

# Human Capital in the Knowledge-based Firm: Evidence from Venture Capital

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## Abstract

An important aspect of knowledge-based firms is the provision of services that are difficult to specify contractually. We examine the involvement of venture capital firms with the companies they finance in terms of non-contractible advice, support in recruiting board members and management, and help with obtaining additional financing. We use a hand-collected dataset of European venture capital deals which contains information about the human capital of individual venture capitalists. Examining both across-firms and within-firm variation, we find evidence that human capital is related to the provision of non-contractible services. Such effects persists even after controlling for the effect of contractual design and organizational structure.

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# 1 Introduction

What are the economic foundations of modern knowledge-based firms? In an influential article, Zingales (2000) argues that while modern economies are dominated by human capital intensive knowledge-based firms, economics has only a rudimentary understanding of how these firms operate. One feature of the knowledge-based firm is that it deals with complex problem solving that requires the processing of what economists call “soft” information (see Garicano (2000) and Stein (2002)). A second distinguishing feature is that people are typically the firm’s most valuable asset, as the firm’s value is mainly generated through the application of its employees’ skills and knowledge. Unlike physical assets, individuals can exert discretion as to when and how they want to apply their skills and knowledge. Together, these two features imply that the provision of *non-contractible* actions is a defining trait of knowledge-based firms.

What determines the provision of non-contractible actions? Building on the seminal paper by Holmström (1979), a large theoretical literature links the provision of non-contractible actions to the existence of a moral hazard problem. The main focus of this literature has been the design of optimal contracts (see Hart (2001) and Prendergast (1999) for recent surveys). A related strand of literature considers the role of organizational structure (see Gibbons (1998)). Following these literatures, empirical tests focus largely on how contractual design (e.g., Gaynor et al. (2004) and Lazear (2000)) and organizational structure (e.g., Baker and Hubbard (2003), Garicano and Hubbard (2004)) determine the provision of non-contractible services.

Fundamentally, human capital is an essential input in the production function of any knowledge-based firms. Rosen (1982) explains how human capital considerations affect hierarchical firm organization. Gibbons and Waldman (1999) emphasize the importance of task-specific human capital. We contribute to this literature by relating human capital inputs to the production of non-contractible services.<sup>1</sup>

In this paper we submit that human capital is an important but often overlooked determinant of the provision of non-contractible actions. We examine the role of human capital in the context of financial intermediation. The recent work of Berger et al. (2004), Liberti (2003), and Stein (2002), emphasizes that processing of soft information plays a central role in financial intermediation. Moreover, apart from providing funding, investors can also provide a variety of valuable services, such as monitoring, corporate governance, advice and support.<sup>2</sup> Our analysis focuses specifically on venture capital, which has become an important and growing part of the financial system, both in the US and globally.<sup>3</sup> We study the role of human capital in the context of venture capital since prior research has already established the importance of non-contractible investor involvement. Theoretical models of venture capital place heavy emphasis on the non-contractible efforts provided by

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<sup>1</sup>The recent studies of Bertrand and Schoar (2003) and of Malmendier and Tate (2003), although different in focus, also share our view that individual managerial characteristics are a key determinant of firms’ decision making.

<sup>2</sup>See, among others, Boot (2000), Fama (1985), Rajan (1992), Shleifer and Vishny (1997), and Stiglitz (1985).

<sup>3</sup>See Bottazzi and Da Rin (2002, 2004), Da Rin, Nicodano and Sembenelli (2004), Gompers and Lerner (1999a), Lerner and Schoar (2004), and Megginson (2004).

the investor.<sup>4</sup> A growing body of empirical evidence documents that venture investors can help their portfolio companies in several ways, including giving advice and support, professionalizing the management team, creating strategic alliances, or exercising corporate governance.<sup>5</sup> However, not all venture capital firms are alike. Using the industry’s language, some are “hands-on,” and provide more non-contractible services than “hands-off” investors. We set out to analyze this heterogeneity in investor behavior.

We base our analysis on a hand-collected dataset of European venture capital investments. The data covers the period 1998-2001, and consists of a sample of venture capital deals in the 15 member countries of the European Union (in the period under study), plus Norway and Switzerland. Our primary data source is a comprehensive survey of all the venture capital firms in these countries, which we augmented with numerous secondary sources. Our dataset consists of information on 124 venture capital firms, 513 partners, and 1,664 portfolio companies. The data collection required considerable time and effort, but resulted in a dataset that is significantly larger than other hand-collected datasets on venture capital, and much richer than the commercially available datasets.

The measurement of non-contractible actions always represents an empirical challenge. While such actions are difficult to contractually specify, they may be reported once they took place. Though labor-intensive, the use of survey data allows us to collect direct evidence on non-contractible activities. We obtain measures for four different types of non-contractible actions: how often an investor interacts with a portfolio company, whether it helps assembling the company’s board of directors, where it is involved with recruiting the management team, and whether it provides any assistance with obtaining additional financing. None of these actions are recorded in standard sources of venture capital data, nor can they be deduced from venture capital contracts.

Another advantage of our data approach is that we are able to construct several measures of human capital. From our survey, we obtain detailed data on individual partners’ background. Conceptually, we distinguish between three types of human capital effects. First, there may be some accumulation of *job-specific knowledge*, where venture capitalists become better over time at providing services. We measure this with a partner’s cumulative experience as a venture capitalist. Second, there is a partner’s *generic business knowledge*. We measure this with a partner’s prior business experience. Third, there is a partner’s *formal knowledge*. We measure this with a partner’s scientific education. For each of these measures, we construct the average human capital profile of the venture firm.

Looking first at across-firms variation, we find clear evidence that human capital is related to the provision of non-contractible services. Venture firms whose partners have more prior business experience are significantly more involved with supporting the companies they finance. Interestingly, the venture experience of the firm’s partners does not have a significant effect on involvement, and science education has relatively little effect.

We then examine whether the effects of human capital cannot be traced back to more familiar effects of contractual design or organizational structure. We add several control variables to capture the effects of contracts and organizations, but find that the results for

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<sup>4</sup>See Casamatta (2004), Fulghieri and Sevilir (2004), Hellmann (1998, 2002, 2004), Inderst and Müller (2004), Schindele (2004), and Schmidt (2003).

<sup>5</sup>See Gompers (1995), Hellmann and Puri (2002), Hochberg (2004), Hsu (2004), Kaplan and Strömberg (2003, 2004), Lerner (1994), and Lindsey (2003).

the human capital variables change very little. This shows that human capital is indeed a separate force that affects the provision on non-contractible services.

The estimated effects for the contractual and organizational variables are of independent interest. For contracts, we find that investor control rights—defined as taking a board seat—are associated with greater provision of non-contractible services. For the organizational variables we find that investor involvement is higher if a venture firm is an independent entity, rather than a so-called “captive” firm (owned by a bank, an industrial company or the government). In addition, we find that the presence of a financing syndicate lowers involvement levels, but that being the leader of a syndicate increases the provision of non-contractible actions. These results contribute to the growing literature on venture capital financing.

An important issue is to what extent the observed correlations between human capital and non-contractible actions should be interpreted as causal. Human capital is clearly exogenous, in the sense that the outcome variables cannot determine the level of human capital. However, there remains an open question to what extent the observed correlations might be driven by selection or treatment effects. To this purpose, we estimate a number of selection models, where we simultaneously estimate how companies match up with different venture firms, and a treatment equation for how different venture firms generate different levels of involvement. Following Berger et. al. (2005), we include an instrumental variable that measures the local availability of different investor types. This variable should affect the selection of investors, but should not have any effect on subsequent actions. We find that accounting for endogenous self-selection does not affect the significance of the main explanatory variables in the treatment equation. It therefore appears unlikely that our results are merely driven by selection effects.

A unique feature of our data is that we also obtained information on which partner is put in charge of which company. In addition to analyzing across-firms behavior, these data allow us to examine differences across partners within the same firm. In a fixed effects (conditional logit) model, we find that venture experience has a positive and significant effect. This refines our understanding of the effect of human capital: within firms, more experienced partner provide more support; if this effect applies to all firms, we might not be able to detect it looking only at across-firms variation. Hence the importance of also looking at within-firm variation. We also examine the issue of task-allocation within venture firms. We find that having more venture experience, or business experience, increases the likelihood that a partner is put in charge of supervising companies.

In a concurrent research project, Gompers et. al. (2005) examine the role of experience on the investment behavior of venture capital firms. They provide evidence that prior deal flow experience positions venture capital firms to take advantage of deal opportunities. They show that firms with more experience are more likely to ramp-up investments when investment opportunities improve, and that this ramp-up often leads to better exits. The two papers provide complementary evidence on the role of human capital in venture capital. They differ in several respect. Gompers et. al. (2005) use US data from Thompson Venture Economics, which provides a long history of venture capital deals with relatively little deal-specific information. Our hand-collected data captures a shorter period of European venture capital deals with rich deal-specific information. Our paper uses direct

measures of the human capital of individual venture capitalists, while they infer a venture firm's experience from its prior deal flow. Their data then remains at the firm level, while we can use partner-level data. Also, they are concerned with outcome variables, focussing on investment and exit patterns, while our analysis focusses on non-contractible investor involvement. Despite all these differences, both papers find remarkably consistent evidence that human capital is important for venture investing.

The paper is structured as follows. Section 2 discusses our data sources. Section 3 motivates our choice of dependent and explanatory variables, and provides their formal definition. Section 4 examines across-firms evidence on the role of human capital. Section 5 discusses the issue of endogeneity. Section 6 examines variation across partners within firms. Section 7 considers several extensions and discusses additional robustness checks. It is followed by a brief conclusion.

## 2 Sources of Data

We build this paper on data which come from a variety of sources. Our primary source is a survey that we sent to 750 venture capital firms in the following seventeen countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the UK. This set of countries includes all the members of the European Union in the period under study, plus Norway and Switzerland.

Venture firms were included in our sample if they satisfied three conditions: (i) they were full members of the European Venture Capital Association (EVCA) or of a national venture capital organization in 2001, (ii) they were actively engaged in venture capital and (iii) they were still in operations in 2002.<sup>6</sup>

We collected our survey data between February 2002 and November 2003. We asked venture capital firms about the investments they made between January 1998 and December 2001. The questions centered on key characteristics of the venture firm and, on the involvement with portfolio companies, on some characteristics of these companies, and on the educational background and work experience of each venture partner.<sup>7</sup>

We received 127 responses with various degrees of completeness. We excluded three venture firms that had been formed in 2001 but had not yet made any investments. We contacted all the venture firms that had sent us incomplete answers and retrieved the missing information whenever possible. We then augmented the survey data with information from the websites of the respondents and their portfolio companies. We also turned to commercially available databases: Amadeus, Worldscope, and VenturExpert, as well as trade publications like the directories of national venture capital associations. We use

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<sup>6</sup>While we excluded private equity firms that only engage in non-venture private equity deals such as mezzanine finance, management buy-outs (MBOs) or leveraged buy-outs (LBOs), we included private equity firms that invest in *both* venture capital and non-venture private equity deals. For these, we considered only their venture capital investments. See Fenn, Liang and Prowse (2003) for a discussion of how the venture capital market is structured in two different segments, 'venture capital' and 'non-venture private equity.'

<sup>7</sup>Throughout the paper we reserve the term 'firm' for the investor (i.e., the venture capital firm) and the term 'company' to the company that receives the venture capital financing.

information from these sources to obtain missing information, such as the dates, stages, and amounts of venture deals, and we also use it to cross-check the information obtained from respondents. Such cross-validation further enhances the reliability of our data. The resulting dataset consists of data on 124 venture firms, 518 venture partners and 1,664 portfolio companies. Notice that for each portfolio company we collect data only on the first financing received from a venture capital firm.

Because of the survey nature of our data, we perform a variety of checks to assess how well the sample represents the population of European venture capital firms. Our main concern is how the sample fares in spanning the underlying population. Since venture capital is an unregulated industry, we lack an official source of data. We thus use information from the main commercial database, VenturExpert, and from the European Venture Capital Association. We also gathered additional data by contacting all firms in the population through phone calls and through their websites. This required considerable effort but allowed us to collect information on more than two thirds of the population. We use this information in Table 1, which compares the sample with the population it is drawn from. Panel A looks at the country composition. While there is some variation in response rates across countries, our data represent a comprehensive cross-section which provides a good coverage of all countries, with an overall response rate of over 16%. This response rate is larger than the typical response rate for comparable surveys of industrial firms, which is around 9% (see the discussion by Graham and Harvey (2001)). No single country dominates the sample, and no country is left out. Remarkably, even the larger venture capital markets are well represented: France, Germany, and the UK all have response rates above 13%. Another strength of our data is that it is not dominated by a few large respondents: the largest venture capital firm accounts for only 5% of the observations, and the largest 5 venture capital firms for only 16% of the observations.

Panel B looks at the structure of both sample and population in terms of venture firm type. We partition the sample into independent, bank, corporate, and public venture capital firms. As we argue later in the paper, different types of venture firms are likely to behave differently, and we want to make sure that our results are not driven by the sample composition. Clearly, our sample closely reflects the distribution of types in the population.

Panel C compares the size distribution of our respondents with that of the population. We consider two size measures: the number of partners, and the amount of funds under management, both measured at the end of 2001. The number of partners is a simple size measure for this form of financial intermediation, which crucially depends on a few high-quality professionals. For the sample and the population both the mean and median values of partners virtually coincide. The amount under management includes all funds managed by a venture capital firm, including those invested in non-venture private equity. The average firms size is larger for the population, due to the presence of some very large private equity firms that invest mainly in non-venture private equity that chose not to respond to our survey. Consistent with this, the median firm size is very similar for the sample and the population.

Finally, we also consider that our respondents may report only part of their portfolio. To this purpose, in late 2003 we checked the websites of all respondents. When we exclude

15 venture firms whose website did not list portfolio companies, we find that the portfolio companies reported to us were over 90% those listed on the websites. Since two years had elapse from the closing of our sample, and new investments had naturally been made, we conclude that our sample covers well over 90% of all deals, suggesting that it is unlikely that our sample suffers from systematic under-reporting.

### **3 Data variables**

Before we explain how we construct our data variables, we provide an economic motivation for our choice of variables. Our dependent variables concern non-contractible actions that venture capitalists can perform for their companies. The main dependent variables concern the human capital of the venture capital firms. Our analysis also controls for the organizational structure of venture capital firms, the types of contracts used in the transaction, and the characteristics of the recipient companies.

#### **3.1 Motivating the dependent variables**

Our dependent variables aim to capture venture capital firms' non-contractible involvement with their companies. The strength of using hand-collected survey data is that it provides us with a variety of involvement measures that are otherwise not available. These measures allow us to capture a broad array of non-contractible activities.

The theoretical work of Casamatta (2003), Hellmann (2004), Inderst and Müller (2004), Repullo and Suarez (2004), Schiendele (2004), and Schmidt (2003) emphasizes, within a double moral hazard setting, the importance of non-contractible effort by the venture capitalist. Our first dependent variable is a summary measure of the intensity of interaction, measuring the reported frequency with which an investor interacts with the company. This variable can be broadly thought of as a proxy for the effort level provided by the venture investor.

The importance of governance in venture capital is developed by Dessein (2004), and Hellmann (1998). Gompers (1995), Gompers and Lerner (1996), Hochberg (2004), Lerner (1995) and Kaplan and Strömberg (2003, 2004) provide supporting empirical evidence. Our second dependent variable is a measure of how much the venture capital firm plays an active role in assembling a board of directors.

One of the unique features of the venture capital relationship is the role that investors play in structuring the management team. Hellmann and Puri (2002) show that venture capitalists play a substantial role in the professionalization of management teams (see also Sahlman (1990)). Our third dependent variable therefore reports whether an investor gets involved in recruiting management teams.

Fundraising is a vital process for entrepreneurial companies (Gompers and Lerner (2001)). While their own funding capabilities may be more limited, venture capital firms can play a key role in the process of obtaining additional financing from other financiers. Our fourth dependent variable examines whether an investor helped the company with raising funds from other sources.

## **3.2 Motivating the independent variables**

### **3.2.1 Motivating the human capital variables**

Ultimately, financial intermediation is performed by people, so that human capital is likely to matter.<sup>8</sup> We consider two possible reasons why human capital may affect investor activities. First, there may be some job-specific learning, where venture partners learn on the job how to become active investors. For this, we look at a partner's experience in venture capital, as measured by the number of years that s/he has worked in the venture capital industry. The natural conjecture is that having more experience improves a partner's ability to perform his/her tasks. Second, a partner's knowledge base may influence his/her investment activities. By knowledge base we mean the experience that the partner brings to the job from prior activities. We focus on two distinct activities: prior work experience and education. For work experience, we look at whether the individual partner had some business experience before becoming a venture capitalist, be it by working in industry (including being an entrepreneur) or consulting. Prior business experience might help a partner to better understand the challenges of portfolio companies, providing a measure of the partner's specialized experience in handling business problems. For education, we specifically look at whether a partner has an education in science or technology. Formal education in science may give a partner a better and deeper knowledge, that can facilitate the appreciation of the technological and operational challenges of the companies s/he is in charge of.

### **3.2.2 Motivating the contractual variables**

Security design has become a large part of the recent theoretical corporate finance literature. The theoretical venture capital literature mentioned above emphasizes the double moral hazard problem. It tries to explain how optimal contracts can address these incentive problems. A common conclusion is that the use of convertible securities can improve overall efficiency. The effect on the effort of the venture capitalist, however, can be ambiguous: In addition to the efficiency effect, convertible securities afford the investor greater downside protection, which might decrease their effort provision.

Another important contractual component is whether investors hold control rights, such as through direct participation on the board of directors. Hellmann (1998), for example, shows that board control can be a prerequisite for venture capital support, since without the control, the entrepreneur may hold up the value generated by the venture capitalist. This suggests that more investor control is likely to increase investor effort provision.

### **3.2.3 Motivating the organizational variables**

The organizational structure of a venture capital firm can influence its strategic objectives, and with it, its level of involvement. The most important organizational dimension is

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<sup>8</sup>The seminal work of Hayek (1945) and Becker (1964) emphasizes the importance of individuals' human capital, in terms of acquiring specific knowledge about a narrow range of problems, and acquiring competencies valuable for decision making and value creation.

whether a venture capital firm is independent or not. Independent firms are profit driven and can define their own investment styles. By contrast, the behavior of so-called 'captive' venture capital firms—those owned by a bank, a corporation, or the government—can be strongly affected by the strategic goals of their parent organization. The work of Gompers and Lerner (2000), Hellmann (2002), Hellmann, Lindsey and Puri (2004)) show how captive venture capital firms behave differently than their independent counterparts.

Our analysis also controls for the age and size of venture capital firms. Looking at US data, Gompers (1996) and Gompers and Lerner (1999b) suggest that the size and age of a venture capital firm may be a proxy for its quality and reputation. Fulghieri and Sevilir (2004) theorize about complementarities between effort and the size of a venture capital portfolio. In the European context, the age of a venture capital firm also signals its vintage: older firms were founded at a time when the European venture capital industry was still in its infant stages (Bottazzi and Da Rin (2004)).

### 3.2.4 Motivating the company-level variables

Our regressions include a number of company-specific characteristics. We adopt a parsimonious specification for the main model, and discuss several additions and extensions in Section 7. We control for industry, since different industries may have different needs for investor involvement. We control of the stage of the company. Early stage companies are typically more resource constrained, and may benefit more from the involvement of the venture capital firm. Venture capital deals are often syndicated among several investors (Brander, Antweiler and Amit (2002), Lerner (1994)). Syndication is likely to reduce investor involvement, because of duplication of effort, and possibly also because of free-riding. Partly as a response to this, syndicates delegate the responsibility for interacting with the company to a syndicate leader, who is expected to remain more involved with the company. We therefore control both for syndication, and for whether the venture firm is the syndicate leader.

## 3.3 Construction of data variables

Table 2 contains descriptive statistics for all the variables used in the analysis, grouped into five classes: dependent variables, human capital variables, contractual variables, organizational variables, and company level variables.

### 3.3.1 Dependent variables

Our dependent variables are constructed at the level of the portfolio company. They capture four different aspects of the involvement of venture capital firms with each portfolio company:

INTERACTION is a dummy variable that takes the value 1 if the venture capital firm is reported to interact with the company on a monthly or weekly basis; 0 if it interacts with on an annual or quarterly basis. We obtain the data from our survey instrument, which asked: *How many times per year does (did) the responsible partner(s)/manager(s) personally interact with this company? (check one)*. Possible answers were: *annually; quarterly; monthly; weekly*.

DIRECTORS is a dummy variable that takes the value 1 if the venture capital firm is reported to be involved in the hiring of outside directors of the company; 0 otherwise. We obtain the data from our survey instrument, which asked: *Has your firm been involved in hiring some of this company's outside directors?* Possible answers were: *Yes, No*.

RECRUITING is a dummy variable that takes the value 1 if the venture capital firm is reported to be involved in recruiting senior management for the company; 0 otherwise. We obtain the data from our survey instrument, which asked: *Has your firm been involved in recruiting senior management for this company?* Possible answers were: *Yes, No*.

FUNDRAISING is a dummy variable that takes the value 1 if the venture capital firm is reported to be help the company obtain additional financing; 0 otherwise. We obtain the data from our survey instrument, which asked: *Has your firm helped this company obtain additional financing?* Possible answers were: *Yes, No*.

### 3.3.2 Human capital variables

In our survey we asked: *Identify anonymously all partners/senior managers active as of December 2001.*<sup>9</sup> On the basis of this information we can measure human capital profiles at two distinct levels. First, we construct them at the level of the venture firm. For this we measure the human capital of each partner, and then take the average across all partners within the firm. What we obtain is the average human capital profile of the venture firm. Our variables are the following:

VENTURE-EXPERIENCE is the average number of years of experience in venture capital. We obtain the data from our survey instrument, which asked (for each partner/senior manager): *Indicate the years of experience as venture capitalist.*

BUSINESS-EXPERIENCE is the fraction of partners which have prior business experience. We obtain the data from our survey instrument, which asked (for each partner/senior manager): *Indicate the professional background (multiple answers possible).* Possible answers were: *finance; industry (including previous entrepreneurial experience); accounting; consulting; legal; other (specify).*

SCIENCE-EDUCATION is the fraction of partners which have an education in science or engineering. We obtain the data from our survey instrument, which asked (for each partner/senior manager): *Indicate the field of education (multiple answers possible).* Possible answers were: *business; humanities; engineering/science; law and social sciences; other (specify).*

Second, we construct similar measures at the level of the individual partner(s) in charge of a portfolio company. For this we consider the partner(s) who have direct responsibility for working with the company, and take the average across those partners only.<sup>10</sup> These variables therefore vary at the company level. We obtain the necessary data from an additional question from our survey instrument, which asked (for each company): *Which partner(s)/senior manager(s) has/had responsibility for monitoring this company?* We denote

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<sup>9</sup>In our survey instrument we specified that: *a partner or senior manager is a person with investment decision power within your firm, i.e. somebody who can decide whether to fund or not a company.*

<sup>10</sup>When constructing this variables we take into account that while typically a single partner is put in charge of a deal, in 15% of the cases more than one partner is put in charge.

these variables with the prefix P (for partner-in-charge): P-VENTURE-EXPERIENCE, P-BUSINESS-EXPERIENCE, and P-SCIENCE-EDUCATION.

### 3.3.3 Contractual variables

We consider two variables which reflect the contractual relationship between the venture firm and each of its companies. Both variables are constructed at the level of the portfolio company:

DOWNSIDE is a dummy variable that takes the value 1 if the instruments used for financing the company includes one of the following: straight debt, convertible debt or preferred equity; 0 otherwise.<sup>11</sup> We obtain the data from our survey instrument, which asked: *Which of the following financial instruments has your firm used to finance this company?* Possible answers were: *common equity; straight debt; convertible debt; preferred equity; warrants.*<sup>12</sup>

BOARD SEAT is a dummy variable that takes the value 1 if the venture capital firm is reported to sit or have sat on the board of directors of the company; 0 otherwise. We obtain the data from our survey instrument, which asked: *Is (or was) your firm represented on this company's board of directors?* Possible answers were: *Yes, No.*

### 3.3.4 Organizational variables

Our organizational variables are constructed at the level of the venture firm:

INDEPENDENTVC, is a dummy variable that takes the value 1 if the venture capitalist defines itself as an independent venture capital firm; 0 otherwise. We obtain the data from our survey instrument, which asked: *Would you define your firm as (check one): Independent venture firm, Corporate venture firm, Bank affiliated venture firm or Other (specify).*<sup>13</sup>

VCAGE is the age of the venture capital firm, measured in months at the end of the sample period. We obtain the data from our survey instrument, which asked: *Indicate the date of creation of your firm (mm/yy).*

VCSIZE is the amount under management of the venture capital firm at the end of the sample period, in millions of current euros. We obtain the data by contacting directly respondent companies after receiving their main answers. For those firms which did not provide the information directly, we gathered the data from commercial databases, company websites and industry sources.

### 3.3.5 Company-level variables

We construct some additional independent variables at the level of the company:

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<sup>11</sup>In Section 7.3 we employ an alternative measure, based on the *main* financing instrument only.

<sup>12</sup>In the instructions to the survey we specified functional definitions of these different financial instruments in order to ensure consistency of responses.

<sup>13</sup>We carefully examined the three respondents which checked the 'other' category. One is a public university fund, and was classified as public; another is a family-controlled fund, and was classified as independent; the third is a fund owned by a government company which engages in financing for small businesses, and was classified as public.

STAGE is an ordered categorical variable that takes the 1 to 4 if a deal is reported as seed, start-up, expansion or bridge. We obtain the data from our survey instrument, which asked: *Indicate the type of your first round of financing to this company (check one)*. Possible answers were: *Seed; Start-up; Expansion; and Bridge*.

SYNDICATION is a dummy variable that takes the value 1 if the company is financed with a syndicated deal, i.e., a deal with more than one investor; 0 otherwise. We obtain the data from our survey instrument, which asked: *Was the deal syndicated?* Possible answers were: *Yes; No*.

SYNDICATE LEADER is a dummy variable that takes the value 1 if the venture capital firm is the leader of the syndicate; 0 otherwise. We obtain the data from our survey instrument, which asked: *If the deal was syndicated, was your firm the lead investor?* Possible answers were: *Yes; No*.

INDUSTRY is set of a dummy variables from our survey instrument, which gave the following choices: *Biotech and pharma; Medical products; Software and internet; Financial services; Industrial services; Electronics; Consumer services; Telecom; Food and consumer goods; Industrial products (incl. energy); Media & Entertainment; Other (specify)*.

## 4 Across-firms analysis

All our dependent variables are binary, so we use a Probit model with the following specification:<sup>14</sup>

$$Y_{ic} = \alpha + H_i\beta_H + N_c\beta_N + R_i\beta_R + X_c\beta_X + \varepsilon_{ic} \quad (1)$$

where  $Y_{ic}$  is the outcome variable (INTERACTION, DIRECTORS, RECRUITING, or FUNDRAISING) for the investment in company  $c$  by investor  $i$ .  $\alpha$  is an intercept.  $H_i$  is the vector of human capital measures for venture firm  $i$  (VENTURE-EXPERIENCE, BUSINESS-EXPERIENCE, and SCIENCE-EDUCATION).  $N_c$  is a vector of contractual variables (DOWNSIDE and BOARD CONTROL), that vary by company.  $R_i$  is a vector of organizational variables (INDEPENDENTVC, VC-AGE and VC-SIZE) that vary by venture firm.  $X_c$  is a vector of company-level variables (INDUSTRY, STAGE, SYNDICATION, and SYNDICATE LEADER), that vary by company. Since our data consists of multiple investments made by different venture capital firms, we cluster our standard errors by venture capital firms. This allows for the error term  $\varepsilon_{ic}$  to be correlated within the deals made by a venture capital firm, and imposes a conservative standard for accepting statistically significant results. Clustering also implies the use of heteroskedasticity-robust standard errors.

For each dependent variable a different Panel of Table 3 reports the results of three model specifications. The first model (column (i)) focuses on the human capital variables alone, controlling only for company-level effects. The second model adds the contractual variables (column (ii)). The third model further adds the organizational controls (column (iii)). For each model, we report the estimated coefficient and (in brackets) its t-ratio. The number of observations differs across regressions because of missing values for some

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<sup>14</sup>All our results continue to hold if we use a logit model.

of the variables. We further discuss this in Section 7.

The main result of Table 3 is that human capital is an important driver of the non-contractible activities performed by venture capitalists. The most important human capital factor is prior business experience, which is consistently positive and statistically significant for all involvement variables. The effect also has a large economic impact. Having business experience increases the probability of involvement between 21% and 51%.

Science education is much less important than prior business experience. In most regressions the coefficient is insignificant, and in the INTERACTION regression it is even negative and significant. Moreover, venture experience has almost no effect, suggesting that job-specific learning is not a major determinant for the across-firms variation.

In columns (ii) and (iii) we verify that the results for the human capital variables are not explained by more traditional contractual or organizational explanations. The most important result is that the effect of prior business experience is essentially unaffected by these additional control variables, whether we look at statistical or economic significance. This suggests that human capital truly constitutes a separate force driving the provision of non-contractible services.

The results of these specifications are also interesting in their own rights. In terms of contractual variables, board control consistently has a positive and statistically significant effect. This confirms the notion that contractual control enables the provision of non-verifiable services. Downside protection does not have a statistically significant effect. Given our previous theoretical discussion, this is not surprising.

In terms of the venture firm level variables, which measure the relevance of the organizational dimension, we find that being an independent venture capital firm consistently has a positive and statistically significant effect. This effect is also economically large, with increases in the probability of involvement ranging from 19% to 21%. Note that this constitutes a new and significant result in the venture capital literature; we will return to it in Section 5.<sup>15</sup>

In terms of company controls, we note that STAGE has a negative effect on the provision of investor effort—as one would expect—or else is insignificant. SYNDICATION has a consistently negative effect, which is also statistically significant. However, being the syndicate leader has a positive and statistically significant effect. Both results do not hold in the INTERACTION regression, where these variables have insignificant effects. These results are consistent with our theoretical discussion above, and make a new contribution to the venture capital literature.

## 5 Endogeneity

In this section we consider potential issues of endogeneity. We do not have the standard statistical endogeneity problem of reverse causality, in the sense that the left-hand side variables directly cause the right-hand side variables. For example, helping a company

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<sup>15</sup>The size of the venture capital firm typically has a negative but insignificant coefficient, suggesting that larger venture firms do not behave significantly different than smaller ones. The venture firm' age coefficient is negative and significant in the regression for INTERACTION, insignificant in the regression for DIRECTORS, and positive and significant for RECRUITING and FUNDRAISING.

with recruiting cannot increase a partner’s prior business experience. Endogeneity only concerns the interpretation of our estimated coefficients. In particular, when interpreting a coefficient, such as the effect of having prior business experience, we may ask to what extent this effect is directly due to prior business experience itself, and to what extent it is due to a selection effect, where companies that require more non-contractual services deliberately seek out venture capitalists with prior business experience. Naturally, both the direct and the selection effect are economically meaningful findings. Nonetheless, in this section we augment our econometric analysis, taking into account the possibility of endogenous selection.

Econometrically speaking, if there is self-selection in the venture capital market, then there is a potential problem that the independent variable is correlated with the error term. To correct for this, it is necessary to estimate a simultaneous equation model, where we augment the main outcome equation with a second equation to explain what factors influence selection for the independent variable. In our context, this requires estimating a bivariate Probit model.

For better identification, we want an instrumental variable that predicts selection in the venture capital market, but that should not affect the subsequent non-contractible actions. Our approach is inspired by the recent work of Berger et. al. (2005) who use such an instrumental variable approach to account for companies’ choices of investor types. They instrument the type of financial intermediary with “local availability,” using characteristics of the local intermediation market as instruments. Local availability is likely to affect the choice of specific intermediary, so that the instrument should affect the dependent variable. However, after the intermediary is chosen, local availability becomes irrelevant for the interactions between the company and its chosen intermediary, so that the instrument should not affect the dependent variable. We can use this approach with our data as follows. For each company, we measure the local availability of venture capitalists with prior business experience. The idea is simply that if many local venture capitalists have prior business experience, then a company is more likely to get such a venture capitalist, implying that local availability affects selection. However, whether other local venture capitalists have prior business experience should have no effect on how the company interacts with its own venture capitalist, so that local availability should not influence the outcomes.

To implement this approach, we estimate a bivariate Probit model, where the outcome regression is the same as in Section 4. We augment it with a selection equation to determine what companies select venture firms with prior business experience. The selection equation requires a binary variable, so that we use a dummy variable (BUSINESS-EXPERIENCE-D) that takes the value 1 if a firm has at least one partner with prior business experience, 0 otherwise. The independent variables in the selection equation are all the company-level variables. As instrument, we add LOCAL-BUSINESS-EXPERIENCE, which is a fraction whose denominator measures the number of investments observed in our dataset that are made in the company’s country, and whose numerator measures how many of these investments were made by a venture capital firm that has at least one partner with prior business experience.<sup>16</sup>

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<sup>16</sup>As discussed in a companion paper (Bottazzi, Da Rin, and Hellmann (2005)), some companies have

Table 4, Panel A, shows the results. We note that accounting for selection does not change the significance of prior business experience. In fact, adding the selection equation hardly affects the main model at all. Interestingly, the estimates for  $\rho$ , which capture the strength of selection on unobservable characteristics, are mostly insignificant. This suggests that selection does not interfere much with the outcome equations. We also note that LOCAL-BUSINESS-EXPERIENCE is significant and has the expected sign, validating its use as an instrument.

So far we have focused on selection related to prior business experience. We may ask a similar question about the other key investor characteristic, whether the venture capital firm is independent or not. To examine whether our result for INDEPENDENTVC is affected by selection effects, we can use the same specification as above, except that we now use a measure for the local availability of independent venture capital firms. LOCAL-INDEPENDENTVC is a fraction whose the denominator measures the number of investment observed in our dataset that are made in the company's country, and whose numerator measures how many of these investments were made by independent venture capital firms. The results are reported in Table 4, Panel B. Unlike with prior business experience, adding a selection equation does affect the estimated coefficients of the INDEPENDENTVC variable. This result is interesting for two distinct reasons. First, it shows that the result for independent venture firms in Section 4 is partly driven by selection effects. Second, it shows that our bivariate probit specification is powerful enough to uncover selection effects for independent venture firms. This suggests that our results on human capital are merely driven by selection effects.

A related issue is whether we can think of the contractual variables as exogenous. At the time that the non-contractual actions are taken, the contracts are clearly given. However, one might be concerned that the company and the investor bargain simultaneously over the contract and the expected level of non-contractible services. In this case, it is again possible that there is some unobserved heterogeneity that creates a correlation between the contractual variables and the error term. We can correct for this in the same manner as in Table 4. In unreported regressions we ran several bivariate Probit model, where we added a selection equation for our main contractual control variable, BOARD CONTROL. For our instruments, we leverage the insights from a companion paper (Bottazzi, Da Rin and Hellmann (2005)), where we show that the choice of contracts is influenced by the legal system (see also Lerner and Schoar (2004) and Kaplan, Martel and Strömberg (2003)). Specifically, we employ two widely used measures of the quality of the legal system. One is the index of procedural complexity, which measures the degree of legal formalism, by averaging the cost, length of time and number of steps necessary to recover a bounced cheque and evict a tenant. This index, published by the World Bank's 'Doing Business' project, is discussed in Djankov et al. (2002). We also use the rule of law index, which measures the quality of legal enforcement and is discussed by La Porta et. al. (1998).<sup>17</sup> The two indices yield similar results. We find that adding a selection

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foreign investors. As a robustness check we rerun these regressions dropping all foreign deals from the sample. Our results do not change.

<sup>17</sup>Since enforcement evolves over time, we use a version of the rule of law index which measures the quality of enforcement in the year 2000 and is published by the World Bank.

equation does not affect the significance of the coefficient of BOARD CONTROL in three out of the four regressions. The exception is for the DIRECTORS regression, where the coefficient for BOARD CONTROL becomes insignificant. This is in fact quite intuitive, suggesting that obtaining board control and hiring board directors are interrelated decisions. Moreover, the coefficients of all the other variables remain essentially unaffected by the addition of a selection equation for BOARD CONTROL. We repeat this exercise for our other contractual variable, DOWNSIDE. This variable is not significant in the main model. Adding a selection for DOWNSIDE does not affect any of our main results.

## 6 Within-firm analysis

### 6.1 Involvement analysis

Our approach so far examines the effect of human capital across venture capital firms. In our data collection, we gathered additional data on which partner (or sometimes partners) is in charge of the company. We obtained this information for about 80% of our observations. This data allows us to push the analysis one step further, and consider the effects of human capital within firms.

The first issue we want to explore is the variation in the provision of non-contractible actions within the same firm. It is important to realize that this is a different question than what we asked before. In Section 4 we were concerned with how differences in the average human capital profiles affected the provision of non-contractible services across firms. In this Section we deliberately ignore all differences across firms, and focus on within-firm variation only, asking whether human capital can explain differences in the level of involvement a company receives, compared to other companies financed by the same venture firm. The within-firm analysis thus does not replicate the across-firms analysis, but allows us to add some new insights.

For the empirical estimation of within-firm effects, we use the following conditional logit model:<sup>18</sup>

$$Y_{ic} = \alpha + H_{ic}\beta_H + N_c\beta_N + X_c\beta_X + F_i\beta_F + \varepsilon_{ci} \quad (2)$$

where  $Y_{ic}$  is the outcome variable for the investment in company  $c$  by investor  $i$ .  $\alpha$  is an intercept.  $H_{ic}$  is the vector of human capital measures for the partner in charge of company  $c$ , at firm  $i$  (PIC-VENTURE-EXPERIENCE, PIC-BUSINESS-EXPERIENCE, and PIC-SCIENCE-EDUCATION).<sup>19</sup>  $N_c$  is a vector of contractual variables that vary by company.  $X_c$  is a vector of company-level variables.  $F_i$  represents the investor fixed effects. Note that the fixed effects render controlling for other investor characteristics irrelevant. By construction, these fixed effects capture all variation in the firms' average human capital profile.

<sup>18</sup>As a robustness check we also reran our model as a linear probability model with fixed effects, and found analogous results.

<sup>19</sup>If several partners are put in charge of a company, we use their average human capital measures. This is different from the human capital measure in (1), which is the average of *all* partners in the firm.

Table 5 reports the results from the conditional logit model.<sup>20</sup> Once again we find that human capital matters. Table 5 shows that venture experience has a positive and significant effect on all the involvement variables. This result reveals that, within firms, venture experience affects the level of involvement of the individual partners. Notice that, if this applies to all firms, then a comparison across firms might be unable to detect this pattern, which only emerges in a within-firm analysis.

Another interesting result is that business experience is no longer significant at the within-firm level. One possible interpretation of this result is that business experience is relatively easily shared among partners in a firm. Sharing within the firm can explain why the coefficient is insignificant for the within-firm regressions, but significant for the across-firms regressions. It also suggests an interesting permutation of the analysis of Table 3. If business experience is easily shared among partners, then all that matters is that at least one partner has business experience. In unreported regression we ran a modified specification of equation (1), replacing firms' average business experience with a dummy variable for the presence of business experience.<sup>21</sup> This is consistent with the notion that prior business experience is readily shared among partners, and that all that matters is that someone within the firm has it.<sup>22</sup> We find that the dummy performs as well as the average measure of business experience.

## 6.2 Which partners get put in charge?

Another relevant dimension we want to explore is the within-firm task allocation. When a firm makes an investment in a company, which partner gets put in charge? Being put in charge gives a partner the primary responsibility for the provision of non-contractible services. Theoretical models suggest that managers with more skills are given more responsibility (Rosen (1982), Garicano (1990)). We ask whether empirically human capital matters for the allocation of tasks within venture capital firms.

To examine this, we turn to a different data construction. Our unit of observation now becomes the potential match between a partner in a venture firm, and a company financed by that firm. A match is realized if the specific partner is in charge of the specific company, and unrealized otherwise. Our dependent variable is IN-CHARGE, which takes the value 1 if there is a realized match; 0 otherwise. The independent variables are the same as before, except that human capital is now measured at the individual partner level. We denote this partner-level variables with P-VENTURE-EXPERIENCE, P-BUSINESS-EXPERIENCE, and P-SCIENCE-EDUCATION. Since for every company there are several potential partners, the number of observation increases, relative to the base dataset.

To obtain our estimates we use the following conditional logit model:<sup>23</sup>

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<sup>20</sup>The conditional logit drops all the observations where there is no within-firm variation. This explains the lower number of observations.

<sup>21</sup>This dummy variable is the same as the one we use in Section 5. It takes the value 1 if a firm has at least one partner with prior business experience, 0 otherwise.

<sup>22</sup>We also ran an additional specification of equation (1), where we replace average venture experience with the highest venture experience of all partners in the firm. Again, this does not affect our results.

<sup>23</sup>As a robustness check we also reran our model as a linear probability model with fixed effects, and found analogous results.

$$I_{cp} = \alpha + H_p\beta_H + N_c\beta_N + X_c\beta_X + F_i\beta_F + \varepsilon_{cp}. \quad (3)$$

where the subscript  $p$  refers to the individual partner.  $I_{cp}$  is the dependent variable (IN-CHARGE), which measures whether or not partner  $p$  has been put in charge of company  $c$ .  $\alpha$  is an intercept.  $H_p$  is the vector of human capital measures for each individual partner  $p$ .  $N_c$  is a vector of contractual variables that vary by company.  $X_c$  is a vector of company-level variables.  $F_i$  represents the investor fixed effects.

Table 6 reports the results. Once again, we find that human capital matters. Partners with prior business experience are significantly more likely to be put in charge of an investment. In addition, we find that venture experience has a positive and statistically significant effect on task-allocation: the longer a partner’s experience in venture capital, the more likely that s/he will be put in charge of an investment. The effect of a science education is insignificant. These results are consistent with the theoretical literature cited above. They also complement our previous analysis, again showing that human capital affects the provision of investor services.

## 7 Further thoughts and robustness checks

### 7.1 Depth of involvement

Hellmann and Puri (2002) note that when venture capitalists support the professionalization of their companies, they are not only concerned with recruiting chief executive officers (CEOs), but also become involved more deeply with building an entire management team. Our survey therefore asked additional detail about the role of venture capitalists in recruiting for a variety of positions within the company.

We use the following four dummy variables: CEO, CFO, VP MARKET, and HEAD OF R&D. They take the value 1 if the venture capital firm is reported to be involved in recruiting the Chief Executive Officer (CEO), the Chief Financial officer (CFO), a vice president of marketing, or the head of R&D, respectively; 0 otherwise. We obtain the data from our survey instrument, as a direct follow-up on the recruiting question, asking: *If Yes, whom? (multiple choices allowed)*. Possible answers were: *CEO; CFO; Vice President for marketing; Director of R&D; and other (specify)*.<sup>24</sup>

Table 7 reports the results from these additional probit regressions, which adopt specification (iii) of model (1).<sup>25</sup> Our results on human capital continue to hold for all of these more detailed recruitment variables, confirming that venture capital firms whose partners have more business experience provide more recruiting services—irrespective of the particular position in the management team.

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<sup>24</sup>We obtained 109 responses which indicated ‘other,’ indicating further management positions, such as Chief Operating Officer or Head of IT services. While we do not report them, we obtain the same results we report in Table 7 also for this category.

<sup>25</sup>Our results continue to hold if we use a logit model.

## 7.2 Additional company characteristics

We want to investigate whether the model we employ adequately controls for the heterogeneity of venture investments. Because each additional company-level variable reduces the number of observations, we prefer to keep our base model parsimonious. We now discuss the effects of adding further company-level variables.

Theory suggests that the size of an investor's equity stake affects the incentives to be involved with a company. Unfortunately, investors consider the size of their stakes sensitive and confidential information, and we were unable to obtain any information on them. However, for about 60% of all companies, we have information on the amount that a venture firm invested in the company. It is likely that investing larger amounts of money is correlated with larger ownership stakes. In unreported regression we find that adding the natural logarithm of the amount invested to our regression does not change our basic results. Consistent with the above reasoning, the coefficient on the amount variable is positive and significant for the DIRECTORS and RECRUITING regressions.

One concern might be that our sample period includes the 'dotcom' period. The dotcom bubble was smaller in Europe than in the US. Nonetheless we ask whether time periods affect our results. We add a set of time dummies, one for each sample year, to measure when an investment was completed, but we find that they do not affect our results. We also reran all of our regressions dropping all companies that were classified as "Software and internet" and found that this did not affect our results either.

In our model involvement depends on the stage of the company. In addition to controlling for stage, we can also control for the age of the company when the investment was completed. Again, this does not affect the results.

Our data covers a total of seventeen different countries. In a companion paper we investigate the importance of country effects on venture capital investing (Bottazzi, Da Rin, and Hellmann (2005)). For this paper, we consider two simple extensions. We group countries by legal origin (LaPorta et. al. (1998)), using both a company's and an investor's legal system of origin. And we use individual country dummies. In all these regressions, we find that our results are not materially affected by these additional controls.

## 7.3 Sample and measurement issues

To construct our INTERACTION variable we pooled weekly and monthly interactions, and we pooled quarterly and annual interactions. To make full use of the information we have, and be sure that pooling has no effect on our results, we also estimate ordered probit models with the disaggregated information, where the dependent variable is an ordered categorical variable for annual, quarterly, monthly, or weekly interactions. We found that pooling did not affect any of our results.

In the construction of our DOWNSIDE measure we have used the information on the *entire set* of securities used to finance a deal. In our survey we also asked which security was the most important in the deal, i.e., we asked what the *main* security used was. We make use of this additional information and modify our downside measure to include only the main security used. Using this alternative measure, however, does not affect our results.

We already discussed that our sample is unprecedentedly large, and that it closely matches population characteristics. As with any other hand-collected data, and in spite of a major effort to fill as many gaps as possible, we still end up with some missing observations on some variables. To verify that our data do not suffer from sample selectivity bias we perform several additional tests. First, we estimate a Heckman sample selection model, using the maximum likelihood approach. In the first step an ordinary Probit model is used to obtain consistent estimates of the sample selection equation. We find no strong patterns among the missing observations. Still, we estimate the second step, to verify that there is no correlation between the selection equation and our main regressions. None of our regressions appear to be affected by this, suggesting that it is unlikely that our results are affected by sample selection problems.

As a further check on sample selectivity bias, we run our regressions on a sample restricted to those companies for which we have complete information. Using such a sample provides consistency across regressions, but discards potentially useful information. In any case, we find that our results continue to hold in this sample.

## 8 Conclusion

What determines the provision of non-contractible services? In this paper we use venture capital data to examine what determines investors' involvement with the companies they finance. Our findings reveal the importance of human capital. We find that venture capital firms with partners that have prior business experience provide higher levels of non-contractible services. Within-firm analysis also shows that partners with more venture experience provide higher levels of non-contractible services. These results are robust to the inclusion of a variety of organizational and contractual variables.

A large and growing theoretical literature has developed on non-contractible actions. The difficulty to obtain suitable data constrains a corresponding development of empirical studies. Our survey-based approach of venture capital activities allows us to measure some non-contractible services that have not been previously analyzed. Future empirical research might take a similar approach to examine other types of non-contractible services. Our analysis is also relevant to future theoretical research. The current theoretical literature focusses on the effects of contracts and organizational design. Our results show that human capital might be under-appreciated in this literature. Finally, we look at venture capital firms as an example of knowledge-based firms. Arguably, the provision of non-contractible services is a critical component of the economic value-added of modern knowledge-based firms more broadly. We believe that this is an important topic for future research.

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**Table 1: Sample properties**

This table compares our sample to the population it is drawn from. Panel A looks at the country composition and response rates, Panel B at the composition by venture firm type, and Panel C at the size composition. Variables are defined in Section 3.3. Partners are measured in units, the amount managed in million of current euros.

Panel A: COUNTRY COMPOSITION AND RESPONSE RATE

	POPULATION	SAMPLE	RESPONSE RATE
Austria	23	8	34.8%
Belgium	34	5	14.7%
Denmark	29	4	13.8%
Finland	33	6	18.2%
France	101	15	14.9%
Germany	146	19	13.0%
Greece	8	4	50.0%
Ireland	15	3	20.0%
Italy	37	6	16.2%
Luxembourg	3	1	33.3%
The Netherlands	52	5	9.6%
Norway	22	2	9.1%
Portugal	10	2	20.0%
Spain	38	10	26.3%
Sweden	17	6	35.3%
Switzerland	43	6	14.0%
UK	139	22	15.8%
<i>TOTAL</i>	<i>750</i>	<i>124</i>	<i>16.5%</i>

Panel B: COMPOSITION BY VENTURE FIRM TYPE

	POPULATION	SAMPLE
Independent	65.7%	67.7%
Corporate	8.0%	9.7%
Bank	19.3%	17.8%
Public	6.9%	4.8%

Panel C: COMPOSITION BY SIZE

	POPULATION			
	Mean	Median	Min.	Max.
Partners	4.3	3	1	25
Amount managed	333.4	60	1	14,200
	SAMPLE			
	Mean	Median	Min.	Max.
Partners	4.2	3	1	20
Amount managed	179.8	52	2	4,500

**Table 2: Descriptive statistics**

This table provides descriptive statistics for all our dependent and independent variables. Variables are defined in Section 3.3. For dummy variables the MEAN column reports the frequency of observations.

VARIABLE	MEAN	MEDIAN	MIN	MAX	<i>OBS</i>
Interaction	0.693	-	0	1	1,475
Directors	0.405	-	0	1	1,534
Recruiting	0.482	-	0	1	1,556
Fundraising	0.520	-	0	1	1,492
Venture-Experience	6.561	5.857	0	20.333	1,639
Business-Experience	0.580	0.667	0	1	1,654
Science-Education	0.380	0.333	0	2	1,654
Stage	2.247	2	1	4	1,452
Syndicate	0.678	-	0	1	1,402
Syndicate Leader	0.236	-	0	1	1,301
Downside	0.483	-	0	1	1,622
Board Control	0.662	-	0	1	1,629
IndependentVC	0.602	-	0	1	1,664
VC-Age	93	54	12	390	1,664
VC-Size	257	109	1.3	4,500	1,652
PIC-Venture-Experience	7.335	6.000	0	32	1,256
PIC-Business-Experience	0.536	0.500	0	1	1,261
PIC-Science-Education	0.402	0.000	0	1	1,249
CEO	0.326	-	0	1	1,428
CFO	0.321	-	0	1	1,428
VP of Marketing	0.092	-	0	1	1,428
Head of R&D	0.111	-	0	1	1,428
Other	0.073	-	0	1	1,426
Biotech and pharma	0.141	-	0	1	1,644
Medical products	0.077	-	0	1	1,644
Software and Internet	0.303	-	0	1	1,644
Financial services	0.035	-	0	1	1,644
Industrial services	0.036	-	0	1	1,644
Electronics	0.052	-	0	1	1,644
Telecom	0.082	-	0	1	1,644
Consumer services	0.113	-	0	1	1,644
Food and consumer goods	0.020	-	0	1	1,644
Industrial products	0.017	-	0	1	1,644
Media & entertainment	0.068	-	0	1	1,644
Other industries	0.056	-	0	1	1,644
Number of companies	-	-	-	-	1,664

**Table 3: Across-firms involvement**

This table reports results from our base model of investor involvement (Equation (1)). Dependent variable are INTERACTION, DIRECTORS, RECRUITING, and FUNDRAISING. Columns (i), (ii), and (iii) of each Panel report three different specification. Independent variables are VENTURE-EXPERIENCE, BUSINESS-EXPERIENCE, SCIENCE-EDUCATION, DOWNSIDE, BOARD CONTROL, INDEPENDENTVC, VC-AGE, VC-SIZE, STAGE, SYNDICATE, and SYNDICATE LEADER. In all regressions, INDUSTRY CONTROLS are included but not reported. Variables are defined in Section 3.3. For each independent variable, we report the estimated coefficient and the t-ratio (in parenthesis), computed using (Huber-White) heteroskedasticity-robust standard errors, clustered by venture firm. Values significant at the 1%, 5% and 10% level are identified by \*\*\*, \*\*, \*.

Panel A: INTERACTION

	(i)	(ii)	(iii)
Venture-Experience	0.036 (0.81)	0.015 (0.35)	0.017 (0.32)
Business-Experience	1.048*** (2.60)	0.806** (2.10)	0.674** (2.14)
Science-Education	-0.880* (-1.77)	-0.965* (-1.87)	-1.583*** (-3.13)
Downside		0.214 (0.90)	0.180 (0.89)
Board Control		0.774*** (3.25)	0.500** (2.19)
IndependentVC			0.568* (1.75)
VC-Age			-0.006*** (-3.06)
VC-Size			0.000 (0.02)
Stage	0.033 (0.24)	0.067 (0.48)	0.170 (1.28)
Syndicate	-0.181 (-0.69)	-0.111 (-0.48)	-0.119 (-0.57)
Syndicate Leader	0.160 (0.74)	-0.054 (-0.29)	-0.017 (-0.09)
Industry Controls	Yes	Yes	Yes
<i>Observations</i>	1,052	1,047	1,045
$\chi^2$	24.92	62.21	64.07
<i>Model p-value</i>	0.097	0.000	0.000
<i>Pseudo R<sup>2</sup></i>	0.077	0.130	0.240

Panel B: DIRECTORS

	<i>(i)</i>	<i>(ii)</i>	<i>(iii)</i>
Venture-Experience	0.047 (0.47)	0.031 (1.01)	-0.006 (-0.21)
Business-Experience	1.032*** (2.88)	0.933*** (3.39)	1.052*** (3.99)
Science-Education	0.389 (0.98)	0.042 (0.12)	0.005 (0.001)
Downside		0.216 (1.07)	0.083 (0.47)
Board Control		1.233*** (5.17)	1.157*** (5.18)
Independent VC			0.662** (2.40)
VC-Age			0.002 (1.54)
VC-Size			-0.001 (-0.80)
Stage	-0.112 (-1.03)	-0.154* (-1.62)	-0.134 (-1.61)
Syndicate	-0.513*** (-2.63)	-0.422** (-2.28)	-0.363* (-1.97)
Syndicate Leader	0.625*** (3.67)	0.438** (2.46)	0.431** (2.41)
Industry Controls	Yes	Yes	Yes
<i>Observations</i>	1,143	1,138	1,136
$\chi^2$	68.72	116.87	154.75
<i>Model p-value</i>	0.000	0.000	0.000
<i>Pseudo R<sup>2</sup></i>	0.140	0.243	0.282

Panel C: RECRUITING

	(i)	(ii)	(iii)
Venture-Experience	0.050 (1.59)	0.034 (1.18)	-0.001 (-0.02)
Business-Experience	1.085*** (3.10)	1.039*** (3.69)	1.189*** (4.52)
Science-Education	0.758** (2.17)	0.489 (1.42)	0.461 (1.36)
Downside		0.358* (1.87)	0.242 (1.40)
Board Control		0.903*** (4.55)	0.847*** (4.24)
Independent VC			0.585** (2.38)
VC-Age			0.003* (1.83)
VC-Size			-0.001 (-1.45)
Stage	-0.152 (-1.60)	-0.199** (-2.36)	-0.185** (-2.38)
Syndicate	-0.468*** (-2.62)	-0.422*** (-2.59)	-0.371** (-2.15)
Syndicate Leader	0.587*** (3.55)	0.440** (2.62)	0.445*** (2.64)
Industry Controls	Yes	Yes	Yes
<i>Observations</i>	1,159	1,153	1,151
$\chi^2$	60.25	134.38	182.41
<i>Model p-value</i>	0.000	0.000	0.000
<i>Pseudo R<sup>2</sup></i>	0.154	0.228	0.265

Panel D: FUNDRAISING

	<i>(i)</i>	<i>(ii)</i>	<i>(iii)</i>
Venture-Experience	0.021 (0.68)	0.012 (0.39)	-0.026 (-0.86)
Business-Experience	1.141*** (3.47)	1.004*** (3.62)	1.283*** (4.59)
Science-Education	0.015 (0.04)	-0.139 (-0.39)	-0.153 (-0.42)
Downside		-0.099 (-0.51)	-0.229 (-1.39)
Board Control		0.673*** (3.18)	0.752*** (3.61)
Independent VC			0.464* (1.75)
VC-Age			0.005*** (2.61)
VC-Size			0.000 (0.24)
Stage	-0.162* (-1.80)	-0.187** (-2.10)	-0.211** (-2.45)
Syndicate	-0.387** (-2.22)	-0.323** (-2.00)	-0.276 (-1.51)
Syndicate Leader	0.553*** (2.89)	0.405** (2.23)	0.416** (2.16)
Industry Controls	Yes	Yes	Yes
<i>Observations</i>	1,107	1,101	1,099
$\chi^2$	46.02	55.67	96.97
<i>Model p-value</i>	0.000	0.000	0.000
<i>Pseudo R<sup>2</sup></i>	0.124	0.156	0.205

**Table 4: Endogeneity**

This table reports results from two bivariate probit regressions models. The dependent variables are INTERACTION, DIRECTORS, RECRUITING, and FUNDRAISING. The independent variables are VENTURE-EXPERIENCE, BUSINESS-EXPERIENCE-D, SCIENCE-EDUCATION, DOWNSIDE, BOARD CONTROL, INDEPENDENTVC, VC-AGE, VC-SIZE, STAGE, SYNDICATE, and SYNDICATE LEADER. In all regressions, INDUSTRY CONTROLS are included but not reported. Variables are defined in Section 3.3. The lower part of the Table reports the selection equation for each dependent variable, where the independent variables are SUPPLY-INDEPENDENTVC, STAGE, SYNDICATE, and SYNDICATE LEADER. In all regressions, INDUSTRY CONTROLS are included but not reported. For each independent variable, we report the estimated coefficient and the t-ratio (in parenthesis), computed using (Huber-White) heteroskedasticity-robust standard errors, clustered by venture firm. Values significant at the 1%, 5% and 10% level are identified by \*\*\*, \*\*, \*.

Panel A: BUSINESS EXPERIENCE

	INTERACTION	DIRECTORS	RECRUITING	FUNDRAISING
Venture-Experience	0.011 (0.24)	-0.008 (-0.25)	-0.002 (-0.06)	-0.022 (-0.74)
Business-Experience-D	1.826*** (4.84)	1.165** (1.97)	1.368*** (2.61)	1.305*** (2.95)
Science-Education	-1.543*** (-2.67)	0.060 (0.15)	0.462 (1.32)	-0.203 (-0.52)
Downside	0.181 (1.02)	0.051 (0.28)	-0.192* (1.11)	-0.242 (-1.44)
Board Control	0.577*** (2.62)	1.241*** (5.19)	0.945*** (4.39)	0.862*** (-3.60)
IndependentVC	0.511* (1.69)	0.609** (2.21)	0.515** (2.08)	0.415 (1.53)
VC-Age	-0.006*** (-2.56)	0.002 (1.16)	0.002 (0.24)	0.003* (1.75)
VC-Size	-0.000 (-0.64)	-0.001 (-1.35)	-0.001** (-2.37)	-0.000 (-0.56)
Stage	0.156 (1.24)	-0.131 (-1.48)	-0.181** (-2.20)	-0.226** (-2.50)
Syndicate	0.017 (0.08)	-0.234 (-1.14)	-0.210 (-1.10)	-0.099 (-0.46)
Syndicate Leader	-0.133 (-0.68)	0.345* (1.82)	0.350* (1.89)	0.362* (1.84)
Industry Controls	Yes	Yes	Yes	Yes
<b>SELECTION EQUATION</b>				
Local-Business-Exp.	3.583*** (3.15)	3.828*** (3.26)	3.821*** (3.32)	3.983*** (3.30)
Stage	0.096 (0.60)	0.029 (0.19)	0.018 (0.12)	0.023 (0.15)
Syndicate	-0.148 (-0.62)	-0.143 (-0.56)	-0.155 (-0.62)	-0.111 (-0.44)
Syndicate Leader	0.460* (1.82)	0.571** (2.35)	0.580** (2.43)	0.516** (2.09)
Industry Controls	Yes	Yes	Yes	Yes
$\rho$	-0.820*** (-2.73)	-0.402 (-1.13)	-0.501 (-1.41)	-0.299 (-1.16)
Observations	1,045	1,136	1,151	1,099
$\chi^2$	344.47	349.07	491.36	314.84
Model p-value	0.000	0.000	0.000	0.000

Panel B: INDEPENDENTVC

	INTERACTION	DIRECTORS	RECRUITING	FUNDRAISING
Venture-Experience	0.013 (0.25)	-0.001 (-0.05)	0.006 (0.19)	-0.029 (-0.94)
Business-Experience	0.680** (2.18)	1.025*** (3.91)	1.159*** (4.48)	1.279*** (4.61)
Science-Education	-1.604*** (-3.23)	0.042 (0.11)	0.495 (1.53)	-0.164 (-0.44)
Downside	0.163 (0.82)	0.108 (0.63)	0.267 (1.63)	-0.239 (-1.47)
Board Control	0.4987** (2.21)	1.128*** (4.99)	0.814*** (3.89)	-0.756*** (-3.60)
IndependentVC	0.828* (1.63)	0.276 (0.57)	0.123 (0.28)	0.632 (1.48)
VC-Age	-0.006*** (-2.92)	0.002 (1.51)	0.003 (1.18)	0.005*** (2.66)
VC-Size	-0.000 (-0.10)	-0.000 (-0.82)	-0.000 (-1.50)	-0.000 (-0.28)
Stage	0.186 (1.30)	-0.143 (-1.54)	-0.198** (-2.32)	-0.202** (-2.16)
Syndicate	-0.099 (0.50)	-0.393** (-2.04)	-0.413** (-2.33)	-0.258 (-1.44)
Syndicate Leader	-0.044 (-0.23)	0.453*** (2.56)	0.475*** (2.82)	0.399** (1.99)
Industry Controls	Yes	Yes	Yes	Yes
<b>SELECTION EQUATION</b>				
Local-IndependentVC	3.533*** (5.72)	3.704*** (6.04)	3.629*** (6.07)	3.663*** (6.10)
Stage	-0.337** (-2.47)	-0.165 (-1.09)	-0.185 (-1.22)	-0.213 (-1.37)
Syndicate	-0.233 (-0.91)	-0.234 (-0.80)	-0.284 (-0.97)	-0.292 (-1.98)
Syndicate Leader	0.258 (1.32)	0.179 (1.10)	0.173 (1.06)	0.251 (1.53)
Industry Controls	Yes	Yes	Yes	Yes
$\rho$	-0.198 (-0.71)	-0.281 (-1.18)	0.340 (1.29)	-0.128 (-0.55)
Observations	1,045	1,136	1,151	1,099
$\chi^2$	184.51	241.97	308.27	188.06
Model p-value	0.000	0.000	0.000	0.000

**Table 5: Within-firm involvement (conditional logit)**

This table reports results from a conditional logit model (Equation (2)). The dependent variables are INTERACTION, DIRECTORS, RECRUITING, and FUNDRAISING. The independent variables are PIC-VENTURE-EXPERIENCE, PIC-BUSINESS-EXPERIENCE, PIC-SCIENCE-EDUCATION, DOWNSIDE, BOARD CONTROL, STAGE, SYNDICATE, and SYNDICATE LEADER. In all regressions, INDUSTRY CONTROLS are included but not reported. Variables are defined in Section 3.3. For each independent variable, we report the estimated coefficient and the t-ratio (in parenthesis), computed using (Huber-White) heteroskedasticity-robust standard errors, clustered by venture firm. Values significant at the 1%, 5% and 10% level are identified by \*\*\*, \*\*, \*.

	INTERACTION	DIRECTORS	RECRUITING	FUNDRAISING
PIC-Venture-Experience	0.118** (2.11)	0.128*** (2.74)	0.090** (1.95)	0.106** (2.50)
PIC-Business-Experience	-0.407 (-0.81)	-0.721 (-0.25)	-0.302 (-0.67)	0.198 (0.44)
PIC-Science-Education	-0.320 (-0.68)	0.044 (0.11)	0.188 (0.56)	0.194 (0.53)
Downside	1.740** (1.95)	0.877** (2.65)	0.005*** (3.44)	0.604 (2.11)
Board Control	2.347*** (6.00)	2.645*** (5.47)	2.096*** (5.91)	1.483*** (4.90)
Stage	0.112 (0.52)	-0.172 (-0.88)	-0.056 (-0.31)	-0.342* (-1.96)
Syndicate	0.191 (0.52)	-0.336 (-1.01)	-0.549* (-1.76)	-0.447 (-1.53)
Syndicate Leader	0.761 (1.60)	0.462 (1.35)	0.700** (2.32)	0.953*** (3.28)
Industry Controls	Yes	Yes	Yes	Yes
<i>Observations</i>	<i>463</i>	<i>556</i>	<i>683</i>	<i>667</i>
$\chi^2$	<i>101.98</i>	<i>78.79</i>	<i>86.34</i>	<i>72.36</i>
<i>Model p-value</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>	<i>0.000</i>
<i>Pseudo R<sup>2</sup></i>	<i>0.260</i>	<i>0.179</i>	<i>0.163</i>	<i>0.133</i>

**Table 6: Within-firm task allocation**

This table reports results from probit regressions (Equation (3)). The dependent variable is IN-CHARGE. The independent variables are P-VC-EXPERIENCE, P-BUSINESS-EXPERIENCE, P-SCIENCE-EDUCATION, DOWNSIDE, BOARD CONTROL, STAGE, SYNDICATE, AND SYNDICATE LEADER. In all regressions, INDUSTRY CONTROLS are included but not reported. Variables are defined in Section 3.3. For each independent variable, column (i) reports the estimated coefficient and the t-ratio (in parenthesis), computed using (Huber-White) heteroskedasticity-robust standard errors, clustered by venture firm; column (ii) provides the change in probability of the dependent variable due to a change in the independent variable implied by the probit coefficient, evaluated at the sample mean. Values significant at the 1%, 5% and 10% level are identified by \*\*\*, \*\*, \*.

	(i)	(ii)
P-Venture-Experience	0.065*** (7.76)	0.064*** (7.66)
P-Business-Experience	0.415*** (3.78)	0.411*** (3.74)
P-Science-Education	0.061 (0.62)	0.063 (0.64)
Downside		-0.074 (-0.66)
Board Control		0.028 (0.22)
Stage	-0.011 (-0.15)	-0.009 (-0.13)
Syndicate	-0.833 (-0.75)	-0.070 (-0.62)
Syndicate Leader	0.008 (0.06)	0.002 (0.01)
Industry Controls	Yes	Yes
<i>Observations</i>	4,303	4,293
$\chi^2$	72.60	70.95
<i>Model p-value</i>	0.000	0.000
<i>Pseudo R<sup>2</sup></i>	0.018	0.018

**Table 7: Depth of involvement**

This table reports results from probit regressions for our probit model (Equation (1)), where the dependent variables are variations of the RECRUITING variable. The dependent variables are: CEO, CFO, VP FOR MARKETING, and HEAD OF R&D. The independent variables are VENTURE-EXPERIENCE, BUSINESS-EXPERIENCE, SCIENCE-EDUCATION, DOWNSIDE, BOARD CONTROL, INDEPENDENTVC, VC-SIZE, VC-AGE, STAGE, SYNDICATE, and SYNDICATE LEADER. In all regressions, INDUSTRY CONTROLS are included but not reported. Variables are defined in Section 3.3. For each independent variable, we report the estimated coefficient and the t-ratio (in parenthesis), computed using (Huber-White) heteroskedasticity-robust standard errors, clustered by venture firm. Values significant at the 1%, 5% and 10% level are identified by \*\*\*, \*\*, \*.

	CEO	CFO	VP MARKETING	HEAD OF R&D
Venture-Experience	0.014 (0.45)	0.027 (0.85)	-0.028 (-0.78)	-0.014 (-0.28)
Business-Experience	0.989*** (3.56)	1.003*** (3.93)	1.311*** (4.22)	1.694*** (3.95)
Science-Education	0.519* (1.85)	0.820** (2.52)	0.599* (1.68)	0.284 (0.53)
Downside	0.138 (0.76)	-0.226 (-1.02)	-0.073 (-0.31)	0.313 (0.88)
Board Control	0.744*** (4.31)	0.642*** (3.64)	0.377* (1.67)	0.417* (1.83)
IndependentVC	0.961*** (4.07)	0.940*** (3.73)	0.928*** (3.61)	1.787*** (4.39)
VC-Age	0.004** (2.33)	-0.000 (-0.09)	-0.001 (-0.59)	0.005* (1.66)
VC-Size	0.000 (0.77)	0.000 (0.09)	-0.003*** (-3.28)	-0.001 (-0.81)
Stage	-0.367*** (-3.87)	-0.092 (-0.84)	-0.244* (-1.85)	-0.720*** (-4.03)
Syndicate	-0.264 (-1.61)	-0.267 (-1.55)	-0.304 (-1.57)	-0.314 (-1.31)
Syndicate Leader	0.460*** (2.90)	0.526*** (3.84)	0.541*** (3.82)	0.547*** (3.17)
Industry controls	Yes	Yes	Yes	Yes
<i>Observations</i>	1,039	1,074	1,019	1,019
$\chi^2$	143.60	149.97	88.23	152.45
<i>Model p-value</i>	0.000	0.000	0.000	0.000
<i>Pseudo R<sup>2</sup></i>	0.308	0.266	0.327	0.436