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Syndication in private equity industry: comparing the strategies of independent and captive venture capitalists

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Abstract

This paper aims to connect two strands of the venture capital literature: the inter-relationships among venture capitalists (VCs) on the one hand, and between VCs and their funds providers on the other hand. It examines the existence of a relationship between type of fund provider and skill characteristics of the VCs partners in a syndication deal. In other words, it examines whether captive/independent VCs privilege partnerships with firms with specific skills? We develop a theoretical analysis to compare the syndication behaviors of independent and captive VCs. Based on a game-theoretical approach, we model whether the type of lead VC has an influence on the optimal (related to skill levels) partnerships established with syndicate members.

Our paper highlights that the source of finance matters for the syndication choice. Its influence takes two forms. The first is related to the heterogeneity between a captive and an independent VC in relation to the returns from the funded project: independent VCs (IVCs) tend to participate in higher profitability syndicated funding projects than captive VCs (CVCs). The second is related to heterogeneity among captive and independent VCs in the ability to syndicate. This is related strongly to the types of financial incentives funds providers employ to align the VC's interests with their own goals. Our analysis suggests that these incentives play a decisive role in the bargaining power of the lead VC and generally make IVCs more attractive syndication partners for other venture capitalists.

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Introduction

Much of the existing research on venture capital focuses on the interaction between entrepreneurial companies and venture capitalist firms (VCs). Work in this area focuses on investment choices (Repullo and Suarez 2004; Fairchild 2004, 2011; De Bettignies and Brander, 2007; Hellmann, 2006), contracting (Hellmann, 2006; Casamatta, 2003; Cornelli and Yosha, 2003), post-investment (Sahlman, 1990; Lerner, 1995; Sorensen, 2007; Tian, 2011; Wang and Zhou, 2004) and exits (Puri and Zarutskie, 2012; Cumming, 2008; Hochberg, 2012). We extend this literature by contributing to the research on the inter-relationships between VCs on the one hand, and between VCs and their funds providers on the other hand.

This paper is related to a specific aspect of the literature studying the inter-relationships among VCs. We focus on the role of partners' *skills* in the formation and efficiency of VC syndicates. Our work is in line with theoretical papers that highlight the importance of skills in syndication processes, and their influence on competition among VCs (Casamatta and Haritchabalet, 2007; Alvim, 2011) or the returns from funded projects (Brander *et al*., 2002). It also adds to the empirical results showing that VCs tend to choose their syndication partners based on their skills and knowledge, for strategic considerations (Hopp, 2008), agency costs (Meuleman et al. 2010), or position in a syndication network (Hopp, 2010; Abell and Nisar, 2007; Hochberg et al., 2007; Sorenson and Stuart, 2001).

We also contribute to the stream of research on the interactions between VCs and their funds providers. Several studies (Van Osnabrugge and Robinson, 2001; Robbie *et al.,* 1997; Hellman *et al.*, 2008; Dushnitsky and Lenox, 2005) show that there are differences in the investment strategies of an *independent* VCs, that is, a firm where no single investor or shareholder is dominant in the firm's ownership, and a *captive* VC, that is, a company that belongs to a corporation that is investing its own resources. Our paper is influenced

particularly by a few works that highlight that captive and independent VCs tend to adopt specific strategies related to syndication. Heterogeneous syndication behaviors are explained by the influence of the new venture on the value of the captive VC's core assets (Hellmann, 2002), differences between captive and independent VCs to enhance the entrepreneur's incentive to exert effort (Arping and Falconieri, 2010), or by the ability of captive venture capitalists to attain central positions in syndication networks (Keil *et al*., 2010).

This paper is the first to link these two strands of the VC literature. It investigates the existence of a relationship between type of funds provider and the skills characteristics of the VC partner in a syndication deal. In other words, it examines whether captive (independent) VCs privilege partnerships with VCs endowed with specific skills?

The paper is organized as follows. First, we review the main results in the literature on the relationships between skills and syndication one the one hand, and on the interactions between types of funds providers and syndication on the other (Section 2). Section 3 develops a model to compare the syndication behaviors of independent and captive VCs. Using a game-theoretical approach, we analyze whether the type - captive or independent - of lead VC has an influence on the optimal form of partnership (partners' skills) established with other syndicate members. Section 4 presents our theoretical results and Section 5 concludes.

2 Syndication, skills and funds providers

2.1. Skills and syndication

The level and nature of the skills of the partners involved in a syndicated venture capital investment are crucial for its efficiency. VCs' skills are determined mainly by two factors. The first is level of experience. This matters for several reasons. First, there is a learning effect from experience of past investments, which facilitates the VCs' interpretation of the information provided by portfolio companies in the form of business plans or monthly

reports, for example (Gorman and Sahlman, 1989; Sapienza, 1992; Cohen and Levinthal, 1990). Second, there is empirical evidence that venture capital firms whose associates have prior business experience (entrepreneurial, managerial or consulting) provide more support and better governance. They are more active in recruiting managers and directors and in fundraising, and interact more frequently with their portfolio companies (Bottazzi *et al.,* 2004, 2008). Also, Sorensen (2007) finds that experienced VCs add more value and result in a higher rate of listings of companies.

The second skills-related factor is level of specialization. VC specialization at a particular stage of development and/or in a particular industry sector can reduce screening and monitoring costs (Manigart, 1994; De Clercq and Dimov, 2003). Moreover, according to Gupta and Sapienza (1992) and Wright and Robbie (1998) limited industry or development stage investment improves the VC firm's level of control over the financed companies; that is, the VC company's better understanding of the industry or development stage makes it more difficult for the portfolio companies to hide management incompetence or conceal information on company performance. Finally, Gompers *et al.* (2009) find that VCs that specialize in just a few industries perform better than generalist VCs.

Thus, VCs are characterized by a particular skills level determined by their specific experience/specialization, a combination that determines their ability to screen, control and manage the investment projects. Whatever the skill level of the VC it is likely to benefit from syndicating and being able to exploit the skills of syndicate members, which, in turn, are likely to enhance the value of the relevant investment portfolios.

Several studies have investigated the role of partners' skills in the formation and efficiency of VC syndicates. Brander et al. (2002) is an important theoretical paper in this area. They consider that VCs may have complementary skills, and propose a value-added hypothesis according to which, syndication adds value to a given project because, compared

to a single VC, a larger number of VCs allows improved managerial support, higher reputation, and a larger variety of contacts for the portfolio firms. This implies that syndicated projects should show higher rates of return than standalone projects. Using Canadian data for the 1990s, they find that syndicated deals produce higher returns, which supports their value-added hypothesis.

Several theoretical papers developed this theory further[4]. Casamatta and Haritchabalet (2007) provide a rationale for the syndication of venture capital investments based on the trade-off between the need to gather accurate information on the quality of an investment opportunity, and the need to maintain monopoly profits. Thus, forming a syndicate may be useful for a lone VC since a syndicate implies a coordination device that prevents the occurrence of profit-dissipating competition. From their model, Casamatta and Haritchabalet conclude that level of experience is a major determinant of the syndication decision. They highlight that: (1) syndication is negatively related to the VCs' level of experience; (2) experienced VCs syndicate with experienced VCs.

Along similar lines, Alvim (2011) constructed a model of syndication involving two differently-experienced VCs, based on the idea that, participation in a project would allow a less experienced VC to learn from cooperation with a more experienced VC, and improve its screening and value-added skills. Furthermore, the less experienced VC should benefit from inclusion in a network of relations which might affect VC competition. A dynamic disincentive to syndicate might occur if potentially profitable syndications are avoided in order not to increase future competition. In this case, the model shows that syndications among VCs with similar levels of experience will be less affected by dynamic considerations. Hence, syndication among similarly experienced VCs will be more likely than syndication among VCs with heterogeneous skills.

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[4] Among other theoretical works that highlight the importance of experience for the formation and efficiency of investment syndicates, see in particular Cestone et al. (2006) and Tykvova (2007).

Several empirical studies show that lead VCs tend to choose syndication partners based on the complementarity of their skills and knowledge (Lockett and Wright, 2001; Manigart *et al*., 2006). Hopp (2008) shows that very similar experience and expertise of lead investor and potential partner hinders collaboration. This result is explained by the significant role played by strategic considerations: in line with Casamatta and Haritchabalet (2007), cooperating with a VC with similar skills could negate the competitive advantage of the leader. Meuleman et al. (2010) show that the higher the levels of knowledge complementarities, the higher are the agency costs associated with mutual monitoring among syndicate partners. In this case, relational embeddedness may facilitate the development of trust among syndicate members, thereby reducing the need for mutual monitoring, and promoting information sharing. The importance of skills is highlighted also by Hopp (2010), who shows that VCs with more industry experience tend to rely more on syndication because of the former's greater number of past transactions and larger number of network partners. This gives them an influential position which increases the probability of their being invited to participate in syndicated deals. As leaders of future syndications, they will be likely to provide syndicate partners with access to other profitable deals. To sum up, industry experience implies a central network position for a VC, which in turn makes it a more attractive syndication partner for other VCs.

2.2 Funds providers and syndication

The typical structure and functioning of the professional private equity industry generally follow the pattern of the VC firms forming a limited VC partnership fund, in which they participate as general partners and which raises money from the limited partners, that is, the funds providers. The limited partners are wealthy individuals and institutions with large amounts of available capital, such as state and private pension funds, university financial

endowments, foundations, and pension and insurance companies, and pooled investment vehicles, such as funds of funds or mutual funds. Within this typical VC firm organization there are *independent* organizations in which no single investor or shareholder is dominant in the firm's ownership (Gompers and Lerner, 2004).

There are also other VC types which vary in their governance and objectives. These are *corporate* VCs, *bank-affiliated* VCs, and *public* VCs (financed mainly with public money). Corporate and bank-affiliated VCs are referred to as *captive* VCs. A captive venture VC is a company that belongs to an established corporation that is investing its own resources. The parent organization may be a financial institution, such as a bank (bank-affiliated VCs), but may be a larger non-financial company (corporate VCs). These VC funds tend to be open-ended and the amounts allocated for investment purposes reflect the overall strategy of the parent institution.

Several empirical studies, providing evidence for different periods and different countries, show that funds providers' investment preferences influence the characteristics of the venture capital investment. The study by Van Osnabrugge and Robinson (2001) which exploits information from interviews and responses to questionnaires from VCs in the UK, show that, compared to captive VCs, independent VC firms tend more often to adopt investment behaviors and preferences that signal competence to their fund providers. In particular, they find that independent VCs are more attracted to investments with high expected financial returns. These findings are supported by other studies (Robbie *et al.,* 1997). Empirical work shows also that although captive VCs, like other funds providers, seek a reasonable rate of return on their funds, they may have other goals, different from those of institutional investors. For instance, Hellman, Lindsey and Puri (2008) in a study of the US venture capital market find that captive banking organizations invest in venture capital funds to build relationships that will benefit their long run lending activities (the so-called

"relationship hypothesis"). Likewise, corporate VCs generally expect "strategic" returns as well as financial returns. These strategic returns include access to new technologies and organizational learning (Chesbrough, 2002; Keil *et al*., 2008).

Despite these differences in organizational structures and objectives, captive VCs are similar to other VCs in that the syndicated investments account for a large fraction of their overall investments (Dushnitsky, 2006). However, a few theoretical and empirical works highlight that captive VCs also tend to adopt specific syndication strategies. In particular, Hellmann (2002) proposes a model in which the entrepreneur can choose among independent VCs (pursuing financial objectives only) and a strategic captive corporate VC (ownership of some asset whose value will be affected by the new venture). Both compete on valuation and on the value-adding support provided to the entrepreneur. The entrepreneur's choice depends on the underlying characteristics of the new venture. In particular, if the new venture cannibalizes the captive core asset, the model predicts syndicated finance where the independent VC is the lead investor, providing active support to the venture and typically having board membership. In the case of the captive VC, it remains a passive investor, does not become involved in support and does not participate as a board member. The role of the captive VC is to hold equity in order to reduce the independent VC's stake in the new venture and prevent excessive cannibalization of the captive VC's core assets.

Arping and Falconieri (2010) recently developed a theory of financing choice between strategic and financial investors. Their approach is founded on the idea that strategic investors, such as corporate VCs, face a trade-off when financing start-up firms to complement their core businesses and to facilitate the internalization of externalities. Although strategic objectives may make it more worthwhile for the investor to elicit high entrepreneurial effort, they may simultaneously undermine commitment to penalizing managerial slack by terminating the entrepreneur's project. Arping and Falconieri study the

case of a syndication deal between a strategic investor and an independent investor. The model shows that syndication makes the strategic investor less reluctant to terminate the project in the event of poor performance because its stake in the project is reduced relative to the standalone case, which in turn, restores the credibility of the termination threat. Thus, syndicating the deal and bringing in an independent investor restores financial discipline and enhances the entrepreneur's incentive to exert effort.

In section 3, we develop a model that is underpinned by the two strands of the literature discussed above and tries to link them. It compares the syndication behaviors of independent and captive VCs.

3 The model

The model analyzes the optimal partnerships of two different types of VCs potentially responsible for a risky project. An independent VC (IVC) raises money from limited partners supposed to be institutional investors; a captive VC (CVC) is affiliated to a parent company which is its permanent financial partner. The model considers situations where the projects funded by different types of VCs have the same initial characteristics. The VC can then manage the project on its own or choose to associate a syndicate. The VC that we describe as the leader or lead VC can manage the project in two stages. In the initial period ("project-seeking stage"), the leader and the syndicate, if any, conduct screening to distinguish - more or less efficiently - good from bad projects. If a project is deemed bad, it is liquidated at the end of the initial stage. If not, it progresses to the development stage. During the development phase, the leader and the syndicate, if any, manage the project.

Syndicates have different skills and qualities which enhance the gain that the VCs can expect from management of a given project. Since syndicates are heterogeneous, they

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generate different costs for lead VCs which must share a part of their profits. Thus, each VC will try to set up a partnership with an appropriate type of syndicate, given the costs and the benefits associated with each kind of partnership. Each syndicate receives one or more propositions to partner, from different types of leaders, and chooses the best proposition. We develop the model as a matching game between leaders and syndicates, in a setting where the leaders are IVCs or CVCs and the syndicates are endowed with different skills. The model analyzes the way a project is developed (including the form of syndication it chooses, if any) according to the nature of the leader and the initial returns from the projects.

3.1 Projects, leaders, syndicates and sequences of the deal

The success or the failure of a deal depends on the nature of the project, the financial support of the leader, the leader's skills and the characteristics of the syndicate.

3.1.1 Projects

Projects correspond to different sectors of activity. Whatever the sector of activity, there are different classes of projects characterized by respective levels of risk and return. A project of class (p, q) has the probability p to provide a gross return R, and a probability q to fail for managerial reasons, and a probability $(1 - p - q)$ to fail for technological reasons. When a project fails, it provides no returns. The class of the project and the return R are observable by VCs.

3.1.2 Leaders

Leaders are defined according to the nature of their funds providers and their level of expertise. When a given leader applies a costly effort e, $(e \in [0,1])$ to disclose a bad project at the initial stage, the probability of disclosing a project that is likely to fail for managerial reasons is also e, independent of the level of risk of the project. The leader's level of expertise

is inversely related with the unitary cost c of its screening effort during the early stage. The cost of e is given by the quadratic function $ce^2 (0 < c)$. If at the end of the initial period the project is not liquidated, the leader monitors the development of the project at a fixed cost $\bar{c}$. During each stage of the process, the leader may or not require the aid and advice of a syndicate.

The payment (or profit) of leaders is the difference between two terms: the undiscounted expected gross return from the project and the undiscounted costs associated with each stage of its development. The expected (net) return is determined by the class of the project, the expertise of the leader, the net contribution of the syndicate, if any, and by the type of the leader's funds providers.

In line with the literature, we suppose that institutional investors encourage high return projects and then pay to IVCs a bonus which we assume will be proportional to the expected gross return from the project[5].

CVCs are linked to a parent company which is the permanent partner. In line with the literature, we suppose that the parent company "strategically" engages in VC financing in order to select firms whose skills will complement its core activities. Because maximizing returns is not the sole objective of the lead VC, we suppose that the compensation scheme is dependent on non-returns variables, such as the proportion of investment projects brought to successful completion. In our setting, we suppose that if the leader is captive, the parent company uses the redistribution to the leader of a fixed bonus, as an incentive device for the project reaching its term. The last component of the payment received by the leaders is provided by the effort of syndicates if leaders choose to associate them with the development of the project.

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[5] IVCs' funds providers are mainly interested in the return on their own investment in the deal. This return depends on the amount of their financial investment, on the nature of the project, on the actions of the leader and syndicate (if any) but the costs supported by the leader and the syndicate are not supported nor shared by the funds provider. The funds provider uses incentives to drive the actions of the leader and syndicates in its preferred direction but does not co-manage the deal.

The leaders' costs are, first, the costs associated with their efforts during the two stages of development. Second, the share of the payment they are obliged to renounce if they integrate syndicates as partners in the development of the projects. There is also another kind of cost that can be compared to the models proposed by Casamatta and Haritchabalet (2007) and Alvim (2011), and which is associated with information transmitted by the leader to the syndicates. This cost is related to the leaders' providing the syndicates - which are also their competitors - with access to private information through participation in the management of the project. We express this fixed cost as C.

3.1.3. Syndicates

Syndicates are partners which the leader may or not associate with the project's initial and development phases. Syndicates have two characteristics: level of specialization and level of experience.

During the initial stage, the screening period, for the sake of simplicity we suppose that the efficiency of the syndicate depends only of its level of sectorial specialization which enables more in-depth understanding of the technology specific to the project and reduces screening costs (Gupta and Sapienza, 1992; De Clercq and Dimov, 2003). Thus, we suppose that specialized syndicates apply an effort g, ($g \in [0,1]$) to disclose bad projects that may fail for technological reasons. Their probability of success then is also g independent of the risk of the project.

During the development stage, syndicating a deal with partners specialized in a particular industry is likely to enhance the profitability of the funded project by improving the VCs' level of control over the financed companies and reducing monitoring costs (Gompers *et al*., 2009; De Clerq and Dimov, 2003; Gupta and Sapienza, 1992; Wright and Robbie, 1998). For this reason we suppose that during the development stage, specialized syndicates can

apply an effort $h, h \in [0,1]$ to boost the returns from a good project by $R(1 + \alpha h)$ where α is a positive parameter.

On the other hand, syndicating during the development stage with experienced partners implies improved managerial support and a larger variety of contacts for the portfolio firms (Brander *et al*., 2002; Alvim, 2011; Hopp, 2010). Therefore, setting up partnerships with experienced VCs may be an efficient method to reduce the probability of the investment projects failing. Therefore, in our model we assume that during the development stage, experienced syndicates apply an effort $d, d \in [0,1]$ to procure a floor-return $\underline{R}$ from an expected proportion d of projects, initially bad for managerial reasons, but which have not been eliminated during the initial stage as a result of the leader's screening efforts.

Syndicates are heterogeneous in their levels of experience and specialization. For simplicity, we assume there are three types of syndicates[6].The first two forms are active in the two periods and provide different forms of aid in each stage of the development of a given project; the third form is active only during the second period.

- *Experienced and specialized syndicates*: in the initial period provide the level of effort g to disclose the quality of the projects at a cost $c_g g^2$, where c_g, is a positive constant. In the development stage, they are able to apply the levels of effort d and h at the respective costs $c_d d^2$ and $c_h h^2$, to procure a return $\underline{R}$ from a proportion d of the projects initially considered bad projects, and to boost the returns from the good projects by $R(1 + \alpha h)$, where c_d, c_h, d and α are positive constants.

- *Specialized and non-experienced syndicates*: in the initial period they provide the level of effort g at a cost $c_g g^2$, and in the development stage the level of effort h at a cost $c_h h^2$.

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[6] For obvious reasons, syndicates that are neither experienced nor specialized will never be chosen by the leader.

- *Experienced and non-specialized syndicates*: during the development stage only, they procure a floor-return $\underline{R}$ from a proportion d of the projects initially considered bad projects, at a cost $c_d d^2$.

For leaders, syndicates are partners not employees. In other words, leaders do not provide to syndicates payments proportional to their level of effort or the time they devote to the partnership. They must share with them a part of their own gain, or at least a part of the gain to which they contribute, but not all of the costs they face. We suppose that the nature/quality of syndicates is observable by leaders. Leaders share with syndicates a proportion[7] of the expected development costs that are saved if the syndicates participate in the project selection at the initial stage. They also share with the syndicates the profit that the latter contributes to generating through their value-adding activity, during the second stage. This form of payment incentive means that the syndicates' rewards are dependent on both their own quality and level of effort, and also the quality of the leader, the incentives provided to the leader by its funds providers, and the quality of the project.

3.1.4 Form of the game and sequence of actions

The model takes the form of a game with two types of players, leaders and syndicates. Since our objective is to study the style of syndication concluded by each type of leader, in a world where they compete to obtain more efficient partnerships, we suppose a single IVC and a single CVC endowed with the same skills as leaders. These two leaders differ only in the type of incentives chosen by their funds provider (a premium paid on the profits to the IVC and a bonus based on the number of developed projects for the CVC). Each of them observes a single project. The two projects are identical: they have the same returns in the case of

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[7]That we supposed given by convention.

success *R*, the same risks components (i.e., p and q). The two leaders have the possibility to match with three available syndicates, one of each style. They can also, if they prefer, develop the project without a syndicate. In each case, we assume the projects are viable. The game has two phases: the matching process phase and the development process phase.

The matching/bargaining process takes the following form:

(i) Each leader chooses the type of solution (partnership with one type of syndicate or stand-alone option) to maximize its net expected return. If this solution includes partnership with a syndicate, the leader proposes partnership with the relevant syndicate, in a take-it or leave-it offer, according to the rules presented in section 3.1.3. If the best solution is the stand-alone one, the leader does not make an offer.

(ii) Syndicates collect the offers, if any. If a given syndicate has two offers, it chooses the better one. When a given syndicate receives only one offer, it accepts it[8].

(iii) When the offer of one of the leaders has been refused at step (ii), this leader either makes a new offer to another syndicate or chooses the stand-alone solution if this is now the better remaining solution.

(iv) If relevant, the syndicate receiving the new offer responds.

The development process then begins. Each leader develops its project in a two stage development setting, with the following sequences.

(i) The first stage (the "project-seeking stage") is a selection stage: during this stage, the leader applies its screening efforts to determining the nature of the project. It is assisted or not by a specialized syndicate, according its previous choices. Leaders and syndicates mutually observe one another's efforts and cannot cheat. When a given project is revealed as

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[8] We suppose, without any consequence other than simplifying technical treatment of the model, that the nature of the offers always excludes that reservation is the best solution for syndicates that receive offers. We then exclude the cases of leaders and syndicates that do not find partners.

a bad project during the initial stage, it is liquidated and the process ends. The leader incurs a loss in the form of the costs that supported the project selection stage. When a given project is not revealed as a bad project the project progresses to the development stage.

(ii) During the second stage ("development stage"), the leader devotes its efforts to the managerial development. If the leader has chosen to associate a syndicate, a specialized syndicate will improve project profitability in the case of a good project, and an experienced syndicate will improve the management of a fraction of the projects not revealed as bad projects during the first stage. If the syndicate is both experienced and specialized, it will devote effort to the first or second objective, depending on the nature of the project. Leaders and syndicates observe their respective efforts and cannot cheat. At the end of the second stage, the remaining bad projects are liquidated; the other projects are introduced to the market or are taken over.

The game is played according to backward induction. The leader rationally anticipates the consequences of its own choices on the choice of effort of each category of syndicate during each stage of the process. It also anticipates the consequences of each possible choice of partnership on its expected payment. The leader's propositions to the syndicates are designed to maximize the leader's gains. It indicates its own level of effort to the syndicates. Each syndicate responds to each proposition by selecting a level of effort that maximizes the syndicate's total net payment. If a syndicate receives two propositions simultaneously, it will choose the proposition that maximizes its payment. The equilibrium solutions to the game are (i) matching pairs between leaders and syndicates, (ii) the level of effort of each of leader and partner in the development process.

In each of four possibilities of association/non-association with a syndicate, leaders have different payoffs functions. Also, each syndicate has two possible payoffs according to the nature of its partnership. The next sub-section discusses the potential payoffs.

3.2 Leaders' and syndicates' payoffs:

The leader's payoffs depend on whether it is an IVC or a CVC, and on the type of their partner in the two stages of development of the project.

3.2.1 Independent VC's profits

The specificity of an IVC is that it is funded by an institutional investor that is interested mainly in a financial return. The incentive device used by the fund provider consists of providing to the leader a bonus in the proportion $\delta, (\delta > 0)$ of the gross return from the project. We begin by formulating the stand-alone payoff, then the profit corresponding to each kind of partnership.

The stand-alone IVC payoff:

This is expressed as (1)

$$\Pi_{alone}^{IVC} = \max_{e\in[0,1]} \quad (1+\delta)Rp - ce^2 - \bar{c}(1-eq) \tag{1}$$

The first term in (1) represents the expected gross return from the project. The second term corresponds to the cost of the screening effort during the initial stage. The third term is the development cost during the second stage. This cost decreases with the amount of effort in the previous stage: the greater is e, the smaller the proportion of bad projects developed during the second period.

The payoff of an IVC matched with an experienced (non-specialized) syndicate during the development period:

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This payoff is expressed as (2)

$$\Pi_{exp}^{IVC} = \max_{e \in [0,1]} \quad (1+\delta)\big[Rp + (1-\gamma)d(1-e)\underline{R}q\big] - ce^2 - \bar{c}(1-eq) - C \qquad (2)$$

where the term $d(1-e)\underline{R}q$ corresponds to the profit generated by the rehabilitated projects, γ is the proportion of this profit payed to the syndicate and C is the cost of diffusion of information supported by the leader when it decides to associate partners who are also competitors in other deals.

The payoff of an IVC matched with a specialized (non-experienced) syndicate during the whole development process:

This payoff is expressed as (3)

$$\Pi_{spec}^{IVC} = \max_{e \in [0,1]} \quad (1+\delta)Rp[1 + (1-\gamma)\alpha h]$$

$$-ce^2 - \bar{c}[1 - eq - (1-\gamma)(1-p-q)g] - C \qquad (3)$$

where the term $\bar{c}(1-p-q)g$ represents the expected reduction in costs during the development stage, $\gamma(1-p-q)g$ is the share of this reduction paid by the leader to the syndicate, $(1+\delta)Rp\alpha h$ is the additional expected profit generated by the effort h of the syndicate during the development period and $\gamma(1+\delta)Rp\alpha h$ is the part of this profit paid to the syndicates.

The payoff of an IVC matched with a specialized and experienced syndicate during the whole development process:

This payoff is expressed as (4)

$$\Pi_{spec/exp}^{IVC} = \max_{e \in [0,1]} \quad (1 - \gamma)(1 + \delta)\big[Rp(1 + \alpha h) + d(1 - e)\underline{R}q\big]$$

$$-ce^2 - \bar{c}[1 - eq - (1 - \gamma)(1 - p - q)g] - C'$$

(4)

where the information cost C' is such that $C < C'$.

3.2.2 Captive VCs' profits

As explained above, we suppose that the VC's parent company uses the redistribution to the leader of a fixed bonus P as an incentive device, when a project is developed to its full term.

*The stand-alone **CVC** payoff:*

This payoff is expressed as (5)

$$\Pi_{alone}^{CVC} = \max_{e \in [0,1]} \quad (R + B)p - ce^2 - \bar{c}(1 - eq)$$

(5)

where B is the amount of the bonus paid by the financial partner when a project is introduced to the market or is taken-over.

The payoff of a CVC matched with an experienced (non-specialized) syndicate during the development period:

This payoff is expressed as (6)

$$\Pi_{exp}^{CVC} = \max_{e \in [0,1]} \quad (R + B)p + (1 - \gamma)d(1 - e)(\underline{R} + B)q$$

$$-ce^2 - \bar{c}(1 - eq) - C$$

(6)

where the term $d(1 - e)(\underline{R} + B)$ is the gross return from a bad project given the bonus distributed by the financial partner, and the efforts of the leader in the initial stage and of the syndicate in the development stage.

The payoff of a CVC matched with a specialized (non-experienced) syndicate during the whole development process:

This payoff is expressed as (7)

$$\Pi_{spe}^{CVC} = \max_{e \in [0,1]} \quad (R + B)p + (1 - \gamma)\alpha Rhp$$

$$-ce^2 - \bar{c}[1 - eq - (1 - \gamma)(1 - p - q)g] - C \qquad (7)$$

where all the terms have already been defined.

The payoff of a CVC matched with a specialized and experienced syndicate during the whole development process:

This payoff is expressed as (8)

$$\Pi_{spec/exp}^{CVC} = \max_{e \in [0,1]} \quad (R + B)p + (1 - \gamma)\big[\alpha Rhp + d(1 - e)(\underline{R} + B)q\big]$$

$$-ce^2 - \bar{c}[1 - eq - (1 - \gamma)(1 - p - q)g] - C' \qquad (8)$$

3.2.3 Experienced (non-specialized) syndicates' profits

The two possible partnerships give the following payments:

The payoff of an experienced syndicate matched with an IVC leader:

This payoff is expressed as (9)

$$\Pi_{IVC}^{exp} = \max_{d \in [0,1]} \quad C + (1 + \delta)\gamma d(1 - e^*)\underline{R}q - c'd^2 \qquad (9)$$

where e^* is the level of effort maximizing the payment of the IVC in such a partnership and $c_d = c'$.

The payoff of an experienced syndicate matched with a CVC leader:

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This payoff is expressed as (10)

$$\Pi_{CVC}^{exp} = \max_{d\in[0,1]} \quad C + \gamma d(1 - e^*)(\underline{R} + B)q - c'd^2 \tag{10}$$

where e^* is the level of effort maximizing the payment of the CVC in such a partnership.

3.2.4 Specialized (non-experienced) syndicates profits

The two possible partnerships provide the following payments:

The payoff of a specialized syndicate matched with an IVC leader:

This payoff is expressed as (11)

$$\Pi_{IVC}^{spe} = \max_{g\in[0,1],h\in[0,1]} \quad C + \bar{c}\gamma(1 - p - q)g + \gamma(1 + \delta)\alpha Rhp$$
$$-c'g^2 - c'h^2 \tag{11}$$

where $c_g = c_h = c'.$[9]

The payoff of a specialized syndicate matched with a CVC leader:

This payoff is expressed as (12)

$$\Pi_{CVC}^{spe} = \max_{g\in[0,1],h\in[0,1]} \quad C + \bar{c}\gamma(1 - p - q)g + \gamma Rp\alpha h$$
$$-c'g^2 - c'h^2 \tag{12}$$

3.2.5 Specialized and experienced syndicates' profits

The two possible partnerships of this last form of syndicate give the following payments:

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[9]We introduce this assumption to avoid sensitivity of our results to difference in syndicates' skills and thus their different contribution to the VC's tasks.

The payoff of an experienced and specialized syndicate matched with an IVC leader:

This payoff is expressed as (13)

$$\Pi_{IVC}^{spec/exp} = \max_{d\in[0,1],g\in[0,1],h\in[0,1]} C' + \gamma(1+\delta)\big[\alpha Rhp + d(1-e^*)\underline{R}q\big]$$
$$+ \bar{c}\gamma(1-p-q)g - c'd^2 - c'g^2 - c'h^2 \tag{13}$$

where e^* is the level of effort maximizing the payment of the CVC in such a partnership.

The payoff of an experienced and specialized syndicate matched with a CVC leader:

This payoff is expressed as (14)

$$\Pi_{CVC}^{spec/exp} = \max_{d\in[0,1],g\in[0,1],h\in[0,1]} C' + \gamma\big[\alpha Rhp + d(1-e^*)(\underline{R}+B)q\big]$$
$$+ \bar{c}\gamma(1-p-q)g - c'd^2 - c'g^2 - c'h^2 \tag{14}$$

4 Optimal syndication choices: results and comments

The game presented in section 3 has many possible outcomes. Our assumptions, especially absence of fixed costs for leaders in the stand-alone case and for syndicates in all cases, preclude any relevance to the reservation solution where leaders would reject the project for development. Whatever the values of the parameters, all profits functions are continuously derivable from the arguments. This property is maintained if the optimal values $e^*, d^*, g^*,$ and h^* are derived by solving the game through backward induction. Each pair {leader, syndicate} or {leader, *stand-alone*} then provides an optimal solution $\{e^*, d^*, g^*, h^*\}$ and a profit for each partner associated to this solution. Comparison of the profits associated with the different partnerships is then always possible for leaders and for syndicates. If two leaders choose initially different forms of assistance (including the *stand-alone* option), their

first proposition is automatically accepted and the game is at equilibrium. If the two leaders propose to associate the same syndicate, the latter compares the profit expected from each partnership and chooses the better offer. If the proposition of a given leader is refused at the first step in the matching game, this leader makes a second offer (including the *stand-alone* option) which automatically is satisfied. The game then ends at this moment. Although a Stackelberg equilibrium always exists, it can take different forms. Formally, if the experienced syndicates (specialized or not) are activated, their level of effort d^* is always positive[10]. Similarly, if specialized syndicates (experienced or not) are activated, their equilibrium levels of efforts g^* and h^* are always positive at equilibrium[11]. However, this does not mean that the equilibrium level of effort e^* would vanish if the optimal solution integrates an experienced syndicate although this would apply when the better solution is to allow a minimal return from a bad project rather than eliminating it at the initial stage of development. This case corresponds to large values of $\underline{R}$, and c and a low value for c'[12]. This is a "technical consequence" of the quadratic form of the cost c. We do not consider this case. Similarly, we also do not consider cases where the values of c and c' are so low that one or more efforts is at its maximal bound $e = 1$, $d = 1$, $g = 1$, or $h = 1$ for one of the pairs {leader, syndicate} at equilibrium. We focus on cases with interior solutions in efforts $\{e^*, d^*, g^*, h^*\}$. Given the simple form of the model, the equilibrium solutions can then be analyzed according to the relevant parameters of the model. The following propositions can then be derived.

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[10]Suppose they are not; in this case the leader's payments given by (2), (4), (6) or (8) are always dominated by (1), (3), (5) or (7). Rationally, then, the leader would never propose such an association.

[11]This property is associated with the form of the cost functions $c'g^2$ and $c'h^2$.

[12] This case would correspond to leaders with low level expertise (very large value of c) able to find high-skilled partners (very low values of c').

Proposition 1: *Whatever the values of the parameters $(p, q, R, \underline{R}, \alpha, \gamma, \delta, B, c', C, C')$, all increases in the efficiency of the leaders (i.e. decreases in c) will decrease the willingness to syndicate with an experienced leader (specialized or not). They have no influence on the willingness of leaders to syndicate with a specialized (not experienced) syndicate.*

Proof: see Appendix 1.

This result is a consequence of the experienced syndicates' contribution. Due to their capacity to compensate for a rather inefficient leader and poor quality screening activity, experienced syndicates allow the non-expert leader efficiently to reject few bad projects during the initial stage without bad consequences on their payoff. Conversely, since the specialization of syndicates tends to complement rather than substitute for the qualities of the leader, the propensity to associate with a specialized syndicate does not depend on the characteristics of the leader.

Proposition 2: *Whatever the values of the parameters $(p, q, \underline{R}, \alpha, \gamma, \delta, B, c, c', C, C')$, all increases in the ex-ante returns R from good projects will increase leaders' willingness to syndicate with specialized syndicates (experienced or not). These increases have no influence on their willingness to syndicate with an experienced (not specialized) syndicate.*

The return from projects has no influence on the efficiency of the experienced syndicates' effort. Thus, the propensity to syndicate with experienced partners is not influenced by the returns expected from the projects. Conversely, since the efficiency of the effort of specialized syndicates in the development stage is governed by the initial "quality" of the good projects, specialization is appreciated more and seen as more valuable if the good projects have high returns. The screening effort in the initial stage contributes also to

minimizing the expected number of bad projects at the beginning of the development stage. After that stage, it is easier to devote all efforts to enhancing the returns from the remaining good projects. Note then that the preference for a syndicate that is both experienced and specialized is limited to cases where the difference in the cost to the leader $(C' - C)$ is reasonable.

Proposition 3: *Whatever the values of the parameters $(p, q, R, \underline{R}, \alpha, \gamma, \delta, B, c, c', C, C')$, and the first choice of the CVC, the IVC can always syndicate with a specialized syndicate when this choice is its first choice.*

Proof: see Appendix 3.

Proposition 4: *Whatever values of the parameters $(p, R, \underline{R}, \gamma, B, c, c')$, there is a range of values of the parameters $(q, \alpha, \gamma, \delta, C, C')$ such that the IVC syndicates with an experienced syndicate, even if this style of syndication is also preferred by the CVC.*

Proof: see Appendix 4

Corollary: IVCs have preferential access to specialized syndicates and the capacity to dispute preferential access of CVCs to experienced syndicates.

Propositions 3 and 4 reveal that IVCs have an advantage on CVCs in the syndication process. While IVCs have preferential access to specialized syndicates, the symmetric result does not hold. IVCs can dispute the preferential access of CVCs to experienced syndicates, while this type of syndication obviously is more adapted to the nature of their bonus and to the interests of their financial partners. Since they are more motivated than CVCs by the

returns from projects, IVCs have a higher propensity to choose the style of syndicate that increases the returns from the project. CVCs are encouraged by their funds providers to develop as many projects as possible. This generates a tendency to syndicate with experienced (not necessarily specialized) partners. However imagine that the performance of specialized syndicates is very weak, and the probability of project success and the quality of the leaders insufficient to motivate IVCs to concentrate on the best projects. In this case, a generous premium paid by the IVC fund-providers on the returns from the projects may motivate the IVCs to choose a syndicate that will rehabilitate the quality of the bad projects during the development stage, and to syndicate with experienced syndicates. In this case, the level of incentive provided by the different funds providers will determine the bargaining powers of the two leaders: if the incentive provided by the IVC fund providers is greater than the bonus paid by the financial partner to the captive VC, the IVC will crowd out the CVC from its "natural" partnership.

Proposition 5: *Whatever the values of the parameters* $(p, q, R, \underline{R}, \alpha, \gamma, \delta, B, c, c', C, C')$, *as soon as the IVC chooses to syndicate, the level of selectivity and/or the profit of the IVC will be higher than the level of selectivity and/or the profit of the CVC, except if the IVC tries to syndicate with experienced (not specialized) partners and finally fails in this syndication attempt.*

Proof: see Appendix 3

This proposition still exhibits the efficiency advantages of IVCs over CVCs. The incentive provided by the financial partners of IVCs orientates their choice of a form of syndication that will improve the selectivity and the profitability of the projects. Only in extreme cases, that is, if the ex-ante probability of the deal's success, its expected return and the level of the

financial incentives provided by the IVCs financial partners are all low, might they have less success in their attempts to syndicate (in this case with experienced partners) and might fail to out-perform the CVCs competitors.

5 Conclusion

This paper provides a number of interesting results related to syndication in the venture capital industry. First, the model suggests a negative relationship between the level of expertise of the lead VCs and their willingness to syndicate. It supports recent empirical studies (Verwaal *et al.*, 2010) and theoretical models (Casamatta and Haritchbalet, 2007) which point to a similar relationship. More generally, our work supports the findings from studies in the tradition of Brander et al. (2002) that propose the notion that syndication permits VCs to combine complementary pieces of knowledge. This allows VCs to access their partners' valuable resources via contributions to the screening of deals during the early stages, and to management during the development stage. Thus highly skilled lead VCs are less reliant on partners to improve deal selection and to offer good quality managerial advice.

Two other results are related more specifically to the main goal of this paper which was to analyze whether type of funds providers influenced the skills characteristics of VC partners in syndication deals. Our paper highlights that the source of finance matters for syndication choices. This influence emerges in two forms.

The first is the heterogeneity between captive and independent VCs in terms of returns from the funded projects: IVCs tend to participate in syndicates funding projects with higher levels of profitability than those involving CVCs. This result is not surprising; several studies have reached similar conclusions. The literature suggests that, as a result of their strategic

objectives, CVCs have less incentive than IVCs to invest in acquiring expertise and technology, to take overall control of entrepreneurs (De Bettignies and Chemla, 2008) or to liquidate their portfolio firms (Arping and Falconieri, 2010). These features would make them less active and efficient investors for their portfolio firms.

Our paper relies on a different interpretation of the relationship between strategic objectives and investment behaviors. The originality of our analysis is that it makes an explicit link between the financial incentives of funds providers and the investment strategies of VCs and especially the types of syndication they privilege. In our interpretation, CVCs are not less active investors but rationally choose to set up partnerships with experienced VCs with lower ability to increase the short term financial profitability of projects than specialized VCs, but which are more efficient at improving the "strategic" returns, such as access to the professional network of portfolio companies, which tends to reduce the probability of projects failing and may be beneficial for their long-run activities.

The model also points to another way that the source of finance can influence the syndication process. This is heterogeneity in the ability to syndicate between captive and independent VCs, which is strongly related to the kind of financial incentives used by funds providers to align VCs' interests with their own goals. Our analysis suggests that these incentives play a decisive role in the bargaining powers of lead VCs and generally make IVCs more attractive syndication partners for other VCs.

However, it should be underlined that the relative lack of attractiveness of CVCs in syndication deals undoubtedly would be mitigated were the model to account for a number of elements that in the interests of simplicity we did not include. For instance, we did not take account of a CVC's unique resources that might make it more attractive as a syndication

partner. Yet, syndicating with a CVC may give access to otherwise inaccessible resources. For instance, corporate VCs provide access to technical resources thanks to the parent company's R&D staff which ameliorate the ability to understand the project's underlying technologies and which provide assistance in the development of the technology (Maula *et al.*, 2005; Dushnitsky and Lenox, 2005). They may also provide access to important market-related resources (Katila *et al.*, 2008), such as a developed distribution system and sales force which might allow the portfolio company more rapid access to global markets[13]. Another avenue for future research would be to discuss the impact of behavioral factors, such as trust or empathy, on the leader's choice of partner and on performance (Fairchild, 2011). In particular, it would be interesting to analyze how the syndication choice of the leader would be modified if the relationships between leaders and types of syndicates were founded on different levels of empathy.

Similarly, the results might differ if the model included intuitions from the emerging research on entrepreneurs' financing choices (Repullo and Suarez, 2004; De Bettignies and Brander, 2007) and took account of the role of the entrepreneur in forming the investment syndicate. This role may partly explain the choice between independent and captive VCs. In particular, if the entrepreneur developed a venture that was complementary to the captive VC's core assets, then the captive would likely be chosen because of the captive's stronger incentives compared to an independent VC to provide supportive effort (Hellmann, 2002). Wang and Wang (2012) explore this further. Their syndication model highlights that when choosing a suitable lead investor, the entrepreneur needs to strike a balance between the syndicate's ability to provide funding to satisfy the company's needs and its potential to

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[13] In the same vein, Keil et al. (2010) underline the specificity of CVCs in terms of syndication networks. Using data for the US market, they show that the unique resources held by corporate parents can substitute for lack of a prior central position in syndication networks. These resources make captive investors highly attractive syndication partners and help them to overcome entry barriers and to quickly attain central positions in ways not available to other types of VCs.

bargain over the company's profits. In other words, their analysis underlines that the better organized and more value-adding "leaders-syndicate" dyads are not necessarily chosen by the entrepreneur because they are also well placed to bargain for a large share of the company's profits. Including these elements in our theoretical framework would be interesting for future research to model the syndication processes.

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Appendix

Appendix 1: Proof of Proposition 1

Consider the stand-alone solution for the IVC given by (1). Determination of the optimal level of effort e^* provides the profit $\Pi_{alone}^{IVC} = (1 + \delta)Rp + (\bar{c}^2 q^2/4c) - \bar{c}$. This profit decreases as c increases. Consider now for the same IVC, the possibility to syndicate with specialized (not

experienced) partners. The profits (3) and (11) provide the following value for the leader profit:

$\Pi_{spec}^{IVC} = \Pi_{alone}^{IVC} + \alpha(1-\gamma)Rp + \bar{c}^2(1-\gamma)\gamma(1-p-q)^2/2c' - C$. The spread between these two

profits then is independent of c, i.e. independent of the leader's expertise. Leader and specialized

syndicate are interested in different parts of the project. However there is neither complementarity nor

substitution between the leader's effort in the initial stage and the syndicate's efforts: these efforts are

simply additive. Thus, the choice between the stand alone option and the possibility to syndicate with

a specialized syndicate does not depend on c. The same conclusions can be derived from comparison

of (5) and (6). Consider now expressions (2) and (9) determining the profit of the IVC associated with

an experienced syndicate. From (9), the optimal effort of the syndicate d^* depends negatively on the

effort of the leader e by the first order relation $d^* = q\,\underline{R}(1+\delta)(1-e^*)\gamma/2c'$ (valid even if $e^* = 0$.

From this point of view, increasing e decreases the effort of the syndicate for given values of

parameters. From (2), it also appears that e now has two effects: all increases in e directly decrease the

expected costs at the development stage. But the term $(1+\delta)\big[Rp + (1-\gamma)d(1-e)\underline{R}q\big]$ reveals that

all increases in e also decrease the effect of a given effort of the syndicate. Definitively, the usual

positive effect of e is dampened by its negative effect on the effort of the syndicate. For a given value

of c, the optimal level of effort of the leader

$e^* = \big[q\bar{c}c' - q^2(1+\delta)^2\gamma(1-\gamma)\underline{R}^2\big]/\big[2cc' - q^2(1+\delta)^2\gamma(1-\gamma)\underline{R}^2\big]$ when it chooses as its partner

an experienced syndicate is then smaller than its level $\bar{c}/2c\,q$ in the stand-alone case. An increase of c

then has less effect on (2) than on (1). The difference between the optimal values of (3) and (1)

expressed as $\dfrac{c'(\bar{c}q-2c)^2}{2[2cc'-q^2\underline{R}^2(1-\gamma)\gamma(1-\delta)^2]} - c - C + \bar{c}q - \dfrac{\bar{c}^2q^2}{4c}$. One can verify that the derivative in c of

this expression is still positive when e^* and d^* are between 0 and 1 [the details of the calculus are

available on request]. The same proof can be replicated by comparing (5) and (6), (1) and (4), and (5)

and (8) and determine that, as soon as the partnership includes an experienced syndicate, this

partnership tends to be increasingly less attractive as the expertise of the leader increases, whatever the

leader's financial partnership.

Appendix 2: Proof of Proposition 2

Consider the stand-alone solution for the IVC given by (1). Determination of the optimal level of effort e^* provides the profit $\Pi_{alone}^{IVC} = (1 + \delta)Rp + (\bar{c}^2q^2/4c) - \bar{c}$. This profit increases with R. Consider now the profit (2) of the IVC associated with an experienced syndicate. Given that the effort/costs of the experienced syndicate have no effect on the return of the good project R, this new profit expresses as $\Pi_{exp}^{IVC} = (1 + \delta)Rp + f$ where f is a function on parameters independent on R. Comparison between the optimal values of (1) and (2) shows that any increases/decreases in R do not change the choice between the stand-alone solution and partnership with an experienced syndicate. The spread between the profit (3) expresses optimally as $\Pi_{spec}^{IVC} = \Pi_{alone}^{IVC} + \alpha(1 - \gamma)Rp + \bar{c}^2(1 - \gamma)\gamma(1 - p - q)^2/2c' - C$. Then all increases in R also increase the (positive or negative) difference between Π_{spec}^{IVC} and Π_{alone}^{IVC}. The same conclusions derive from comparison between (1) and (4). The same kind of proof provides the same result when one analyses the influence of R on the choices of the CVC.∎

Appendix 3: Proof of Proposition 3

Whatever the values of the parameters $(p, q, R, \underline{R}, \alpha, \gamma, \delta, B, c, c', C, C')$, if the IVC proposes association with a specialized (not experienced) leader, given expression (11), the efforts of the latter are respectively $g_{IVC}^{spe} = \bar{c}\gamma(1 - p - q)/2c'$ and $h_{IVC}^{spe} = \gamma(1 + \delta)\alpha R/2c'$. If the CVC proposes association with the same specialized (not experienced) syndicate, given expression (12), the levels of effort of the latter are respectively $g_{CVC}^{spe} = \bar{c}\gamma(1 - p - q)/2c'$ and $h_{CVC}^{spe} = \gamma\alpha R/2c'$. The resulting comparison between (11) and (12) proves that, whatever$(p, q, R, \underline{R}, \alpha, \gamma, \delta, B, c, c', C, C')$, $\Pi_{IVC}^{spe} > \Pi_{CVC}^{spe}$. The specialized syndicate always chooses to associate with the IVC ∎

Appendix 4: Proof of Proposition 4

Whatever the values of the other parameters, if C' is bigger than some ceiling value $\overline{C}'$, (4) is still smaller than (1), (2) and (3), while (8) is still smaller than (5), (6) and (7). Both VCs then renounce association with an experienced and specialized syndicate. Similarly, if α, *i.e.*, the advantage provided by the specialized syndicate during the development stage, in relation to improvement to the quality of a good project, is too small, the advantage of the specialized syndicate progressively reduces in (3) and (7) to its assistance in the screening tasks during the initial stage (it is only this assistance that can justify the information cost C supported by the leader). Similarly, the advantage of the specialized syndicate as assistance provider during the initial period does not compensate for the cost C when q tends towards $(1 - p)$. Thus, for any positive value of C, when α and $(1 - p - q)$ are small, there is no advantage for any leader to associate with a specialized syndicate. Conversely, for any triplet (α, p, q), there is a threshold maximal value of C, such that above this value it is still more advantageous for the IVC to choose the stand-alone solution than to associate with a specialized syndicate. Given that δ is positive, in this case the CVC also prefers the stand-alone option to association with a specialized syndicate. By comparing (1) and (2), we see that for given values of the other parameters, the higher is δ or $\underline{R}$, the greater is the propensity for (2) to be greater than (1). Comparing (5) and (6), we observe similarly that the higher is B or $\underline{R}$, the greater is the propensity for (6) to be larger than (5). When a high value of C' discourages the leaders from associating with experienced and specialized syndicates, the CVC then chooses to associate with experienced syndicates at the first step in the matching/bargaining process. At the second step of the bargaining process, the experienced syndicate must then compare the two propositions, *i.e.* the profits given respectively by (9) and (10) where the optimal level of effort e^* is different and given in each expression by the optimization of each leader associated to (2) and (6). In order to explore the outcome of this comparison, we can express first the optimal effort d^* associated with each situation from (9) and (10), then express as a function of parameters the optimal values of e^* in (2) and (6), and finally compare the payments (9) and (10). Consider first the choices resulting from the IVC offer. By backward induction, we obtain from (9) $d^* = q \underline{R}(1 + \delta)(1 - e^*)\gamma/2c'$ where e^* is the optimal level

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of effort if the leader and d^* the optimal level of effort of the syndicate. From (2), we then get $e^* = \left[q\bar{c}c' - q^2(1+\delta)^2\gamma(1-\gamma)\underline{R}^2\right]/\left[2cc' - q^2(1+\delta)^2\gamma(1-\gamma)\underline{R}^2\right]$. If these two expressions are substituted in (9), the expected profit of the experienced (not specialized) syndicate is $C + \frac{c'q^2(\bar{c}q-2c)^2\underline{R}^2\gamma^2(1+\delta)^2}{4\left[2cc'+q^2\underline{R}^2-\gamma(1-\gamma)(1+\delta)^2\right]^2}$. The same methodology provides the value $d^* = q(B+\underline{R})(1-e^*)\gamma/2c'$ for the level of effort given by (10) of an experienced (not specialized) syndicate matched with a CVC.

Similarly, by backward induction, the effort of the CVC leader given by (6) is $e^* = \left[q\bar{c}c' - q^2(B+\underline{R})^2\gamma(1-\gamma)\right]/\left[2cc' - q^2(B+\underline{R})^2\gamma(1-\gamma)\right]$. If we substitute these values in (10), we obtain the expected profit of the experienced (not specialized) syndicate, when it is matched with the CVC. This profit expresses as $C + \frac{c'q^2(\bar{c}q-2c)^2(B+\underline{R})^2\gamma^2}{4\left[2cc'-q^2(B+\underline{R})^2\gamma(1-\gamma)\right]^2}$. Comparison between the two profits that the syndicate can expect from association with the two leaders provides contrasting results, depending on several parameters, and particularly on δ, $\underline{R}$ and B. For instance, for the following values of parameters, $\{c = 5, C = 0, \bar{c} = 30, p = 0.85, q = 0.15, R = 80, \underline{R} = 32, \gamma = 0.5, c' = 6, B = 12, \alpha = 0\}$ and a value of C' sufficiently high to dissuade leaders from associating with specialized and experienced syndicates, $\Pi_{IVC}^{spe} = 0.26516$ while $\Pi_{CVC}^{spe} = 0.20498$. In this case, given the values of C, C' and α, the best association for both leaders is with experienced syndicates: for the same bargaining power γ of the two leaders, the syndicate's gain is larger with the IVC than with the CVC

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Appendix 5: Proof of Proposition 5

Consider the different choices of syndication of the IVC during the matching/bargaining stage of the game:

- if the IVC chooses initially to syndicate with a specialized (not experienced) syndicate, given proposition 1, this choice is always validated by the syndicate. The efforts of leader and syndicate during the initial stage are given by $e_{spe}^{IVC} = \bar{c}q/2c$ and $g_{IVC}^{spe} = \bar{c}\gamma(1-p-q)/2c'$. The expected

number of bad projects developed in the development stage is then $\left(1 - e^{IVC}_{spe}\right)q + (1 - g^{spe}_{IVC})(1 - p - q)$. The CVC then ultimately chooses one of the remaining three options, whatever the value of parameters. In all cases, $e^{CVC} < e^{IVC}_{spe}$, while the level of effort of the syndicate during the initial stage is at most $g^{spe}_{IVC} = \bar{c}\gamma(1 - p - q)/2c'$. Given that the number of bad projects eliminated in the initial stage is proportional to the effort of the leader and the syndicate, it is then always smaller for the CVCs.

- if the IVC initially chooses to syndicate with specialized and experienced partners, $e^{IVC}_{spe/exp} = \left[q\bar{c}c' - q^2(1 + \delta)^2\gamma(1 - \gamma)\underline{R}^2\right]/\left[2cc' - q^2(1 + \delta)^2\gamma(1 - \gamma)\underline{R}^2\right]$ and $g^{spe/exp}_{IVC} = \bar{c}\gamma(1 - p - q)/2c'$. If this choice is confirmed, the CVC finally chooses one of the remaining options. Given that the CVC could choose to syndicate with a specialized partner or to stand alone, in some of these cases, the level of selection of the CVC can be higher than for the IVC. If the level of selection of the CVC is greater, it is excluded that $e^{CVC}_{exp} < e^{IVC}_{spe/exp} = e^{IVC}_{exp}$. From this inequality, we can deduce that, if the level of selection is greater for the CVC, then $\left(B + \underline{R}\right)^2 < (1 + \delta)^2\underline{R}^2$ or $B < \delta R$. Comparing (3) and (7), we can deduce that the profit (3) of the IVC is bigger than the profit (7) of the CVC, that the profit (4) of the IVC is bigger than the profit (8) of the CVC, and that the profit (1) of the IVC is bigger than the profit (5) of the CVC. Since in this case, the profit (6) is bigger than (5), (7) and (8), we conclude that the profit (6) is bigger than the biggest among (1), (3) and (4). If the offer of the IVC is not accepted by the syndicate, i.e. if the CVC makes a better offer to the same experienced (and not specialized syndicate), the profit of the CVC may be bigger than the profit derived by the IVC. However, given that the benefit resulting from specialization does not depend on the benefit resulting from experience, the IVC will never choose the stand-alone option at the next step in the matching/bargaining stage of the game. If it chooses as second-best partner the specialized syndicate, its level of selection will be higher than the level of the CVC. If it chooses to match with the experienced syndicate, its level of selection will be lower than the level of selection of the CVC. It is the only case where the level of selectivity and/or the profit of the IVC is not higher than the level of selectivity and/or the profit of the CVC.

- if the IVC chooses initially to syndicate with experienced partners, when its choices are confirmed, the same deductions can be made. In this case, as it is not optimal for the IVC to syndicate with a specialized syndicate (experienced or not), specialized syndicates are no more interesting for the CVC. The specialized syndicate then has to choose between the CVC and the IVC according to the amount of profit on the rehabilitated bad projects shared with it by each. If the offer of the IVC is better, given that the advantage is bigger for the good than the bad projects for the IVC, the IVC may not always show the highest level of selection of bad projects but will have the biggest profit. If the offer is not the better, the IVC's profit may be smaller than the profit gained by the CVC. However, given that the experienced (and not specialized) syndicate ultimately provides the smallest selection possible, the level of selection will be higher for IVC than for the CVC ∎