(1-\theta_2)}$$

We also define $p(s_1, s_2)$ as the unconditional probability that signals s_1 and s_2 are observed, while $p(s_2/s_1)$ is the probability that s_2 is observed given s_1.

In a first best word, gathering the second VC's signal is beneficial provided this induces a change in *VC*1's decision of whether or not to fund the project. For the sake of simplicity, we focus on the case where if *VC*1 observes a bad signal $\underline{s}_1$, then it is not worth gathering the second VC's opinion. This requires assuming:

$$q\theta_2(1-\theta_1)(H-I) + (1-q)\theta_1(1-\theta_2)(L-I) - \psi[q(1-\theta_1) + (1-q)\theta_1] < 0$$

which imposes that θ_2 is not too large with respect to θ_1:

$$\theta_2 < \frac{(1-q)(I-L)\theta_1 + \psi[q(1-\theta_1) + (1-q)\theta_1]}{(1-q)(I-L)\theta_1 + q(H-I)(1-\theta_1)} \equiv \overline{\theta}_2(\theta_1) < 1 \qquad (2.2)$$

This assumption implies that in a symmetric information context where s_1 is public, *VC*1's utility when his signal is bad is equal to zero.

Conversely, when *VC*1 has observed a good signal, gathering a second signal is profitable provided:

$$q\theta_1\theta_2(H-I) + (1-q)(1-\theta_1)(1-\theta_2)(L-I) - \psi[q\theta_1 + (1-q)(1-\theta_1)] \geq 0$$

This requires that the second VC has enough expertise to change *VC*1's initial assessment, as stated in the following:

Lemma 1. *The value of syndication is positive provided VC2's expertise is large enough:*

$$\theta_2 \geq \underline{\theta}_2(\theta_1) \equiv \frac{(1-q)(I-L)(1-\theta_1) + \psi[q\theta_1 + (1-q)(1-\theta_1)]}{(1-q)(I-L)(1-\theta_1) + q(H-I)\theta_1} > \frac{1}{2} \quad (2.3)$$

The minimum level of VC2's expertise decreases with VC1's expertise θ_1.

Remark. Casamatta and Haritchabalet (2003) provide a complete taxonomy of VCs' expertise levels ensuring that syndication is profitable in a symmetric information context. We here focused on the case where *VC*2's information may only be valuable (i.e., change *VC*1's initial assessment) when *VC*1's signal is good. In our first best benchmark, the threshold $\underline{\theta}_2(\theta_1)$ for *VC*2's expertise behaves as its analogous in Casamatta and Haritchabalet (2003): when *VC*1 is more confident about his own (positive) evaluation, even a second (positive) signal of low precision is enough to encourage investment. This explains why $\underline{\theta}_2$ is decreasing in θ_1. In the following, we shall argue that even under condition (2.3), gathering the second VC's opinion may be too costly when the VCs' signals are soft information.

The syndication contract

Once he has observed the private signal s_1, the first VC offers a contract to *VC*2 as a way to gather a second opinion about the project. If the project is funded and a syndication contract is signed, this specifies the amount of funds $P \in [0, I]$ that *VC*2 must provide, and *VC*2's return in case the project is funded and succeeds (fails), R_2^H (R_2^L). *VC*1 then provides funds $I - P$ and expects a payment $H - R_2^H$ in case of success ($L - R_2^L$ in case of failure). We assume that *VC*1 has all the bargaining power vis-à-vis *VC*2.

3. VC Incentives and Expertise

IF the second VC's evaluation is called for, various incentive issues arise due to the unobservability of private signals. Consider the second VC's information gathering process. *VC*1 cannot observe whether *VC*2 acquires the information or not, hence *VC*2 must be given incentives to gather the signal s_2 at cost Ψ. Furthermore, the signal s_2 is soft information. This implies that (i) *VC*2 may not report the signal truthfully to *VC*1 if she has observed one; (ii) *VC*2 may report a signal even if she has not observed any. This last issue dramatically affects the moral hazard incentive constraint for *VC*2.

A further incentive issue arises from the fact that *VC*1's signal is also manipulable. *VC*1 may be tempted to report a positive signal and propose a syndication contract to *VC*2 even in case $s_1 = \underline{s}_1$. Hence, *VC*2 will fear that she is *buying a lemon* unless the syndication contract ensures that *VC*1's report is truthful. In what follows, we first focus on the benchmark case where *VC*1's signal is public and only *VC*2 suffers from incentive problems. We then analyze *VC*1's incentive problem and see how this impacts the contracting possibilities as well as the desirability of syndicating with more or less expert VCs.

3.1. The benchmark: VC1's signal is public

*VC*2 decides to acquire information provided the following moral hazard incentive constraints hold:

$$p(\overline{s}_2/\overline{s}_1)\ [q(\overline{s}_1/\overline{s}_2)R_2^H + (1 - q(\overline{s}_1/\overline{s}_2))R_2^L - P] - \psi \geq 0 \tag{3.1}$$

that is, gathering the signal is better than not gathering it and reporting $s_2 = \underline{s}_2$. And:

$$p(\overline{s}_2/\overline{s}_1)\ [q(\overline{s}_1/\overline{s}_2)R_2^H + (1 - q(\overline{s}_1/\overline{s}_2))R_2^L - P] - \psi \geq q(\overline{s}_1)R_2^H + (1 - q(\overline{s}_1))R_2^L - P \tag{3.2}$$

that is, gathering the signal is better than not gathering it and reporting $s_2 = \overline{s}_2$.

If she observes a good signal, *VC*2 must be better off reporting it truthfully than reporting a bad signal:

$$q(\bar{s}_1, \bar{s}_2)R_2^H + (1 - q(\bar{s}_1, \bar{s}_2))R_2^L - P] \geq 0 \tag{3.3}$$

If instead the signal observed is bad, *VC*2 must prefer to report it rather than reporting a good signal:

$$q(\bar{s}_1, \underline{s}_2)R_2^H + (1 - q(\bar{s}_1, \underline{s}_2))R_2^L - P \leq 0 \tag{3.4}$$

It is easy to see that the only relevant constraints are (2) and (3), as these two constraints imply the adverse selection constraints (4) and (5).

Clearly, since *VC*1 is the residual claimant on the returns to the project, he chooses chooses P, R_2^H, and R_2^L so as to minimize *VC*2's rent

$$p(\bar{s}_2/\bar{s}_1)\ [q(\bar{s}_{1,}\bar{s}_2)R_2^H + (1 - q(\bar{s}_1, \bar{s}_2))R_2^L - P] - \psi$$

subject to constraints (2) and (3). This requires setting both constraints binding and thus $q(\bar{s}_1)\Delta R_2 = P - R_2^L$, where $\Delta R_2 \equiv R_2^H - R_2^L$. Hence, at the optimum:

$$\frac{q\theta_1}{q\theta_1 + (1-q)(1-\theta_1)}\Delta R_2 = P - R_2^L$$

and

$$\frac{q\theta_1\theta_2 + (1-q)(1-\theta_1)(1-\theta_2)}{q\theta_1 + (1-q)(1-q\theta_1)}\left(\frac{q\theta_1\theta_2}{q\theta_1\theta_2 + (1-q)(1-\theta_1)(1-\theta_2)}\Delta R_2 + R_2^L - P\right) - \psi = 0$$

implying the following Proposition:

Proposition 1. *The optimal syndication contract when VC1's signal* $\bar{s}_1$ *is public is:*

$$P - R_2^L = \frac{q\theta_1 + (1-q)(1-\theta_1)}{(1-q)(1-\theta_1)(2\theta_2 - 1)}\psi$$

$$\Delta R_2 = \frac{q\theta_1 + (1-q)(1-q\theta_1)}{(1-q)(1-\theta_1)(2\theta_2 - 1)}\frac{1}{q(\bar{s}_1)}\psi$$

which leaves VC2 with a zero rent.

When his signal is public, $VC1$ faces a standard principal-agent problem where $VC2$, the agent, must be induced to collect a signal and reveal it truthfully. Gromb and Martimort (2004) provide the solution to this problem for the simple case of one expert as well as that of multiple experts. Differently from Gromb and Martimort (2004), where agents have limited liability, here $VC1$ is able to extract all of $VC2$'s rent via $VC2$'s co-financing of the project. In other words, $VC1$ manages to solve at no cost the hired expert's incentive problem by asking her to put her money where her mouth is.

Remark: Implementation - One way to implement the above contract is to sell $VC2$ preferred stock with senior rights in case of liquidation (R_2^L) at price P, while $VC1$ retains common stock. In many private equity transactions this is the type of deal that lead *VCs* offer to late *VCs*. It is often the case that the face value of preferred stock (the amount paid before moving to paying common stock) is close to the cost paid by its holder, i.e., $P - R_2^L$ is small in real life deals.

Liquidation preference and VCs' expertise.
As in Gromb and Martimort (2004), providing incentives for information gathering to an expert becomes less difficult when the latter has more expertise: when θ_2 is large, low powered incentives can be given to the second venture capitalist (i.e., ΔR_2 can be low). In our model, this also implies that a more experienced $VC2$ will be asked to provide a smaller share of the funding P, with respect to the payment R_2^L that she receives in case of failure; namely, $VC2$ will have a larger liquidation preference:

$$\frac{\partial(\mathrm{P} - R_2^L)}{\partial\theta_2} < 0$$

$VC2$'s contract also varies with $VC1$'s expertise θ_1:

$$\frac{\partial\Delta R_2}{\partial\theta_1} > 0, \quad \frac{\partial(\mathrm{P} - R_2^L)}{\partial\theta_1} > 0$$

When $VC1$ has more expertise, $VC2$ is more tempted to *free ride* on $VC1$'s signal, and is more hardly induced to gather her own signal s_2. Hence $VC2$'s contract becomes more high-powered and $VC2$ is granted less *liquidation preference,* i.e., $P - R_2^L$ is large.

The value of syndication.
In this benchmark model, as $VC2$ is left with no rent, $VC1$'s gains from syndication are equal to the project's NPV net of the signal collection cost. This implies the following:

Corollary 1. *Venture capitalist VC1 holding a positive (and public) signal of project profitability always proposes a syndication deal to VC2 provided $\theta_2 \geq \underline{\theta}_2$. The deal is signed and the project funded if, and only if, VC2's assessment is also positive. The value of syndication for VC1 is increasing in θ_2.*

Proof. The proof follows immediately from condition 1 and from the result that $VC1$ can fully extract $VC2$'s agency rent.

3.2. VC1's incentives when both signals are soft information

We now assume that $VC1$'s signal is also non-verifiable and manipulable. $VC1$ may then be tempted to report a positive signal and propose a syndication contract to $VC2$ even in case $s_1 = \underline{s}_1$. As a consequence, $VC2$ will fear that she may be buying an overpriced claim unless the syndication contract ensures that $VC1$'s report is also truthful.

Consider the optimal syndication contract derived in the benchmark. Should $VC1$ always report his signal truthfully? In particular, when $s_1 = \underline{s}_1$, should $VC1$ forego the investment or rather propose a syndication contract to $VC1$ claiming he has a positive opinion on the project? If the syndication contract satisfies the following condition:

$$q(\underline{s}_1, \overline{s}_2)(H - L) + L - I + (P - R_2^L) - q(\underline{s}_1, \overline{s}_2)\Delta R_2 > 0$$

then it will not induce thruth-telling when $VC1$ has a bad signal. Notice that $VC1$ has two motives for misreporting a bad signal. First, $VC2$ may not put much trust in her own assessment and rather wants to rely on $VC2$'s opinion. If the contract makes sure that $VC2$ only wants to go ahead if she has received a good signal, $VC1$ may want to fund the project whenever $VC2$ does, even though $s_1 = \underline{s}_1$. This first effect is stronger when $VC2$ is a more reliable expert, i.e., when θ_2 is larger. Secondly, $VC1$ may be simply trying to *sell a lemon* to $VC2$, inflating her own assessment of the project. This temptation is stronger when $VC2$ is asked to provide a large part of the initial funding, which is indeed the case when $VC2$'s expertise θ_2 is small.

A venture capitalist who has privately observed a good signal must then find a way of credibly signalling to *VC*2 that his signal is good. Notice that *VC*1 can always guarantee himself the low information intensity optimum by offering *VC*2 an option contract $\{C, C_0\}$ specifying a syndication contract $C = \{\Delta R_2, R_2^L, P\}$ for the *good-signal VC1,* and the null contract C_0 yielding zero-utility for the *bad-signal VC1,* so as to solve:

$$\underset{C,\,Co}{Max} \frac{q\theta_1\theta_2}{q\theta_1 + (1-q)(1-\theta_1)}[H - L - \Delta R_2] +$$

$$\frac{q\theta_1\theta_2 + (1-q)(1-\theta_1)(1-\theta_2)}{q\theta_1 + (1-q)(1-\theta_1)}[P - R_2^L, + L - I]$$

s.t.:

$$\frac{q\theta_1\theta_2}{q\theta_1 + (1-q)(1-\theta_1)}\Delta R_2 -$$

$$\frac{q\theta_1\theta_2 + (1-q)(1-\theta_1)(1-\theta_2)}{q\theta_1 + (1-q)(1-\theta_1)}(P - R_2^L) - \psi \geq 0 \qquad (3.5)$$

$$\frac{q\theta_1\theta_2}{q\theta_1 + (1-q)(1-\theta_1)}\Delta R_2 -$$

$$\frac{q\theta_1\theta_2 + (1-q)(1-\theta_1)(1-\theta_2)}{q\theta_1 + (1-q)(1-\theta_1)}(P - R_2^L) - \psi \geq \qquad (3.6)$$

$$\frac{q\theta_1}{q\theta_1 + (1-q)(1-\theta_1)}\Delta R_2 - (P - R_2^L)$$

$$\frac{q(1-\theta_1)\theta_2}{q(1-\theta_1)\theta_2 + (1-\mathrm{q})\theta_1(1-\theta_2)}(H - L - \Delta R_2) + L - I + (P - R_2^L) \leq 0 \qquad (3.7)$$

The first two constraints are the moral hazard constraints (3.1) and (3.2). They here ensure that *VC*2 gathers her signal (and reveals it truthfully) if the contract C is picked by *VC*1. Constraint (3.7) makes sure that a *bad-signal VC1* will optimally choose not to start the project at all rather than offer *VC*2 the contract $\{\Delta R_2, R_2^L, P\}$. Notice that by construction, *VC*2 always breaks even by accepting the option contract $\{C, C_0\}$, independently of what her beliefs are regarding the first *VC*'s private information. Thus *VC*1 can always guarantee himself the value of the above program. In this preliminary analysis, we will focus on this low information intensity optimum.

Indeed, in the low information intensity optimum, either (3.7) or (3.1) binds. For low levels of θ_2, (3.7) does not bind and the optimal contract described in Proposition 1 is incentive compatible for *VC*1. Conversely, for large levels of θ_2, it is (3.7) which binds, so that in contrast with the public *VC*1 – signal case, *VC*1 is obliged to leave a positive rent to the second venture capitalist (even though the latter has no limited liability). This implies the following:

Proposition 2. *When θ_2 is large enough, the symmetric information contract is not incentive compatible for VC1. In the low information intensity optimum, VC1 has to leave a positive rent to VC2; this rent is increasing in θ_2.*

3.3. The choice of a syndication partner

In this section we investigate the lead VC's choice of a syndication partner. As argued earlier, in a first best framework the value of syndication is always increasing in the level of *VC*2's expertise (Casamatta and Haritchabalet, 2003). This result is unchanged when only *VC*2's signal is soft information. However, when *VC*1's incentives are also an issue, it may prove too costly to syndicate with a very experienced partner: *VC*1 may be too tempted to falsely report a good signal and rely on the positive assessment of *VC*2, if the latter has much expertise. This may oblige *VC*1 to distort the syndication contract, possibly leaving a large rent to his partner. The benefit of relying on a more precise second assessment of the project may then be outweighed by the incentive cost of syndication.

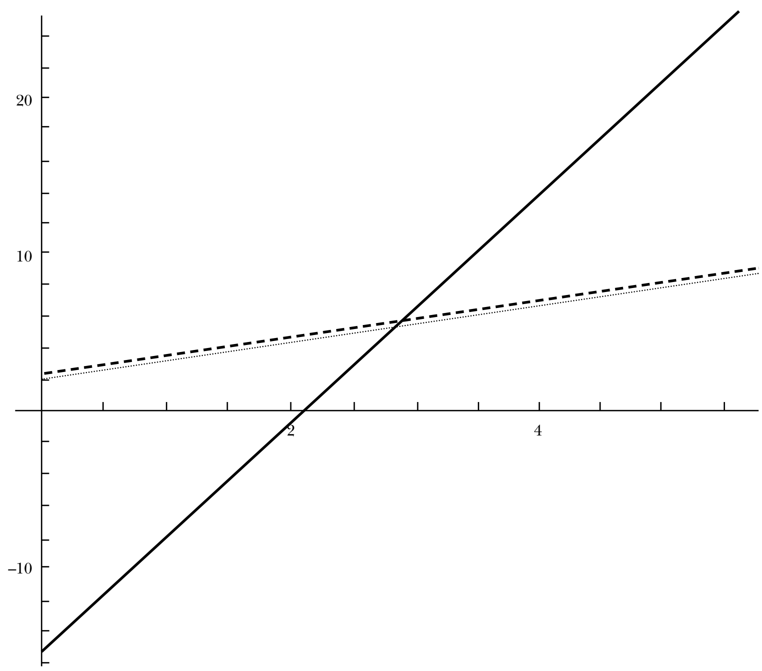
To investigate this further, we analyze our model numerically [5]. In the example reported here, we set parameter values: $q = 1/2$, $\psi = 1$, $H = 9$, $L = 2$, $I = 6$, and compute the optimal syndication contract and the value of syndication VS(θ_1, θ_2) for different pairs (θ_1, θ_2). Our simulations all shared the feature that, for any given θ_1, *VC*1's incentive constraint becomes binding for θ_2 sufficiently large, thus shaping the optimal syndication contract. Graphic 3.1*a* displays for instance the incentive compatible contracts for levels of

5. Numerical simulations were performed with the aid of Mathematica.

expertise $\theta_1 = 15/28$, $\theta_2 = 87/99 \cong 0.879$. The optimal contract in the benchmark case is defined by the intersection of the loci IC_2^1 and IC_2^2 , which lies below the locus IC_1. When $VC1$'s signal is soft information, the optimal contract is defined by the intersection of IC_2^2 and IC_1, thus leaving $VC2$ with a positive rent. Such rent is increasing in θ_2. Graphic 3.1*b* displays the set of incentive compatible contracts for the same parameter values except that a lower level of θ_2 has been chosen ($\theta_2 = 0.825$). In this case, as predicted by Proposition 2, $VC1$'s incentive constraint does not bind and the optimal contract is the benchmark case contract.

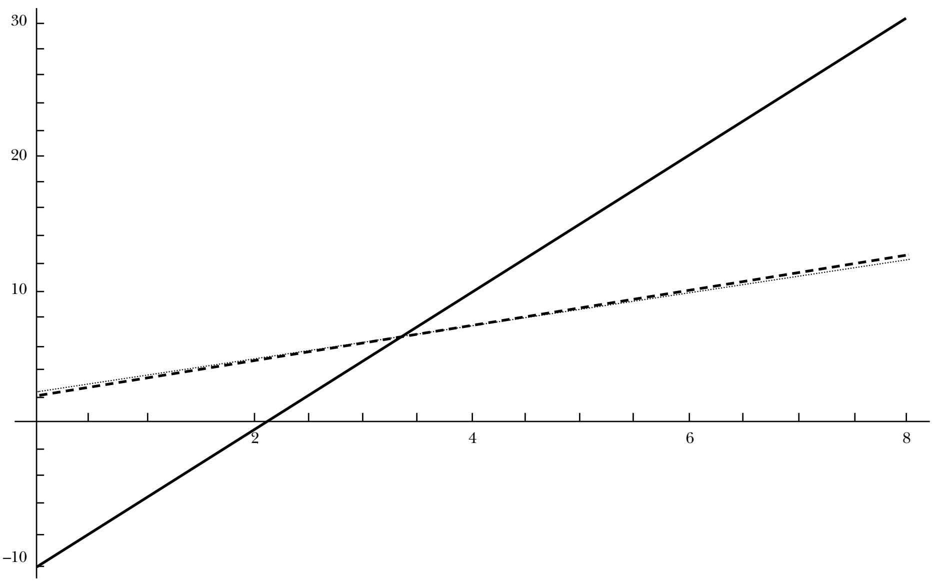
We then study how the value of syndication $\mathrm{VS}(\theta_1, \theta_2)$ varies with $VC2$'s expertise. We set different levels of θ_1 and for each one we check whether VS is maximized at $\theta_2 = \overline{\theta}_2(\theta_1)$. Indeed, we find that unless θ_1 is large, VS is maximized at $\theta^*_2 << \overline{\theta}_2(\theta_1)$. For instance, in the numerical example reported above, we find that $\partial \mathrm{VS}/\partial\theta_2 \equiv 0.064$ at $\theta_1 = 15/28$, $\theta_2 = 8/9 \equiv \overline{\theta}_2(15/28)$. We then state the following:

GRAPHIC 3.1*a*: Set of incentive compatible contracts ($\theta_2 = 0.879$)



The horizontal axis measures $(P - R_2^L)$,while the vertical axis measures ΔR_2. Parameter values are as follows: $q = 1/2$, $\psi = 1$, $H = 9$, $L = 2$, $I = 6$, $\theta_1 = 15/28 \cong 0.536$, $\theta_2 = 87/99 \cong 0.879$. The flat continued line is the locus where $VC2$'s incentive constraint (2) binds. Contracts above this line satisfy the constraint (2). Conversely, only contracts below the steep continued line satisfy $VC2$'s incentive constraint (3). The optimal contract in the benchmark case is defined by the intersection of these two lines: $P - R_2^L = 2.84$, $\Delta R_2 = 5.3$. The discontinuous line represents instead the locus of contracts where $VC1$'s incentive constraint binds (the constraint is slack for contracts above the discontinuous line). Notice that the benchmark case contract does not satisfy $VC1$'s incentive constraint in this example.

GRAPHIC 3.1*b*: Set of incentive compatible contracts (θ_2 = 0.825)



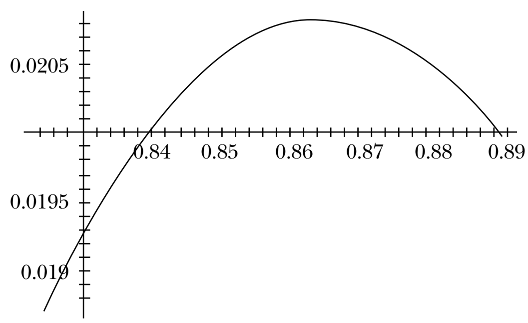
Here the set of incentive compatible contracts is represented for the same values of parameters q, ψ, H, L, I, θ_1 but for a smaller level of θ_2: $\theta_2 = 0.825$. Notice that in this example the benchmark case contract lies below the discontinuous line, i.e. it does satisfy *VC*1's incentive constraint.

Proposition 3. *There exists an open set of parameters such that the value of syndication for VC1 is concave in the level of VC2's expertise, and is maximized at* $\theta^*_2 << \overline{\theta}_2$.

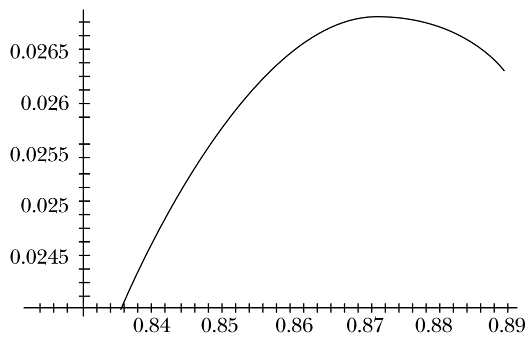
This result contrasts with the predictions obtained in previous papers. In a symmetric information setting the value of syndication for the lead *VC* is always (weakly) increasing in the quality of *VC*2's signal. After all, disposing of a more precise additional signal cannot make *VC*1's investment selection process any worse. In a setting where only *VC*2's signal is manipulable, *VC*1 also gains more from syndicating with a more experienced *VC*2, in that a more precise signal improves *VC*1's investment selection process, and implies a smaller rent for *VC*2, if any. Conversely, in a setting where *VC*1's signal can be manipulated, syndication becomes less valuable to *VC*1 when θ_2 is very large. This is so because a more experienced *VC*2 will fear more that *VC*1 is trying to sell her an overpriced claim, implying higher incentive costs.

Using the same numerical examples, we also investigate the issue of who syndicates with whom, and find that the optimal level of *VC*2's expertise is increasing in θ_1. In Graphics 3.2*a*, 3.2*b* and 3.2*c* we refer again to parameter values: $q = 1/2$, $\psi = 1$, $H = 9$, $L = 2$, $I = 6$. We plot VS(θ_2) for the following levels of θ_1: $\theta_1 = 0.53$, $\theta_1 = 0.55$, $\theta_1 = 0.57$. The function VS(θ_2) is concave and achieves its maximum at, respectively, $\theta_2 \cong 0.855$, $\theta_2 \cong 0.875$, $\theta_2 \cong 0.89$. Our numerical results confirm the prediction found in symmetric information frameworks (Casamatta and Haritchabalet, 2003) that "experienced venture capitalists should syndicate with experienced venture capitalists". Yet, the logic behind the two results is quite different. In Casamatta and Haritchabalet (2003), a very experienced *VC*1 finds it profitable to invest alone after observing a positive signal. Thus, he is ready to syndicate and share the project returns only if this means gathering a very precise signal from *VC*2. In our model, we rule out this explanation by assuming that *VC*1 never wants to invest in the project alone anyway (assumption 2.1). Our result thus relies on the incentive costs of syndication: a very experienced *VC*1 suffers a less serious incentive problem when it comes to revealing his signal to *VC*2; also, such problem is not dramatically worsened when *VC*2's expertise is increased. This implies that an experienced lead VC does not need to pay a large agency rent in order to benefit from syndicating with an experienced partner.

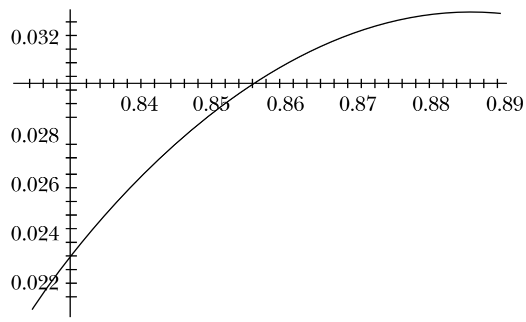
GRAPHIC 3.2*a*: **Value of syndication as a function of θ_2 ($\theta_1 = 0.53$)**



GRAPHIC 3.2*b*: **Value of syndication as a function of θ_2 ($\theta_1 = 0.55$)**



GRAPHIC 3.2*c*: **Value of syndication as a function of θ_2 ($\theta_1 = 0.57$)**



4. Conclusions

WE have analyzed the incentive issues arising when a venture capital syndicate is formed. A lead venture capitalist with a private signal of project profitability seeks the opinion of another venture capitalist before he funds the project. An appropriately designed syndication contract must induce the second VC to gather a profitability signal and reveal it to the lead VC. However, the syndication deal must also ensure that the lead VC's information is credibly signalled to his syndication partner. We studied how the quality of VCs' signals affects the incentive costs of syndication, and conclude that the lead VC may not want to syndicate with a very experienced VC. We also provide numerical simulations showing that more experienced VCs tend to pick more experienced syndication partners. This prediction is in line with existing empirical evidence (Lerner, 1994).

Our analysis so far does not allow detailed predictions to be made on the shape of the VCs' financial claims. In a two-outcome setting, it turns out that we cannot say much about whether the syndicating partners's claims resemble debt, equity, or more sophisticated claims such as participating convertible preferred. We thus plan to extend our model to a threeoutcome setting to address the issue of which claims should be held by different partners in a venture capital syndicate.

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