

Do Venture Capitalists' characteristics affect the
performance of the firms they back?

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DO VENTURE CAPITALISTS' CHARACTERISTICS AFFECT THE PERFORMANCE OF THE FIRMS THEY BACK?

Abstract

Previous research has already addressed the issue of the impact of venture capital (VC) backing on the growth patterns of investee firms. Based on qualitative, hand-collected data, other studies analyzed the different tasks performed by venture capitalists (VCs) to add value to their portfolio companies. The aim of this paper is to provide evidence of the effect of some VCs' characteristics on the performance of the investee firms over time. The findings are based on panel data of numerical variables on a highly representative sample of VC investments in Continental Europe. This approach allows us to keep track of the changes over time and to control for the effect of the funding and the value added by VCs separately. Our findings show that value added is significant in companies at the expansion stage for some VCs characteristics, whereas performance on start-up companies seems related to funding alone.

Keywords: Venture Capital; Performance; Value added; Impact; Entrepreneurial Finance; Growth of the firm;

JEL Classification: G24, M13, O31

EFM Classification: 810

1. Introduction

A much discussed and now widely accepted issue is that venture capitalists (VCs) add value to their portfolio companies (MacMillan et al., 1988; Gorman and Sahlman, 1989(Gorman and Sahlman 1989); Sapienza, 1992; Sapienza et al., 1996). There are different ways by which VCs can add value. These fall into two groups: 1) through monitoring and control; 2) using their intangible assets such as network of contacts, experience in the industry and know-how. Acting as a sounding board and advising on strategic matters are the two roles in which VCs are most often involved.

Companies receiving venture capital (VC) seem to perform better than comparable companies funded from other sources of capital (Amit et al., 1998; Manigart and Van Hyfte, 1999). In fact, empirical evidence proves that VC-backed companies have a higher economic impact in their regions, creating more employment, paying more taxes and investing more in intangible assets (Alemany and Marti, 2005).

Interestingly, entrepreneurs seem willing to accept less money or lower valuations in order to obtain funding from VCs with a high reputation. Indeed, high reputation triples the likelihood of entrepreneurs accepting VCs' offers, reducing the price paid for the company's stake by 10 to 14% on average (Hsu, 2004).

Is it only reputation that matters? Are companies financed by these high-reputation VCs performing better? And if so, what characteristics help reputation?

How important is the track record of VCs? Although reputation and experience should be important, research shows that the more experienced VCs do not seem to perform better (Shepherd, Zacharakis and Baron, 2003).

Assuming that VC-backed firms outperform their non-VC-backed equivalents, we aim to provide further evidence on the positive effect that some VCs' characteristics exert on the growth patterns shown by the former. This paper seeks to shed light on this subject, examining which observable characteristics of the VCs best explain the financial results and growth patterns of their portfolio firms. Our contribution to the existing literature is twofold. First, we rely on numerical data gathered from both investee firms and VCs rather than qualitative data from only one of the two. Second, we use the actual investment committed by the VCs as a control variable so as to properly identify some VCs' characteristics related to the value added.

We base our analysis on objective, numerical data from a highly representative sample of investments in a country that ranks third in the Continental European VC market. The sample represents almost 80% of the Spanish population of VC deals. Three databases are used; one to identify investments, another containing the financial accounts of VC-backed firms, and the last including historical information on the VCs. Additionally, other observable information regarding the characteristics of the investor has been added for each year during which the company was in the VC's portfolio. These characteristics include, amongst others, size, age, number of investment managers and number of portfolio companies.

Using panel data methodology we find that growth patterns of key financial variables are closely related to VC funding in early and growth stage firms. Additionally, characteristics such as age of the VCs, our proxy of experience, and the attention that a portfolio firm receives from the investment managers, proxy of involvement, are relevant for companies in the growth stage. Other characteristics such as specialization versus generalist strategy, private versus public-sector funding or size of the funds under management do not seem to affect performance. Surprisingly, time available per company does not have the same effect in all companies, and in some cases the effect was negative. More research is needed to understand this effect.

This paper has implications for both VCs and entrepreneurs. On the one hand, VCs can improve their return if they get involved in companies in which their efforts would imply higher returns. Similarly, entrepreneurs should be selective in trying to find which VCs would maximize the value added to their firms.

The rest of the paper is organized as follows: Section 2 presents prior research on value added by VCs, performance of portfolio companies and VCs' characteristics. Additionally, it formulates hypotheses regarding VCs' characteristics and financial performance. Section 3 describes the data and methodology used to test the hypotheses. Section 4 includes the empirical results and the final section discusses results, limitations and implications.

2. Literature review and hypotheses

VC research has already addressed the issue of VCs' ability to add value to portfolio firms. Some VC-backed success stories such as Apple Computers, Digital Equipment, FedEx, Genetech and Sun Microsystems, among others, which became public companies early on, attracted the attention of both academics and politicians.

Kunkel and Hofer (1991) and Timmons (1994) asserted that VC-backed firms show a higher survival rate than average companies. More recently, Lerner (1999), Manigart and Van Hyfte (1999), Engel (2002) and Alemany and Marti (2005) find that VC-backed firms grow faster than a group of comparable companies financed from other sources. However, Manigart and Van Hyfte (1999) provide evidence that Belgian VC-backed firms show a lower survival rate.

Regarding the adverse selection problem faced by VCs, Amit et al. (1990) argue that the best ventures are able to find cheaper sources of funding than VC. Consequently, VCs are only 'invited' to invest in second-best projects. These studies reinforced the idea that somehow VCs were helping or influencing companies to perform better.

The questions that previous research was trying to answer regarding VCs and value added were 'how' is it added, 'who' adds value, 'how much' value is added and, finally, 'why' VCs are interested in adding value to portfolio companies.

Timmons and Bygrave (1986) analyzed a sample of 1,501 highly innovative companies that received venture financing between 1967 and 1982. They found that the most innovative companies were financed by a small number of VCs. As some investors seemed to be better than the rest, this pioneering research introduced empirical facts on the aspect of 'who' adds more value.

In 1989 Gorman and Sahlman conducted a survey among 100 VCs, obtaining 49 complete responses. The research goal was to gain understanding of the process of VC investing. Two of the areas covered were how much time VCs spend with portfolio firms, and what roles they play. The very descriptive findings have been the basis of many subsequent studies.

MacMillan et al. (1988) focused their research on 'how' and 'how well' VCs add value. They sent out a questionnaire to 350 VCs, asking about twenty different activities and the degree of involvement on a seven-point scale. They also included a question regarding the performance of the portfolio. From the 62 completed answers, the authors identified serving as a sounding board as the most important task performed by VCs. One of the most interesting findings was the identification through cluster analysis of three groups of VCs based on their level of involvement. The groups (Laissez-Faire, Moderate and Close Tracker) were then analyzed. Interestingly, the authors found that: a) the difference in performance level of the portfolio companies of the three groups was statistically insignificant; and b) the tests did not explain why the

VCs' involvement levels were different, concluding that this was a decision of the VCs themselves.

Other studies on 'how' VCs add value include Gomez-Mejia et al (1990) on high tech firms, Ehrlich et al. (1994) on start-ups, and Rosenstein et al. (1993). Instead of asking the VCs, these three studies surveyed the entrepreneur. A summary on the 'how' section shows that the key activities of the venture managers were acting as a sounding board, giving strategic advice and helping with top management recruiting efforts, together with their role on the Board of Directors (Zahra and Pearce, 1998; Rosenstein et al., 1993).

The agency theory is the key to understanding 'why' VCs add value. Their role is to reduce the information asymmetry that would arise from direct investments of fund providers in recently established, unknown ventures (Black, 1998). VCs accept the role of direct investors in those firms on behalf of fund providers, giving rise to two different agency relationships (Sahlman, 1990), one that relates investors with VCs and another that links VCs and investee firms. The information asymmetry problem in the first agency relationship is faced by investors in two ways. First, a competitive screening process of VCs is developed, following a serious due diligence on the selected organizations. Second, and this is 'why' VCs are interested in adding value, a substantial share of their revenues is based on the success achieved. Therefore, the VCs' interests are aligned with those of the entrepreneurs and also with those of the investors who provide the capital.

VC backing also has a positive effect on portfolio companies since it signals to the market that the company has been screened and selected by VCs, and therefore a thorough due diligence has been performed. Moreover, having VCs as investors ensures close monitoring of the evolution of the company and help in key aspects of the business. This positive signal will persuade other investors, as well as potential employees, to join the VC-backed company, reinforcing the positive effect on its future growth (Davila et al., 2003; Leleux and Surlemont, 2003). At IPO, having high-quality VC backing improves timing and results. This is due to the strong legitimating effect that the VCs offer, especially in the case of young companies (Barry et al., 1990).

Some studies have compared the activities of VCs and the performance of the portfolio firm. Sapienza (1992) takes two perspectives into consideration: the investor's and the entrepreneur's. He is interested in involvement and in its effect on the performance of the firm. The results of 51 matched pairs of lead investor-CEO surveys established that some variables increased the value of the involvement, while others did not appear to have any impact on value added. Within the variables that positively affect the value added by the VCs, and so the performance of the firm, are: level of innovation of the firm, open communication, frequent VCs/CEO contact, and low level of conflict. Conversely, the stage of the firm and the CEO's experience did not have any impact on VCs' involvement.

Sapienza et al. (1996) conducted similar research covering the US plus the three leading European countries in terms of VC investment (the UK, Netherlands and

France). They analyzed the data on four countries, although in Europe only VCs were surveyed. VC-backed firms' performance was based only on the perceptions of the investor. The value added for each role was measured in terms of the importance of the role multiplied by the effectiveness achieved. One of the key findings, surprisingly, although consistent with Sapienza et al. (1994), was that VCs add more value to over-performing firms. The previous belief had been that VCs help more when the portfolio firm is in clear need. In this study of four countries, the authors found no evidence of a correlation of VCs' experience with value added.

Recent studies by De Clercq and Sapienza (2005) and Arthurs and Busenitz (2005) identify more variables, such as levels of trust, social interaction and greater dynamic capabilities, which affect the perceived or actual performance of the VC-backed firm.

It is accepted that some VCs add more value than others. The implication is that entrepreneurs do not see VC only as a source of money, but as a source of 'intelligent' money. Hsu (2004) found that high-reputation VCs are able to negotiate better terms when investing in a venture. Entrepreneurs are willing to accept lower valuations, between 10 to 14% lower, from VCs from which they expect to receive more value.

Reputation seems to matter, but it is as yet unclear what variables add to reputation. Normally, reputation is seen as experience, number of deals and number of portfolio companies that make it to IPO. But are these the variables that matter? Are there other observable variables that affect performance? Shepherd et al. (2003) found evidence that the more experienced VCs do not seem to perform better.

Summarizing, VCs add value in different ways, resulting in a better performance of their portfolio companies. But is it possible to characterize the best VCs for a specific venture? Are there any investor characteristics that, controlling for stage, industrial sector and size of the VC-backed firm, are correlated with the company's performance?

Since most VC funds have limited lives, VCs have to raise funds periodically to continue their investments and divestment activity. The biggest share of the yearly amount of new funds raised is captured by the most experienced VCs. It can be inferred that these VCs are able to show a good track record to attract investors to follow-on funds and, hence, the performance of the fund is related to the performance of the portfolio firms. Therefore, the first hypothesis to be tested is as follows:

H1: The greater the investor's experience, the better the performance of the investee firm over time.

A second measure of VCs reputation is the amount of funds under management. It is assumed that highly reputed VCs are those able to raise more funds over time. In developed VC markets, the ability to attract funds depends on the manager's reputation. (Gompers and Lerner, 2001; Schmidt and Wahrenburg, 2003). It remains to

be tested, however, if the VCs with larger sums under management add more value, allowing us to test the following hypothesis:

H2: The larger the amount of funds under management, the better the performance of the portfolio firm.

However, the value added is related to the attention paid by venture managers to each portfolio firm. We assume that investment managers will have more time available to add value if the number of portfolio companies subject to their scrutiny is low. Balboa and Martí (2006) find that VCs' reputation is related to the ratio of investment managers per investee company. Therefore, the third hypothesis to be tested is:

H3: The lower the ratio of portfolio companies to VC investment managers, the better the performance of the firm.

Nevertheless, the ability to add value does not depend only on the availability of time. Since VCs invest in companies from different sectors and at different stages of development, it may well be that the quality of the value added is different if the VCs are specialized or generalist. VCs that only invest in one industry or in one stage have more knowledge and are able to reduce information asymmetries to a greater extent than their generalist counterparts. They are more experienced in the specific industry or type of business, being able to add more value. Therefore, our last hypothesis is as follows:

H4: Specialized VCs add more value than generalist VCs.

3. Data and methodology

3.1. Data collection and sample description

The scope of the research includes all companies that received VC funding in Spain in the period 1991 to 1999. The population is 921 companies. The sample includes 799 companies that have been identified, including accounting data, whenever possible, up to three years after the first VC round. The sample represents 87% of the population.

The sample is not affected by survival bias, as is sometimes the case in VC research, as we include companies that are no longer in business. According to the SABI database and additional research, by the end of 2002, 637 firms were alive and active (80%), 79 were alive but merged (10%), 39 had gone bankrupt (5%) and for the remaining 40 the reason for their business inactivity was not clear.

We track these firms for at least three years after the first round of VC financing. Individual investments are taken from the official database of the Spanish VC Association (ASCRI), which records activity of both members and non-members. For each individual portfolio firm we collect panel data on the amount invested, the

stage of development at the time of the first round, the location, the headcount and the industry. We also add VCs' characteristics, such as age, number of investment managers, number of portfolio companies, number of deals closed per year, amount of funds under management and origin of funds. We completed the panel data with the profit and loss accounts and balance sheets of those firms, which were taken from the SABI database.

As the aim of this paper is to study the relationship between VCs and the performance of their portfolio companies, we will not describe the Spanish VC market in any detail. Detailed information on Spanish VC activity can be found in Marti (2004), Marti et al. (2005) and Alemany (2006).

Table 1, Panels A and B, summarizes the distribution of the portfolio companies at the time of the first VC round and the total amount of investment received in constant terms (base 2001). This investment figure reflects all amounts of VC money received by the portfolio company, and therefore includes later rounds. The companies are classified according to their stage of development (Table 1, Panel A) and their type of business (Table 1, Panel B). Panel C presents the average holding period of the VCs, including statistics for the 418 companies that were already divested.

Table 1
Description of the sample and total VC money received

Panel A: Stage of VC-backed firm and amount of funds committed

Stage (First Round)	Number		Total venture capital investment (€ thousand base 2001)				
	of Firms	%	Mean	S. D.	Median	Min.	Max.
Early	338	42.3	1,391	4,338	316	1	47,174
Expansion	365	45.7	4,049	9,643	987	5	83,492
Late	96	12.0	6,957	9,169	3,474	44	47,867
Total	799	100.0	3,274	7,987	702	1	83,492

Panel B: Activity of VC-backed firm and amount of funds committed

Activity (First Round)	Number		Total venture capital investment (€ thousand base 2001)				
	of Firms	%	Mean	S. D.	Median	Min.	Max.
Raw Materials	48	6.0	1,216	2,217	478	15	11,995
Industry	386	48.3	2,807	5,781	938	5	61,835
Trading	103	12.9	4,988	12,459	905	1	71,096
Services	186	23.3	3,689	9,707	514	1	83,492
Technology	76	9.5	3,607	7,218	524	19	38,091
Total	799	100.0	3,274	7,987	702	1	83,492

Panel C: Number of years from first round to VCs' exit (a)

Years to exit	Firms		%				
	of Firms	%	Mean	S. D.	Median	Min.	Max.
Years to exit	418	52.3	4.22	2.27	4.0	0	11

(a) Includes 63 write-offs. The remaining 381 firms had not been divested at the end of 2001.

The mean investment received, in constant terms, was €3.3 million although due to the high dispersion observed, with a standard deviation of €8.0 million, the median amounted to just €0.7 million. The characteristics of the firm at the time of the first round of financing affected the amount of funds received. Early stage companies (42% of the sample) received, on average, €1.3 million, while the sum committed to

expansion (46% of the sample) and late (12% of the sample) stage companies amounted to €4.0 and €7.0 million, respectively investment.

Regarding the type of activity of the firm, the largest group is industrial production with 48% of the sample, thus indicating the different nature of VC in Europe. The firms in the raw materials business received less money and are fewer, representing only 6% of the sample. One out of ten companies belongs to the technology sector, with total VC funds over the average, although their median was below the sample mean.

On the representative sample of VC-backed firms, we search for data on the growth patterns observed in some selected variables, namely sales, earnings before interest, taxes, amortization and depreciation (EBITDA), total assets, intangible assets and headcount. Sales and EBITDA were selected because they allow a better understanding of the evolution of a company which is growing. Profit and loss items below EBITDA are negatively affected by depreciation and amortization, which in the first years after a round of financing are significant due to the increase in capital that is allocated to new assets.

We complete the database with VCs' characteristics such as VC management experience, total funds under management, origin of funds, specialized or generalist focus, number of portfolio companies and number of investment managers.

Table 2 provides a description of the size of the portfolio companies, in terms of sales in constant 2001 Euros, according to some VCs' characteristics. Some VCs seem to have marked preferences in terms of the size of the companies they decide to back. Large VCs invest in companies that are seven times bigger than those of small VCs (up to 12 million Euros to invest), or four times the average company invested in by medium-sized VCs. Also, the number of investment managers affects the size of the company backed. The larger the number of investment managers, the larger the initial size of the VC-backed firm. Other characteristics, such as the number of companies in their portfolio, the number of investments in year '0' or the age of the VCs do not seem to determine the size of the company receiving the money at the time of the first round of financing.

The missing data on the sales figures of VC-backed companies at the time of the first VC round imply access to a subset of up to 611 companies, representing 67% of the population of investments closed in Spain between 1991 and 1999.

Table 2
Sales of the VC-backed companies at the time of the first financing round

Panel A: Size of the VCs and sales of the VC-backed firm							
Size VCs (a)	VC-backed		Sales at first round of VC financing (€ million base 2001)				
	Firms	%	Mean	S. D.	Median	Min.	Max.
Small	168	27.5	4.4	18.2	0.3	0.0	207.7
Medium	257	42.1	8.5	27.5	1.1	0.0	273.2
Large	186	30.4	31.2	84.8	8.0	0.0	947.1
Total	611	100.0	14.3	52.1	1.7	0.0	947.1

(a) Small is a fund up to €12 million, Medium between 12 and 60, and Large more than €60 million.

Panel B: Origin of funds of the VCs and sales of the VC-backed firm							
Origin of Funds	VC-backed		Sales at first round of VC financing (€ million base 2001)				
	Firms	%	Mean	S. D.	Median	Min.	Max.
Government	318	52.0	7.6	22.2	0.7	0.0	207.7
Private	293	48.0	21.5	71.0	3.7	0.0	947.1
Total	611	100.0	14.3	52.1	1.7	0.0	947.1

Panel C: Number of investment managers at the VCs and sales of the VC-backed firm							
No. Inv. Manag.	VC-backed		Sales at first round of VC financing (€ million base 2001)				
	Firms	%	Mean	S. D.	Median	Min.	Max.
0 to 3 people.	92	15.2	5.7	16.0	0.1	0.0	89.8
4 to 6 people.	188	31.1	12.3	36.2	1.9	0.0	367.9
7 to 10 people.	205	33.9	16.8	44.8	2.7	0.0	334.2
+ 10 people.	120	19.8	20.2	90.0	1.7	0.0	947.1
Total	605	100.0	14.4	52.4	1.7	0.0	947.1

Panel D: Number of portfolio companies and sales of the VC-backed firm							
No. Portfolio Co.	VC-backed		Sales at first round of VC financing (€ million base 2001)				
	Firms	%	Mean	S. D.	Median	Min.	Max.
0 to 5	76	12.6	11.7	20.2	0.4	0.0	89.1
6 to 15	155	25.6	22.9	89.2	1.1	0.0	947.1
16 to 25	129	21.3	12.2	36.5	1.3	0.0	273.8
26 to 35	134	22.1	9.1	17.6	2.4	0.0	92.1
+ 35	111	18.3	13.3	39.7	2.3	0.0	334.2
Total	605	100.0	14.4	52.4	1.7	0.0	947.1

Panel E: Number of portfolio companies per investment professional and sales of the VC-backed firm							
Firms per inv. manager	VC-backed		Sales at first round of VC financing (€ million base 2001)				
	Firms	%	Mean	S. D.	Median	Min.	Max.
0 to 2	252	41.9	19.9	73.8	1.3	0.0	947.1
>2 to 3	222	36.9	10.3	25.6	1.7	0.0	197.4
>3 to 4	76	12.6	13.0	40.3	2.7	0.0	334.2
More than 4	52	8.6	7.3	13.3	0.5	0.0	70.5
Total	602	100.0	14.4	52.5	1.7	0.0	947.1

Table 2 (cont.)

Panel F: Number of investments year '0' and sales of the VC-backed firm							
No. of investments in year '0'	VC-backed		Sales at first round of VC financing (€ million base 2001)				
	Firms	%	Mean	S. D.	Median	Min.	Max.
0 to 2	138	22.8	15.0	45.4	1.1	0.0	367.9
3 to 4	148	24.5	19.1	85.3	0.8	0.0	947.1
5 to 9	211	34.9	12.1	33.7	2.0	0.0	334.2
10 or more	108	17.9	11.5	23.5	3.8	0.0	197.4
Total	605	100.0	14.4	52.4	1.7	0.0	947.1

Panel G: VCs' age and sales of the VC-backed firm							
VCs' age	VC-backed		Sales at first round of VC financing (€ million base 2001)				
	Firms	%	Mean	S. D.	Median	Min.	Max.
0 to 5 years	160	26.2	9.0	26.5	0.4	0.0	273.2
+5 to 10 years	200	32.7	21.1	78.6	3.2	0.0	947.1
+10 to 15 years	152	24.9	16.0	41.6	2.5	0.0	273.8
+ 15 years	99	16.2	6.3	18.5	0.9	0.0	152.6
Total	611	100.0	14.3	52.1	1.7	0.0	947.1

3.2. Methodology

To test our hypotheses, we rely on econometric techniques applicable to panel data, with the VC-backed firm being the unit of analysis. This approach offers several advantages (Hsiao, 2003; Arellano and Bover, 1990). First, it allows us to control for the effects of variables that specifically affect the dependent variable of each investee firm but are unobservable (the so-called individual heterogeneity), meaning that the coefficients estimated reflect the real impact of x on y . Second, it provides a large amount of information, which reduces colinearity among the explanatory variables. Third, it allows us to analyze a series of important economic questions which could not be studied through the exclusive use of time or cross-section data series.

The general model to be tested is

$$y_{it} = \alpha + x_{it}'\beta + \eta_i + v_{it} \quad i = 1, 2, \dots, N ; t = 1, 2, \dots, T$$

observing an endogenous variable, y_{it} , and a vector of explanatory variables, x_{it} . The sub index 'i' refers to the VC-backed firm and the sub index 't' to the respective year. The term η_i represents the specific effects of each portfolio firm which are not observable and which are assumed to be constant through time for the same company. There are two approaches to this equation. In the fixed effects approach, there is no need for parametric assumptions on the conditional distribution of unobservable heterogeneity (η_i), given the explanatory variables. In this case, the vector η_i is a group of N individual fixed effects which can be estimated along with

the vector of parameters β . Following Arellano and Bover (1990) the individual effects can always be treated as random variables, without loss of generality, if these individual effects are not correlated with the variables observed. Therefore, a parametric specification for the conditional distribution of unobservable individual effects η_i is imposed, in such a way that they are realizations of individual effects which follow a certain distribution. Finally, ε_{it} is a zero average residual with variance σ_ε^2 ; $\varepsilon_{it} \sim N(0, \sigma_\varepsilon^2)$.

The aim of the model is to test whether some VCs' characteristics exert a significant impact on the investee's performance over time. Therefore, the dependent variables are the absolute growth, year-by-year, of sales, EBITDA, employment and intangible assets. As in Baum and Silverman (2005), absolute growth rather than relative growth was computed to avoid the distorting effect of very large changes in some years.

The model's independent variables are the characteristics of the VCs, namely, VCs' experience, VCs' funds under management and the ratio of portfolio firms per investment manager. The first measures the age of the VCs at the time of the first round. VCs' funds under management is a dummy variable that equals one if the VC organization has funds with over €60 million under management, or zero otherwise. The ratio of portfolio firms per investment manager represents the total number of portfolio firms at a given moment divided by the number of investment managers working at that time on the VC organization.

Two control variables are also included. First, the absolute growth in total assets lagged one period, since growth on the endogenous variables could be explained by an implied growth of the size of the firm's activities. Second, the cumulative amount committed by the VCs on a given VC-backed firm, also lagged one period. The inclusion of this variable is a contribution to the literature because it allows us to separate the effect of funding from the monitoring and value added by the VCs on the growth patterns of the portfolio firm.

All numerical variables, except VCs' experience, are expressed in constant 2001 Euros and change over time. The number of years for each company goes from 0 to 4, although we use the financial information of year -1 to calculate the growth in year 0. The variable representing VCs' age does not change over time.

In order to regress the proposed models we have to simplify the general model assuming that the exogenous variables are not correlated with the individual effects. Otherwise, the variable VCs' age would be dropped in the regression if a within groups ordinary least squares estimator was applied. Then we estimate the models using a generalized least squares (GLS) estimator with random effect regression of the model presented in the following equation.

$$y_{it} = x_{it}'\beta + \varepsilon_{it} ; \varepsilon_{it} = \eta_i + v_{it}$$

3.3. Descriptive statistics

We measure the performance of VC-backed companies looking at the growth of sales, EBITDA, employment and intangible assets. The first set of analyses takes each VC's characteristics and studies the different levels of growth achieved by the VC-backed firms. These analyses help us to illustrate the links between the backed company's performance and the VC's characteristics. The period of analysis is from the year of the first round of VC, namely 'event year' or 'year 0', to three years later, 'year 3'. This period has been selected to include the years of permanence of VC in the portfolio company. In the sample, year 4 is when, on average, divestments take place.

Provided that growth patterns differ for companies at various stages of development and in different business activities, we control for stage and type of business. Firms that receive the first round of VC funding from the start-up point to the moment they reach the break-even point are included in the early stage group. Firms with a track record of earnings, which receive their first round in order to finance the growth of the business through a capital increase, are grouped into the expansion stage. Finally, buyouts, turnaround and replacement capital deals, which generally do not involve an entry of fresh money into the firm, are classed as late stage investments. Regarding the type of business, we classify the companies in five groups: raw materials, industrial production, trading, services and technology. The descriptive statistics of the performance-related variables regarding the two most important VC's characteristics for the three subsets are shown in Tables 3 to 6.

Table 3
Growth of sales (CAGR) and stage of the firm

Panel A: VCs' age				
VC-backed Firm Stage	VCs' age at year '0'	SALES		Valid Data
		Mean (%)	Median (%)	No. Firms Yr3
EARLY	0 to 5 years	136.4	n.a.	N=68
	+5 to 10 years	43.9	243.6	N=68
	+10 to 15 years	104.9	155.7	N=56
	More than 15 years	24.2	223.1	N=38
	<i>Total</i>	59.0	278.0	N=230
EXPANSION	0 to 5 years	-4.2	16.5	N=68
	+5 to 10 years	35.3	26.4	N=95
	+10 to 15 years	15.7	22.8	N=74
	More than 15 years	31.1	5.1	N=48
	<i>Total</i>	24.3	22.6	N=285
LATE	0 to 5 years	29.1	16.5	N=22
	+5 to 10 years	4.2	16.5	N=43
	+10 to 15 years	20.1	11.9	N=15
	More than 15 years	-2.6	31.1	N=2
	<i>Total</i>	13.6	18.1	N=82

Panel B: Number of portfolio firms per investment manager				
VC-backed Firm Stage	Firms per investment manager Time '0'	SALES		Valid Data
		Mean (%)	Median (%)	No. Firms Yr3
EARLY	<= 2	114.2	703.0	N=91
	>2 to 3	40.6	182.4	N=82
	>3 to 4	57.3	251.9	N=26
	More than 4	25.8	335.6	N=26
	<i>Total</i>	58.9	277.2	N=225
EXPANSION	<= 2	25.4	22.5	N=123
	>2 to 3	16.2	20.9	N=103
	>3 to 4	26.4	22.1	N=37
	More than 4	21.2	7.8	N=19
	<i>Total</i>	24.1	21.8	N=282
LATE	<= 2	18.3	25.4	N=43
	>2 to 3	17.3	15.6	N=32
	>3 to 4	-9.1	5.9	N=3
	More than 4	48.5	-1.5	N=3
	<i>Total</i>	13.6	18.6	N=81

Mean: Cumulative average growth of the aggregated sales of the group from year '0' to year '3'.

Median: Median of the sales growth of individual firms in each group from year '0' to year '3'.

Table 4
Growth of EBITDA (CAGR) and stage of the firm

Panel A: VCs' age				
VC-backed Firm Stage	VCs' age at year '0'	EBITDA		Valid Data
		Mean (%)	Median (%)	No. Firms Yr3
EARLY	0 to 5 years	203.8	n.a.	N=72
	+5 to 10 years	60.6	n.a.	N=69
	+10 to 15 years	-416.5	n.a.	N=59
	More than 15 years	-152.5	n.a.	N=39
	<i>Total</i>	-17.4	n.a.	N=239
EXPANSION	0 to 5 years	0.1	34.1	N=68
	+5 to 10 years	29.3	25.9	N=95
	+10 to 15 years	26.3	36.4	N=75
	More than 15 years	43.0	10.8	N=49
	<i>Total</i>	24.7	18.6	N=287
LATE	0 to 5 years	29.4	19.4	N=22
	+5 to 10 years	2.9	27.4	N=43
	+10 to 15 years	-14.7	7.7	N=15
	More than 15 years	-297.5	-445.6	N=2
	<i>Total</i>	9.5	23.5	N=82

Panel B: Number of portfolio firms per investment manager

VC-backed Firm Stage	Firms per investment manager Time '0'	EBITDA		Valid Data
		Mean (%)	Median (%)	No. Firms Yr3
EARLY	<= 2	-409.6	n.a.	N=96
	>2 to 3	38.6	n.a.	N=86
	>3 to 4	47.1	n.a.	N=26
	More than 4	62.4	n.a.	N=26
	<i>Total</i>	-25.7	n.a.	N=234
EXPANSION	<= 2	24.4	22.0	N=123
	>2 to 3	23.5	21.3	N=105
	>3 to 4	15.1	2.0	N=37
	More than 4	26.5	15.6	N=19
	<i>Total</i>	24.7	17.3	N=284
LATE	<= 2	6.0	14.1	N=43
	>2 to 3	31.0	35.0	N=32
	>3 to 4	-11.4	175.1	N=3
	More than 4	-246.0	-136.3	N=3
	<i>Total</i>	9.5	23.5	N=81

Mean: Cumulative average growth of the aggregated EBITDA of the group from year '0' to year '3'.

Median: Median of the EBITDA growth of individual firms in each group from year '0' to year '3'.

Table 5
Growth of employment (CAGR) and stage of the firm

Panel A: VCs' age

VC-backed Firm Stage	VCs' age at year '0'	EMPLOYMENT		Valid Data
		Mean (%)	Median (%)	No. Firms Yr3
EARLY	0 to 5 years	40.4	20.9	N=100
	+5 to 10 years	16.7	26.0	N=92
	+10 to 15 years	47.1	68.1	N=79
	More than 15 years	-1.6	34.3	N=51
	<i>Total</i>	23.0	35.7	N=322
EXPANSION	0 to 5 years	2.5	-1.1	N=85
	+5 to 10 years	24.7	11.8	N=108
	+10 to 15 years	24.7	9.2	N=90
	More than 15 years	31.5	13.0	N=66
	<i>Total</i>	21.0	7.9	N=349
LATE	0 to 5 years	4.5	19.3	N=26
	+5 to 10 years	-2.0	4.9	N=46
	+10 to 15 years	20.8	11.4	N=18
	More than 15 years	37.7	34.7	N=5
	<i>Total</i>	3.3	10.8	N=95

Panel B: Number of portfolio firms per investment manager

VC-backed Firm Stage	Firms per investment manager Time '0'	EMPLOYMENT		Valid Data
		Mean (%)	Median (%)	No. Firms Yr3
EARLY	<= 2	26.2	31.7	N=125
	>2 to 3	18.9	42.1	N=117
	>3 to 4	24.8	11.0	N=38
	More than 4	14.3	40.9	N=37
	<i>Total</i>	22.4	35.7	N=317
EXPANSION	<= 2	17.0	5.5	N=146
	>2 to 3	23.6	5.5	N=126
	>3 to 4	7.6	6.3	N=53
	More than 4	55.6	19.5	N=21
	<i>Total</i>	21.2	8.0	N=346
LATE	<= 2	7.9	9.2	N=50
	>2 to 3	-0.3	13.2	N=37
	>3 to 4	-5.3	-6.8	N=4
	More than 4	-12.5	-12.9	N=3
	<i>Total</i>	3.5	10.0	N=94

Mean: Cumulative average growth of the aggregated employment of the group from year '0' to year '3'.

Median: Median of the employment growth of individual firms in each group from year '0' to year '3'.

Table 6
Growth of intangible assets (CAGR) and stage of the firm

Panel A: VCs' age				
VC-backed Firm Stage	VCs' age at year '0'	INTANGIBLE ASSETS		Valid Data
		Mean (%)	Median (%)	No. Firms Yr3
EARLY	0 to 5 years	95.2	N/M	N=73
	+5 to 10 years	36.0	67.8	N=70
	+10 to 15 years	81.3	59.2	N=60
	More than 15 years	99.6	87.6	N=40
	<i>Total</i>	76.6	98.1	N=243
EXPANSION	0 to 5 years	4.7	-0.7	N=69
	+5 to 10 years	44.5	47.4	N=95
	+10 to 15 years	53.2	48.1	N=75
	More than 15 years	27.2	18.9	N=51
	<i>Total</i>	35.1	28.6	N=290
LATE	0 to 5 years	119.1	65.6	N=23
	+5 to 10 years	24.7	64.0	N=43
	+10 to 15 years	15.3	84.3	N=15
	More than 15 years	-3.5	6.4	N=2
	<i>Total</i>	34.6	69.1	N=83

Panel B: Number of portfolio firms per investment manager

VC-backed Firm Stage	Firms per investment manager Time '0'	CAGR (%)	CAGR (%)	Valid Data No. Firms Yr3
EARLY	<= 2	102.3	127.6	N=98
	>2 to 3	84.7	97.1	N=87
	>3 to 4	35.6	114.0	N=26
	More than 4	28.8	88.9	N=27
	<i>Total</i>	77.3	94.7	N=238
EXPANSION	<= 2	33.9	36.4	N=126
	>2 to 3	31.9	12.5	N=105
	>3 to 4	24.3	31.6	N=37
	More than 4	72.6	58.9	N=19
	<i>Total</i>	35.1	26.3	N=287
LATE	<= 2	29.1	62.3	N=44
	>2 to 3	53.0	52.9	N=32
	>3 to 4	99.8	125.8	N=3
	More than 4	79.0	66.8	N=3
	<i>Total</i>	35.3	69.8	N=82

Mean: Cumulative average growth of the aggregated intangible assets of the group from year '0' to year '3'.

Median: Median of the intangible assets growth of individual firms in each group from year '0' to year '3'.

After analyzing the growth rates for the different characteristics and controlling for the VC-backed firm size, stage and industry, we performed a non-parametric test for equality of means within groups. We used the Kruskal-Wallis test, rejecting the null hypothesis of equality of means in the case of portfolio companies in the expansion stage for the characteristic of age of VCs, and for the late stage companies for age of VCs and growth in employment and with number of investment professionals and growth in both employment and intangible assets.

Portfolio companies in the early stage group do not seem to be affected by the characteristics of the VCs. All of them, as a group, present the best financial performance results when compared with non-VC-backed companies (Alemany and Marti, 2005). The presence of VCs as well as the amount of money invested have a positive and significant effect on this performance. Therefore, for early stage companies it is not so important what the VCs are like but the fact of having a professional investor in the capital of the company. This might indicate that it is 'easier' to add value to early stage companies, because anything that the VCs can do to help them has a big impact.

4. Results

Panel A in Tables 7 and 8 shows the regression results on the four endogenous variables for the whole sample. Before commenting on the coefficients of the variables related to the main issue of the paper, it is important to highlight that there is evidence of the positive, significant effect of lagged cumulative investment committed in sales, EBITDA and employment growth. These results reinforce the previous findings on the positive impact that VC exerts on portfolio firms.

Regarding the three main explanatory variables, namely the size of funds of the VC organization, the age of the VC organization, and the ratio of portfolio companies per investment manager, the results are not so conclusive when the models are tested on the whole sample of investee firms. Except for the variable representing employment growth, there seems to be little evidence of the significant effect exerted by the proposed variables related to performance. In the case of sales growth, just the age of the VCs is significant, along with both control variables, whereas EBITDA and intangible assets growth are not related to any of the three main explanatory variables. Nevertheless, the model that seeks to explain employment growth finds that both the size and the age of the VC organization are positive and significant, while the ratio of portfolio companies per investment manager is negative and significant, as expected. Therefore, hypotheses 1, 2 and 3 are only accepted when performance is measured through employment growth.

Tables 1 and 2 show the high dispersion of investments and revenues of VC-backed firms. This is usual in Continental Europe since the scope of investments ranges from very small seed ventures to very large leveraged acquisitions. Therefore, in Panels B to D of Tables 7 and 8 we show the regression results for three subsets related to early, expansion and late stage investments.

Panel B is related to the sub-sample of firms that were starting up when the first VC round was granted. The results show that only the control variables are significant whereas none of the three variables related to value added are significant. More precisely, both control variables are significant in the models that represent sales and EBITDA growth but only growth in total assets is significant in the model related to employment growth. The model representing growth in intangible assets, which

provides evidence of the impact of lagged investments, shows an unexpected positive and significant value of the ratio of portfolio companies per investment manager. These results provide evidence of the impact of funding alone on the performance of the VC-backed firms, whereas the proxies of value added do not seem to significantly affect the performance of those firms. This raises new questions to be addressed in future research. Is it just money that matters? A positive answer would be contrary to the findings of Hsu (2004) on US start-ups. But it could lead to a second question. Do European VCs have the technological knowledge to add value to the most innovative start-ups?

Panel C is related to the regression results of the subset of existing companies that were funded to contribute to their expansion plans. Contrary to the findings on the group of early stage companies, the coefficient related to the age of the VCs is positive and significant in the models that explain sales, EBITDA and employment growth, whereas the ratio portfolio companies per investment manager is negative and significant, as expected, in the models representing EBITDA, employment and intangible assets growth. As a result, hypotheses 1 and 3 are not rejected on investee companies at the expansion stage, providing evidence of the significant effect of some VCs' characteristics on their portfolio company's performance.

Regarding the subset of late stage companies acquired by VCs, sales, EBITDA and intangible assets growth are not related to any of the proposed variables, except the cumulative VC investment in the last model. Turning to employment growth, there is weak evidence of the positive effect of the size of the VCs' funds and of the negative effect of a high ratio of portfolio firms per investment manager. What is unexpected is the negative sign of the control variable related to the cumulative VC investment. Nevertheless, it should be noted that in late stage investments, the funds committed by the VCs are usually devoted to buying existing shares rather than new shares that increase the equity capital of the investee firm. Therefore, in most cases, no fresh money to finance further growth is provided.

Other characteristics tested in the regression model, namely origin of funds (private vs. Government-related funds) and strategy of the VCs (specialized vs. generalist), do not seem to have a significant effect on the performance of the VC-backed firms. These results apply to both the whole sample and the stage sub-samples.

To sum up, excluding late stage companies, it seems that the performance of VC-backed startups is more closely related to the availability of new funds arriving at the company than to the value added by VCs. Turning to VC-backed companies at the growth stage, we find a significant effect of the value added by VCs on their growth patterns up to year three after the investment.

Table 7
Effect of VCs' characteristics on sales and EBITDA growth of VC-backed firms

Panel A: Complete sample of VC-backed companies				
<i>Independent Variables</i>	<i>Dependent variable:</i> SALES GROWTH		<i>Dependent variable:</i> EBITDA GROWTH	
	Coefficient	Std. Error	Coefficient	Std. Error
Size VCs (1)	1141732	1676948	97602.96	206118.8
Age VCs (2)	152027.6 ***	54864.31	4187.681	6611.129
Portfolio companies per inv. manager (3)	-494078.7	355133.6	-76714.27	47020.9
Growth in total assets L1 (4)	0.238 ***	0.022	0.003	0.003
Cumulative VC investment L1 (5)	0.423 ***	0.115	0.093 ***	0.015
Constant	1723407	1801544	357221.2	233482.8
<i>Companies</i>	633		643	
<i>Observations</i>	1947		2004	
Panel B: Sub-sample of early stage companies				
Size VCs (1)	-364026.9	766033	487846.8	440369.3
Age VCs (2)	-29624.6	57468.4	-50745	33921.56
Portfolio companies per inv. manager (3)	-56776.07	136079.7	-44468.03	77926.06
Growth in total assets L1 (4)	0.115 ***	0.007	-0.032 ***	0.004
Cumulative VC investment L1 (5)	0.272 ***	0.101	0.664 ***	0.059
Constant	1318827 *	695698.7	-49972.65	398718.4
<i>Companies</i>	233		240	
<i>Observations</i>	581		627	
Panel C: Sub-sample of growth stage companies				
Size VCs (1)	3361153	3032761	143494.9	217353.7
Age VCs (2)	234734.9 **	96582.95	16105.48 **	6749.804
Portfolio companies per inv. manager (3)	-1030387	656329.9	-154409.5 ***	53538.32
Growth in total assets L1 (4)	0.685 ***	0.061	0.073 ***	0.006
Cumulative VC investment L1 (5)	0.169	0.181	0.016	0.015
Constant	2011219	3431755	480741.8 *	269069.8
<i>Companies</i>	311		314	
<i>Observations</i>	1051		1062	
Panel D: Sub-sample of late stage companies				
Size VCs (1)	-1397467	2159671	122977.4	625836.2
Age VCs (2)	-6.447.244	62084.42	6722.927	17991.02
Portfolio companies per inv. manager (3)	67026	568681.8	55687.57	164794.4
Growth in total assets L1 (4)	.2525349	.0680729	0.028	0.020
Cumulative VC investment L1 (5)	.3496267	.1428758	0.059	0.041
Constant	91191.9	2557128	-613263.6	741012.7
<i>Companies</i>	89		89	
<i>Observations</i>	315		315	

GLS random effects' regression of the model $y_{it} = x_{it}'\beta + \varepsilon_{it}$; $\varepsilon_{it} = \eta_i + v_{it}$, with i denoting company and t denoting year. The dependent variables are *sales growth* (in constant currency absolute terms) and *EBITDA growth*. The independent variables are: (1) Dummy variable that equals 1 if the VC fund has over €60 million under management, or 0 otherwise. (2) Age of the VC fund at the time of the investment. (3) Number of portfolio companies per investment manager in year 't'. (4) Growth in company's total assets from 't-2' to 't-1' (in constant currency absolute terms). (5) Cumulative VC investments in the portfolio company until 't-1' in constant currency (base 2001).

***= significant at 1%, ** = significant at 5%, * = significant at 10%.

Table 8
Effect of VCs' characteristics on employment and intangible asset growth of VC-backed firms

Panel A: Complete sample of VC-backed companies				
Independent Variables	Dependent variable: EMPLOYMENT GROWTH		Dependent variable: INTANG. ASSET GROWTH	
	Coefficient	Std. Error	Coefficient	Std. Error
Size VCs (1)	35.409 *	18.939	39431.42	161098.3
Age VCs (2)	2.675 ***	0.602	-5529.088	5175.607
Portfolio companies per inv. manager (3)	-10.442 **	4.286	-29796.67	36029.03
Growth in total assets L1 (4)	9.95e-07 ***	3.13e-07		
Cumulative VC investment L1 (5)	1.41e-06	1.42e-06	0.149 ***	0.012
Constant	29.232	21.258	286658.3	175005.1
<i>Companies</i>	693		721	
<i>Observations</i>	2180		2529	
Panel B: Sub-sample of early stage companies				
Size VCs (1)	-14.241	10.486	35690.2	253251.9
Age VCs (2)	0.292	0.865	-13984.53	20639.89
Portfolio companies per inv. manager (3)	0.893	1.396	89588.25 **	40170.57
Growth in total assets L1 (4)	7.45e-07 ***	6.06e-08		
Cumulative VC investment L1 (5)	-8.05e-07	1.14e-06	0.103 ***	.0278954
Constant	0.453	7.564	-180398.4	203281.2
<i>Companies</i>	270		290	
<i>Observations</i>	709		907	
Panel C: Sub-sample of growth stage companies				
Size VCs (1)	52.270	34.742	-74154.97	176102.9
Age VCs (2)	4.049 ***	1.087	7627.572	5529.445
Portfolio companies per inv. manager (3)	-20.425 **	8.276	-115205.3 ***	43423.81
Growth in total assets L1 (4)	1.33e-06	8.94e-07		
Cumulative VC investment L1 (5)	1.94e-06	2.37e-06	0.084 ***	0.012
Constant	52.225	42.027	586585.1 ***	212219.4
<i>Companies</i>	332		340	
<i>Observations</i>	1138		1255	
Panel D: Sub-sample of late stage companies				
Size VCs (1)	49.183 *	29.521	-110260.5	731610.5
Age VCs (2)	0.007	0.791	-12129.38	19208.55
Portfolio companies per inv. manager (3)	-14.218 *	7.849	-94321.42	192026.4
Growth in total assets L1 (4)	3.86e-06 ***	9.45e-07		
Cumulative VC investment L1 (5)	-4.65e-06 **	1.90e-06	0.303 ***	0.047
Constant	50.923	35.241	219071.7	866534.7
<i>Companies</i>	91		91	
<i>Observations</i>	333		367	

GLS random effects' regression of the model $y_{it} = x_{it}'\beta + \varepsilon_{it}$; $\varepsilon_{it} = \eta_i + v_{it}$, with i denoting company and t denoting year. The dependent variables are *employment growth* (in constant currency absolute terms) and *intangible assets growth*. The independent variables are: (1) Dummy variable that equals 1 if the VC fund has over €60 million under management, or 0 otherwise. For the analysis of the dependent variable, intangible assets growth, this independent variable has been excluded due to the high correlation between the two variables. (2) Age of the VC fund at the time of the investment. (3) Number of portfolio companies per investment manager in year 't'. (4) Growth in company's total assets from 't-2' to 't-1' (in constant currency absolute terms). (5) Cumulative VC investments in the portfolio company until 't-1' in constant currency (base 2001).

***= significant at 1%, ** = significant at 5%, * = significant at 10%.

5. Conclusion and discussion of results

Academics and politicians agree on the important role VC plays in fostering economic growth. It is now widely accepted that funding plus value added by investors helps VC-backed companies outperform their non-VC-backed equivalents. Nevertheless, the lack of representative data has delayed the availability of papers providing relevant evidence on the positive impact exerted by VCs on investee firms. However, there are papers that address the answers to questions such as 'how' value is added, 'who' adds value, 'how much' value is added and, finally, 'why' VCs are interested in adding value to portfolio companies.

Our contribution to the literature can be presented from different perspectives. Regarding data, we rely on objective, numerical data rather than hand-collected qualitative data. The sample includes nearly 87% of VC investments in Spain, which ranks third in the Continental Europe VC market. The catalogue of investments is completed with accounting data of investee firms and information on the VCs' characteristics. As regards methodology, since we rely on panel data, we are able to measure performance through the evolution of growth patterns over time. Additionally, our empirical model controls for the impact of the VC investment committed, allowing us to better measure the non-financial value added by VCs.

The results obtained for the whole dataset show a significant effect on employment growth of characteristics such as the VCs' amount of funds under management, the VCs experience and the ratio of portfolio companies per investment manager. Nevertheless, only VC age is significant with regard to the sales growth. Our findings also indicate that growth of sales, EBITDA and intangible assets are significantly related to the cumulative VC investment committed.

Nevertheless, because of the heterogeneity of the sample, which includes a range going from seed to late stage companies, these results are not conclusive. The results on the subset of early stage companies are somewhat striking, since value added-related variables are not significant even though the cumulative VC investment committed is significant. Regarding investments in growth companies, VC age is positive and significant and the ratio of portfolio companies per investment manager is negative and significant, as expected, while cumulative investment is not significant. In late stage portfolio companies there is no evidence of a significant effect of VCs' characteristics on the investee's performance, except on employment growth.

The main limitation of our findings is the nature of the characteristics analyzed. Our paper relies on quantitative, easily measurable characteristics. More research is required to increase the number and scope of the VCs' characteristics, such as education or previous work experience of investment managers, participation in the Board or time actually devoted to the portfolio company. Additionally, future research should aim to explain why the value added in early stage companies does not significantly affect the investee's performance over time. Is there a lack of technological

knowledge? Are there any other measurable characteristics that could affect firms' growth?

Several implications can be drawn from our findings. First, at least from the perspective of sales and employment growth, VCs add value to portfolio companies once we control for the effect of the VC funding. Second, value added changes with the stage of development of the investee firm. Money is more important than value added for early stage companies. Some research questions arise from this finding. Among them, we would highlight the question as to whether VCs in Europe are able to add value to new ventures. Turning to companies at the growth stage, the previous experience of VCs and the availability of time of their managers exert a more significant impact on the performance of investee firms than the funding provided.

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