serie ec
WP-EC 2012-02

Certification effect and capital structure determinants in venture-backed companies

Marina Balboa, José Martí-Pellón and Alvaro Tresierra-Tanaka

Ivie

Versión: febrero 2012 / Version: February 2012

Edita / Published by:
Instituto Valenciano de Investigaciones Económicas, S.A.
C/ Guardia Civil, 22 esc. 2 1º - 46020 Valencia (Spain)

WP-EC 2012-02

Certification effect and capital structure determinants in venture-backed companies*

Marina Balboa, José Martí-Pellón and Álvaro Tresierra-Tanaka**

Abstract

This paper analyzes changes in capital structure behavior in a sample of Spanish venture capital (VC) backed companies that may occur after a VC investment due to the certification effect provided by VC investors. Our results show significant changes in determinants such as tangibility, size and profitability. Regarding tangibility and size, the entry of an external investor eases the need to have neither tangible assets nor a large size to obtain additional debt financing. About the effect of profitability, the investments made after the initial VC investment do affect short-term profitability, but this situation is not linked to the restricted access to external debt. We find that VC investors contribute to unlisted growing companies by attracting other long-term sources of funds to continue their growth process.

Keywords: capital structure determinants, venture capital, trade-off theory, value added.

JEL classification: G32, G24.

Resumen

Este artículo analiza los cambios que pueden ocurrir en la estructura de capital de empresas que reciben capital riesgo una vez que han recibido dicha financiación, y que podrían deberse al efecto certificación que proporcionan los inversores de capital riesgo. Los resultados muestran cambios significativos en algunas de las variables determinantes de la estructura de capital, como los activos tangibles, el tamaño de la empresa, y su rentabilidad. En cuanto a las dos primeras variables, la entrada del inversor de capital riesgo relaja la necesidad tanto de poseer un volumen de activos tangibles elevado, como la de tener un tamaño empresarial grande para obtener financiación adicional a través de deuda. En cuanto a la rentabilidad, y aunque las inversiones que se realizan una vez que se ha recibido la financiación de capital riesgo tienen un efecto sobre la rentabilidad empresarial a corto plazo, no se encuentra que ello impida el acceso a financiación adicional a través de deuda. El trabajo muestra que los inversores de capital riesgo contribuyen a que las empresas no cotizadas consigan financiación de otras fuentes a largo plazo que les permita continuar con su proceso de crecimiento.

Palabras clave: capital riesgo, estructura de capital, teoría del *trade-off*, valor añadido.

Clasificación JEL: G32, G24.

* We acknowledge the financial support from the Spanish Ministry of Education under research grant ECO2008-02599/ECON and from the *Generalitat Valenciana* under project GVPRE/2008/316.

** M. Balboa: Department of Financial Economics, Faculty of Economics, University of Alicante, 03690 San Vicente del Raspeig (Alicante, Spain). Corresponding author: marina.balboa@ua.es. J. Martí-Pellón: Department of Financial, Economics and Accounting III, University Complutense of Madrid, Faculty of Economics; Alvaro Tresierra-Tanaka, Faculty of Economics, University of Piura.

1. *Introduction*

There is a vast body of literature that analyzes the role that venture capitalists (hereinafter, VCs) play in their investee firms. The impact that venture capital (hereinafter, VC) has on job creation, professionalization of the firm, performance, efficiency improvement and innovation, among others, has been thoroughly studied (Kortum and Lerner, 2000; Hellmann and Puri, 2002; Davila, Foster and Gupta, 2003; Baum and Silverman, 2004; Alemany and Martí, 2005; Engel and Keilbach, 2006, Croce, Marti and Murtinu, 2010; among others.). However, there are few studies related to the capital structure of VC-backed companies and, more specifically, to the effect that VC has on subsequent financing of the firms the VCs back. Once the firm approaches, and attracts, a VC investor, a substantial change occurs in the capital structure of the investee company. At the time of the investment event, a significant amount of equity, or quasi-equity, is added. If a staging strategy (Sahlman, 1990) is applied, then more equity is added in subsequent years. However, the impact of VC is not restricted to obtaining follow-on equity financing from the same or from other VC investors, but it also includes additional debt financing (Baeyens and Manigart, 2006).

One of the main factors that drive this effect on subsequent financing is the value-adding services that VC investors provide for their investee companies. Among these services, contacts with investment bankers should be highlighted (Sahlman, 1990; Tykvová, 2007). These contacts, along with the increased equity base and the reputational effect of having a financial partner (Megginson and Weiss, 1991) such as a VC firm, allow the investee firm to access further debt financing. Therefore, after the entry of a VC investor, substantial changes in the capital structure of the portfolio companies are expected to occur.

However, as far as we are aware, the literature has not analyzed yet the effect on the capital structure of firms after the entry of a VC investor. In order to fill this gap, the aim of this paper is to provide evidence on the determinants of the debt ratio after the initial VC investment, and also to compare these determinants with those found before the VC entry.

Moreover, we aim to analyze whether any of these changes help explain the effect that VC could have on further financing. With this in mind, we focus on the investee firm characteristics, which represent the demand side of the VC market, whereas most of the existing literature focuses on supply side approaches (Baeyens and Manigart, 2006).

The analysis is carried out on a large sample of Spanish VC-backed companies that received an initial VC investment between 1995 and 2004, keeping track of their accounting data until 2007, whenever possible. By focusing on the Spanish market, we are able to check the effect on capital structure determinants of an external equity injection into firms located in a representative European bank-oriented market. Furthermore, we agree with De Clercq, Sapienza and Zaheer (2008) that limiting the scope of the analysis to one country increases the likelihood that the participants operate under similar constraints derived from the institutional and legal environment. The sample is composed of companies in an expansion stage, including both successful and failed firms, and it is thus not affected by a survival bias.

The results show that debt is less dependent on tangibility after receiving the VC investment. Regarding size, the impact on the debt ratio after the investment is less clear, showing either a similar or a weaker relationship between these two variables. The effects of volatility, growth opportunities and effective taxes paid are similar in the pre and post-investment periods, with the latter two variables showing a positive and significant effect on the debt ratio. Finally, profitability shows a stronger negative impact after the VC event.

A main contribution of this paper is the evidence provided on the capital structure determinants after an equity financing shock occurs in a company, which has received little attention in the literature. This paper also contributes to increasing the VC literature from a demand side perspective, which is often neglected. Also, the evidence presented is free of any survival bias, since both successful and failed companies are included in the sample.

The rest of the paper is organized as follows. Section two provides an overview on the theory concerning the pre and post-investment activities of VCs and their possible effect on debt financing. Section three describes the data and the methodology employed. The results of the regressions are presented in Section four. Finally, Section five concludes and discusses the results.

2. *Venture Capitalists and their Effects on Debt Financing*

2.1 Venture Capitalists: Pre and Post-investment Activities

Firms with significant growth opportunities and/or high research and development expenditures may face severe information asymmetry problems (Gompers, 1995), which may lead to agency problems such as adverse selection and moral hazard. This may generate a substantial difference between the costs of internal and external funds (Carpenter and Petersen, 2002), which limits the possibility of obtaining external financing.

Even if debt is available, banks typically require assets to be placed as collateral[1] and may include covenants in debt contracts to reduce information asymmetry problems (Berger and Udell, 1998). In addition, banks are cash flow lenders, since they are interested in lending money to firms that can honor the debt payments (Carey, Post and Sharpe, 1998). Even more problematic is the access to external equity, given that the potential investors will demand a high premium to compensate for the possible adverse selection problems (Akerlof, 1970). In the case of unquoted companies, the illiquid nature of the shares acquired is also a reason for concern. To sum up, unquoted companies without assets to be pledged as collateral, as well as a traceable track record, have difficulties in attracting external funding. In this context, unquoted companies with valuable growth opportunities are limited to making their

[1] There is a vast body of literature that shows the key role that collateral plays in the contract between borrowers and lenders (see Chan and Thakor, 1987; Titman and Wessels, 1988; Frank and Goyal, 2009; among others).

investments mainly on the basis of internally generated funds (Bertoni, Ferrer and Marti, 2012).

To mitigate this problem, VCs appear as specialized financial intermediaries that are more apt to dealing with information asymmetry problems, thus allowing growing companies to receive funds that cannot be obtained from other sources. As Fried and Hisrich (1994) point out, VC represents the only source of external funds for some companies. VCs are considered specialized, well-informed investors that operate in environments where their relative efficiency in selecting and monitoring investments gives them a comparative advantage over other traditional investors (Amit, Brander and Zott, 1998; Ueda, 2004). The information processing capacities that VCs possess help them to reduce information asymmetries and, therefore, adverse selection and moral hazard problems. But VCs do not limit their activity to providing funds, since they perform a variety of pre and post-investment activities.

Regarding the pre-investment activities, it should be noted that VCs carry out an intensive screening, thorough scrutiny and valuation process of the company before providing capital. They assess factors such as management team competence, product and market/industry characteristics and financial aspects of the investment opportunity (Tyebjee and Bruno, 1984; Fried and Hisrich, 1994; Muzyka, Birley and Leleux, 1996; Shepherd, Ettenson and Crouch, 2000; Zacharakis and Meyer, 2000; among others).

According to Wright and Robbie (1996), VCs use a wide range of financial and non-financial information, including unpublished accounting and/or subjective information, in order to assess the feasibility of a specific investment. In a European study, Manigart, Wright, Robbie, Desbrières, and De Waele (1997) find evidence on the information sources used by VCs in their evaluation process, which include their own due diligence reports, the coherence of the business plan and the financial reports (historic and projected).

Another tool that VCs could use to reduce the uncertainty of the new investments is syndication[2] (Bygrave, 1988; Lerner, 1995; Hopp and Rieder, 2010), whereby the VC firm that originates the deal invites other VCs to take part in the investment. Beyond the interest in dividing up the funding needed for the investment and the related risk, which is spread among different players, the VC firm presenting the project aims to get a 'second opinion' from other VC investors (Lerner, 1994). Syndication may improve the selection process because more than one independent VCs would be screening the project (Brander, Amit and Antweiler, 2002). In the same vein, Casamatta and Haritchabalet (2007) argue that syndication helps to gather information, thus improving the selection process. Overall, all these pre-investment activities allow VCs to better address the problems of adverse selection.

Regarding the post-investment activities, once the initial investment is carried out VCs are deeply committed to adding value to their portfolio companies. Gorman and Sahlman (1989) find that, on average, the lead investor visits each company 19 times per year and spends 100 hours in direct contact. VCs play an active role through a variety of activities. Among others, Sahlman (1990) and Hellmann and Puri, 2000) include providing value-adding services such as strategic and tactical advice, recruitment of senior management, work with suppliers and customers, help in obtaining new funds. In some situations they are even willing to take over day-to-day operations (Sahlman, 1990). These value-adding services have been recognized as key factors in promoting the economic development of investee firms (Bygrave and Timmons, 1992). Syndication can help to further increase the value added to investee companies, since syndicate members are able to share their specific knowledge, complementary skills and information (Brander, Amit and Antweiler, 2002).

[2] Of course, there are other reasons for syndication. Manigart, Lockett, Meuleman, Wright, Landström, Bruining, Desbrières, and Hommel (2006) classify the motives in four groups: financial aspects, access to deal flow, deal selection and value-adding services. They consider that the first two improve management of the overall portfolio, whereas the latter two improve management of the individual firm.

The advisory role played by VCs entails a frequent interaction with the firm's chief executive officer (CEO), which depends on several factors, such as the incongruousness of potential goals, CEO experience and task uncertainty, among others (Sapienza and Gupta, 1994). Furthermore, VC managers will have at least one seat on the company's board of directors (Gompers and Lerner, 2001), with their involvement being more intensive when the need for oversight and monitoring is greater (Lerner, 1995). VCs also help to formulate human resources policies, establish stock option plans and hire key executives, thus playing an important role in the professionalization of the investee firm (Gorman and Sahlman, 1989; Hellmann and Puri, 2002). The close monitoring of the company after the initial round allows VCs to address moral hazard problems (Lerner, 1995) and helps them to respond quickly to warning signals, thus preventing serious troubles from 'infecting' the firm (Hassan and Leece, 2008).

Therefore, in both pre and post-investment activities VCs play an important role on the performance of companies, which is based both on the effect of several VC factors and their managerial strategy (Jain, 2001) as well as on their role as information producers (Chan, 1983; Sahlman, 1990). Given that VCs are perceived as 'informed investors' who are capable of identifying firms with good prospects, their involvement provides a certification effect that may enable the firm to obtain further funds from other sources (Megginson and Weiss, 1991). In the same vein, Sahlman (1990) points out that VC-backed companies can often gain access to additional funds because they have access to the VCs´ contacts in the financial community. Baum and Silverman (2004) also state that VC investment should facilitate the investee firm's efforts to obtain other necessary resources.

2.2 Debt Financing Behavior after the Initial VC Investment

With regard to the funding of portfolio firms after the first capital infusion, issuing more equity would imply a dilution of the VC investor's stake and, therefore, a decreased

share in the potential gain if the project is successful. On the other hand, the increased equity base after the investment, the certification that VCs provide of the investee firm's prospects and the decrease in the level of information asymmetries facilitate the access to new debt. Therefore, VCs push companies to use debt financing when available, thus reducing the need to commit more capital. Delaying the next capital infusion gives VCs time to evaluate the firm's prospects and to decide whether or not they will fund the next equity round (Ibrahim, 2010).

Baeyens and Manigart (2003) find that, for unquoted companies after an initial VC investment, VC-backed companies rely more on long and short-term financial debt than non VC-backed companies. Along the same lines, Baeyens and Manigart (2006) analyze the financing strategies in a sample of unquoted start-ups, which are more affected by information asymmetry problems, bankruptcy risk and limited debt capacity, after receiving VC. Contrary to their expectations, they find that these firms rely more on debt than equity, which could be explained by the certification effect that VCs provide to their portfolio companies. Given the screening and monitoring activities carried out by VCs to reduce information asymmetries, other fund providers may benefit from the efforts of VCs at no cost.

Therefore, the capital structure of VC-backed companies may change after the initial VC round. This implies that some differences in the factors that affect debt financing may arise when the pre and post-investment stages are compared. The variables that have already proved to have an impact on the capital structure are tangible fixed assets, the size of the firm, profitability, volatility, growth opportunities and corporate taxes paid (among many others, Titman and Wessels, 1988; Harris and Raviv, 1991).

According to the theory of capital structure, agency problems and the probability of liquidation of the firm justify the need to use collateral to obtain debt and guarantee debt repayment (Berger and Udell, 1998). In this line, the level of tangible fixed assets should have

a positive relationship with the level of debt (Titman and Wessels, 1988; Hovakimian, Opler and Titman, 2001; Frank and Goyal, 2003; Flannery and Ragan, 2006; among others). The entry of a VC investor could reduce the need for collateral, since the high involvement of VCs after the investment reduces the information asymmetries and mitigates the potential agency problems (Chan, 1983; Amit, Brander and Zott, 1998). In addition to the close monitoring, the value-adding services and the capital infusion provided by the VC investor reduce the risk of insolvency (Ibrahim, 2010), which implies that the potential liquidation of the company is less probable. Finally, the certification effect of VCs and their contacts in the financial community help investee companies in obtaining debt in more favorable terms (Sahlman, 1990; Baum and Silverman, 2004). Our first hypothesis originates from these ideas:

Hypothesis 1: After the initial VC investment, the level of collateral required to obtain debt is not as important as in the pre-investment period.

Size is another firm characteristic related to the debt level. There is a vast body of literature that shows a positive relationship between both variables (Titman and Wessels, 1988; Hovakimian, Opler and Titman, 2001; Frank and Goyal, 2003; among others), since large firms are expected to be better diversified. Regarding the change in that relationship after the VC investment, it should be noted that a significant part of the increase in size will be initially funded with equity or quasi-equity instruments. Then, after the initial VC investment, the relationship between size and debt could be affected by the weight of the equity committed to the investee company, thus reducing the dependency of size on changes in debt levels immediately after the VC investment. However, the augmented equity base and the certification effect provided by VCs will also allow the firm to increase its debt exposure. With this in mind, we hypothesize the following:

Hypothesis 2: The relationship between debt and size is unclear after the initial VC investment, with the most likely outcome being a reduction in the positive relationship in the short term.

Regarding profitability, there is evidence of a negative relationship between this variable and the debt ratio in small and medium-sized, unquoted companies (Sogorb-Mira, 2005; Heyman, Deloof and Ooghe, 2008), since the most profitable firms prefer to finance investments internally. In the case of VC-backed companies, pre-tax relative earnings are expected to decrease immediately after the initial VC round due to the investments made to take advantage of the firm's growth opportunities, which lead to an increase in fixed costs and depreciation. But the investee company may be in need of obtaining external funds to continue with the growth process. In this line, the certification effect provided by VCs may help the investee company to increase its debt exposure after the initial VC financing event. This leads to the following hypothesis:

Hypothesis 3: The relationship between debt and profitability is expected to become even more negative than before after the initial VC round.

According to the finance literature, the relationship between earnings volatility and debt is expected to be negative (Titman and Wessels, 1988; Harris and Raviv, 1991; Michaelas, Chittenden and Poutziouris, 1999; among others), since a high dispersion of earnings would endanger debt payments at some future date. Nevertheless, higher volatility is expected in VC-backed companies after the initial VC investment. As explained previously, a relative decrease in earnings is anticipated shortly after the investment takes place, but then faster growth in earnings is expected to occur (Manigart and van Hyfte, 1999; Alemany and Martí, 2005; Engel and Keilbach, 2007; among others) once the investee firm absorbs the investment shock. Therefore, volatility is expected to increase as earnings grow. As a consequence, the traditional negative relationship could become positive after the VC

investment event due to the fact that VC-backed firms are able to obtain funding from other sources (e.g. banks) after the VC investment event. This brings about the following hypothesis:

Hypothesis 4: After the initial VC investment the relationship between earnings volatility and debt remains unclear.

One of the characteristics of firms that aim to obtain VC backing is the existence of sizable growth opportunities (Manigart, Baeyens and Verschueren, 2002; Kaplan and Strömberg, 2004; Bertoni, Ferrer and Martí, 2012). According to Michaelas, Chittenden and Poutziouris (1999), small independent unquoted companies with high growth opportunities should use more debt, since internally generated funds would be insufficient to finance their investments. Consequently, a positive relationship between both variables is expected. At the time of the initial VC investment, VC-backed companies experience a shift towards a greater share of equity (Sahlman, 1990). After that, however, the increased equity base (which reduces the probability of bankruptcy), as well as the certification effect that VC investors provide, will imply a renewed access to bank financing to take advantage of growth opportunities. In parallel with the additional funding received, the firm will also increase both tangible and intangible assets, with the latter being the proxy for future growth opportunities. Therefore, a positive relationship between debt and growth opportunities is also expected after the VC investment. Thus, we hypothesize the following:

Hypothesis 5: The positive relationship between debt and growth opportunities in growing unquoted companies is not expected to change after the initial VC round.

The literature has highlighted the direct and positive relationship between the effective corporate tax paid and debt (Graham, 1996; Michaelas, Chittenden and Poutziouris, 1999). Firms that pay higher taxes could benefit more from tax shields. Right after the VC entry,

however, the effective taxes paid would decrease due to the higher fixed costs and larger depreciation, whereas the debt ratio would also decrease due to the equity added by the VC firm. Nevertheless, after the investment shock is absorbed, VC managers will usually make the firm's earnings grow faster (Baum and Silverman, 2004; Alemany and Marti, 2005), which would lead to a significant increase in the corporate taxes paid. At the same time, the use of debt would be encouraged in order to take advantage of tax shields and to avoid a further dilution of the VCs if more external equity is raised. The increase in the amount of debt will be possible thanks to the increased equity base (i.e. the initial VC investment) and the subsequent certification effect provided by VCs. Our sixth hypothesis follows naturally from this discussion:

Hypothesis 6: The relationship between effective corporate tax paid and debt is expected to be positive and stronger after the initial VC investment.

3. *Data and Methodology*

3.1 Data and Sample Selection

The data are based on Spanish VC-backed firms that were in an expansion stage at the time of the initial VC investment. The time period analyzed includes VC investments made from 1995 to 2004, keeping track of their accounting data from at least three years before to at least three years after the investment event. Therefore, the time frame used in the analyses ranges from 1992 to 2007. According to Martí, Salas and Barthel (2010), 1,572 private equity investments were recorded over the period 1995-2004, including all stages from seed to buyout, but excluding investments in financial and real-estate sectors. We were able to find relevant accounting data for 1,313 of these firms, 458 of which were in an expansion stage at the time of the initial investment. We focus the analysis on firms at the expansion stage for three reasons. First, since the capital structure behavior is driven by very different factors depending on the stage of the company, including firms at early, expansion and late stages

would derive to conclusions that may not be valid for all companies. Second, since we need data before the VC investment event, firms at the early stages have to be excluded because there are not enough data available to analyze this period. Third, we do not include companies at late stages because we are interested in analyzing the behavior of the debt ratio in firms that are supposed to suffer from information asymmetry problems, as stated in the previous section.

In order to analyze the impact of the VC entry on the capital structure behavior, we need to have enough time series observations during the pre and post-investment periods. As already commented, we select firms for which we have at least three consecutive years of complete accounting data before and after the initial VC investment. Only 265 of the 458 VC-backed companies in the expansion stage fulfill these requirements, and these are the ones included in the sample. Table 1 shows that the number of firms is different each year because we have an unbalanced panel. It also shows the distribution of firms according to the economic sector to which that firm belongs. We distinguish between technology and non-technology sectors, where technology sectors include the following categories: information technologies, medical/health care/life science and research & development. As can be observed, most of the firms belong to non-technology sectors. Regarding the information about VC investments, the sources of data were the local Private Equity and Venture Capital Association (ASCRI) and www.webcapitalriesgo.com. The accounting data were obtained from the AMADEUS database.

Table 1

Distribution of sample by year and sector of activity

Year	Firms	Technology sector	Non-technology sector
1992	4	1	3
1993	43	2	41
1994	94	11	83
1995	131	14	117
1996	152	17	135
1997	189	18	171
1998	227	23	204
1999	232	24	208
2000	239	25	214
2001	247	26	221
2002	253	27	226
2003	248	27	221
2004	247	27	220
2005	237	26	211
2006	226	24	202
2007	145	17	128

3.2 Model and Methodology

In order to analyze the determinants of the debt ratio in VC-backed firms before and after they are subject to a VC investment, we rely on the following model, which is based on capital structure theories, as stated in the second section:

$$DEBT_{it} = \beta_0 + TANG_{it}(\beta_1 + \beta_2 t_{VC}) + SIZE_{it}(\beta_3 + \beta_4 t_{VC}) + PROF_{it}(\beta_5 + \beta_6 t_{VC}) + VOL_{it}(\beta_7 + \beta_8 t_{VC}) + GO_{it}(\beta_9 + \beta_{10} t_{VC}) + ETR_{it}(\beta_{11} + \beta_{12} t_{VC}) + \eta_i + \mu_{it} \quad (1)$$

where η_i are the specific unobservable individual effects for each firm, which do not vary over time; and μ_{it} is an error term. The definition of all the variables used in the estimation process and their predicted effect on the debt ratio, both before and after the VC entry, can be found in Table 2. The reason to consider two alternative measures for the variables Tang, Prof and Vol is to add robustness to the measurement of the variables that are more likely to change after the VC investment. The dummy variable t_{VC} takes on the value 1 from the investment event onwards, and zero otherwise. It is introduced as an interaction term to allow analyzing whether the VC entry affects the capital structure behavior of investee firms. That is, if the corresponding β_i is significantly different from zero, then the VC entry has a significant effect on the leverage ratio.

In addition to those factors, we also control for industry effects in two ways. First, we define a dummy variable that takes the value of 1 if the investee firm belongs to a high technology sector, and zero otherwise. Second, we include an industry variable representing the median leverage per year for each sector, as suggested by Lemmon, Roberts and Zender (2008) and Frank and Goyal (2009). Finally, time dummies are also included to control for possible time effects on the leverage ratio.

Table 2

Dependent and Explanatory Variables

Panel A. Description of Variables

Variable	Description	Authors
Debt	Ratio between long term debt and long term debt plus total equity.	Rajan and Zingales (1995); De Miguel and Pindado (2001).
Tang1	Ratio between tangible fixed assets and total assets.	Rajan and Zingales (1995); Hovakimian, Opler, and Titman (2001); Frank and Goyal (2003); Flannery and Rangan (2006).
Tang2	Ratio between tangible fixed assets plus inventories and total assets.	Titman and Wessels (1988); Sogorb-Mira (2005).
Size	Natural logarithm of total assets.	Titman and Wessels (1988); Hovakimian, Opler, and Titman (2001); Fama and French (2002); Flannery and Rangan (2006).
Prof1	Ratio between earnings before interest, taxes, depreciation and amortization (EBITDA) and total assets.	Titman and Wessels (1988); Hovakimian, Opler, and Titman (2001); Ozkan (2001).
Prof2	Ratio between earnings before interest and taxes (EBIT) and total assets.	Fama and French (2002); Frank and Goyal (2003); Sogorb-Mira (2005); Flannery and Rangan (2006).
Vol1	Moving standard deviation of the change in EBITDA, computing the current and the two previous years.	Balboa, Martí, and Tresierra (2009).
Vol2	Moving standard deviation of the change in EBIT, computing the current and the two previous years.	Balboa, Martí, and Tresierra (2009).
GO	Ratio between intangible assets and total assets.	Michaelas, Chittenden, and Poutziouris (1999).
ETR	Ratio between the effective corporate tax paid and the earnings before tax.	Ozkan (2000); Lopez-Gracia and Sogorb-Mira (2008).

Panel B. Predicted effect on the debt ratio

	Effect on debt ratio	
Firm characteristic	**Before the VC investment**	**After the VC investment**
Tangible assets	Positive	Positive, but smaller
Size	Positive	Unclear, but likely to be positive
Profitability	Positive / Negative	Negative, and stronger
Volatility	Negative	Unclear
Growth opportunities	Positive / Negative	Positive
Effective tax paid	Positive	Positive

Since the data refer to time series observations on a sample of firms, the panel data methodology is employed to estimate the models. In order to analyze the possible correlation between the exogenous variables and the individual effects, the Hausman test (Hausman, 1978) is used to check whether fixed or random effects are best suited to the estimation process.

In addition, and as a robustness check, we also estimate a simplified model, namely model (2), in which we split the sample into two parts, dividing the pre and post-investment observations in all VC-backed firms, and then run model (2) in both subsamples.

$$DEBT_{it} = \beta_0 + \beta_1 TANG_{it} + \beta_2 SIZE_{it} + \beta_3 PROF_{it} + \beta_4 VOL_{it} + \beta_5 GO_{it} + \beta_6 ETR_{it} + \eta_i + \mu_{it} \quad (2)$$

3.3 Descriptive Statistics

The leverage ratios before and after the initial VC investment event are presented in Table 3. It shows that VC-backed companies increase the mean and the median debt ratio after the initial VC round, but the ratio also exhibits more dispersion.[3] This finding is in line with the evidence found by Baeyens and Manigart (2006), who report that, after the VC investment, firms rely more on debt than equity.

With regard to the explanatory variables, some differences between the pre and post-investment periods are found. Table 4 shows that the second measure of tangibility (*Tang2*), which includes both fixed assets and inventories, is slightly greater before the VC entry, whereas no significant difference is found in the first measure of tangibility (*Tang1*). The

[3] A further comment should be made about the maximum and minimum leverage ratios, since values above one and below zero are found, respectively. They are related to negative equity values, due to cumulative losses that are found in some firms. Excluding these observations could lead to a bias in the results obtained. Michaelas, Chittenden and Poutziouris (1999) and Hall, Hutchinson and Michaelas (2000) argue that excluding bankrupt firms from their sample could censor it. Additionally, Baeyens and Manigart (2003) argue that including both surviving and non-surviving companies eliminates a positive survival bias and increases the validity of the results.

difference in *Tang2* could be explained by a tighter inventory management implemented after the VC investment, as well as the emergence of scale economies in inventory requirements as the firm grows. The size of the company after the investment is larger, which is an expected result given the infusion of funds and the corresponding increase in total assets.

Regarding profitability, the significant decrease in the first years after the VC investment is to be expected, since investee firms immediately hire more employees and invest in assets that are subject to depreciation (Alemany and Marti, 2005; Marti, Salas and Barthel, 2010). Conversely, revenues do not increase initially at the same rate. Along these lines, the variable *Prof*1, which is related to the EBITDA, does not decrease as much as *Prof*2 (EBIT), since the former variable does not include depreciation whereas the latter accounts for a larger depreciation. A second explanation for the decrease in both variables is based on the scaling process applied to all variables. The increase in the denominator, namely total assets, due to the additional investments made after the VC investment, does not immediately lead to an increase in EBITDA and EBIT. The increased spending after the initial VC investment also affects the effective taxes paid, which decrease significantly in the first years after the investment. Turning to volatility, no significant differences are found in the mean values, albeit with larger values after the VC investment. Regarding median values, there is a significant increase in EBIT dispersion after the initial VC investment. The investment activity carried out by the investee company after the initial VC funding leads to a significant increase in growth opportunities, which are proxied by intangible assets. Finally, and as already commented, the effective taxes paid are significantly lower after the initial VC investment.

Table 3

Descriptive Statistics of the Debt Ratio

Stage	Obs.	Mean	Median	Std. Dev.	Min	Max
Before VC investment	1,092	0.3074	0.2695	0.2692	-0.5106	2.2414
After VC investment	1,752	0.3638	0.3325	0.4475	-6.3690	5.8199
p –value		0.0000	0.0000			

Debt: Ratio between long term debt and long term debt plus total equity.

Table 4

Descriptive Statistics of the Explanatory Variables

Variable	Period	Obs.	Mean	Median	Std. Dev.	Min	Max
Tang1							
	Pre	1,092	0.2675*	0.2279	0.1894	0.0000	0.9673
	Post	1,752	0.2575	0.2316	0.1934	0.0000	0.8940
Tang2							
	Pre	1,092	0.4282***	0.4409***	0.2165	0.0000	0.9673
	Post	1,752	0.3982	0.3994	0.2233	0.0000	0.9084
Size							
	Pre	1,092	15.6494***	15.6226***	1.3430	11.7519	19.9404
	Post	1,752	16.4716	16.4466	1.2393	10.9682	20.4937
Prof1							
	Pre	1,092	0.1134***	0.1046***	0.1034	-0.8000	0.6863
	Post	1,752	0.0794	0.0786	0.1123	-0.8747	0.9199
Prof2							
	Pre	1,092	0.0670***	0.0608***	0.0978	-0.9536	0.6346
	Post	1,752	0.0284	0.0338	0.1262	-2.0451	0.8876
Vol1							
	Pre	1,092	1.4756	0.2641	8.8352	0.0003	176.5412
	Post	1,752	1.7141	0.2897	10.2095	0.0002	176.2310
Vol2							
	Pre	1,092	2.1787	0.4137***	13.1157	0.0001	271.7149
	Post	1,752	2.3021	0.5272	8.7462	0.0007	137.8687
GO							
	Pre	1,092	0.0631***	0.0258***	0.0886	0.0000	0.6243
	Post	1,752	0.0806	0.0338	0.1155	0.0000	0.8095
ETR							
	Pre	1,092	0.2318***	0.2615***	0.1985	0.0000	1.0000
	Post	1,752	0.2055	0.1935	0.2269	0.0000	1.0000

Tang1: Ratio between tangible fixed assets and total assets; Tang2: Ratio between tangible fixed assets plus inventories and total assets; Size: Natural logarithm of total assets; Prof1:Ratio between EBITDA and total assets; Prof2: Ratio between EBIT and total assets; Vol1: Moving standard deviation of the change in EBITDA, computing the current and the previous two years; Vol2: Moving standard deviation of the change in EBIT, computing the current and the two previous years; GO: Ratio between intangible assets and total assets; ETR: Ratio between the effective corporate tax paid and the earnings before tax.
Differences in means (t- test) and medians (chi-squared test statistic) are reported between pre and post investment stages.
Significance at levels ***1%, **5%, *10%.

Pairwise correlations amongst all variables are shown in Table 5. Excluding the obvious conflict between variables included in the same category, there is no concern about the correlation amongst the remaining ones.

4. *Results*

The results of the regression models are shown in Table 6. The results of the Hausman test, which was run in all models, indicate that fixed effects estimation is the most suitable method in all specifications. As already stated in Section three, all models include, as control variables, time and industry dummies[4] in order to control for these possible effects on the debt ratio.

The results show that the debt ratio is positively related to the tangibility of assets and size. These results are robust in all specifications and are consistent with the literature related to capital structure (Titman and Wessels, 1988; Hovakimian, Opler and Titman, 2001; Frank and Goyal, 2003; among others). In relation to profitability, we find partial evidence about the negative relationship of this variable with the debt ratio, since only *Prof1* is significant. The volatility variable does not have a significant impact on the debt ratio in any model. As already commented in Section two, this could be due to the ambiguous relationship between volatility and debt in firms that are later backed by VC investors. The variable representing growth opportunities is positively and significantly related to the debt ratio, which is expected in growing firms, as commented in Section two, since firms with growth opportunities must raise debt to finance the growth process, both before and after the initial VC round. The relationship before the investment round is expected due to the insufficiency of internally generated resources, while the one after the event is anticipated due to the certification effect

[4] We use as industry variable the second definition: the median leverage per year for each group, since the fixed effects estimation removes all the variables that are time invariant.

Table 5

Correlation Matrix

	Tang1	Tang2	Size	Prof1	Prof2	Vol1	Vol2	GO	ETR
Tang1	1.0000								
Tang2	0.7951	1.0000							
p-value	0.0000								
Size	-0.0433	-0.0639	1.0000						
p-value	0.6131	0.0287							
Prof1	0.0651	-0.0179	-0.0358	1.0000					
p-value	0.0226	1.0000	0.9273						
Prof2	-0.0128	-0.0298	0.0509	0.9063	1.0000				
p-value	1.0000	0.9952	0.2600	0.0000					
Vol1	-0.0212	-0.0270	-0.0215	-0.0494	-0.0473	1.0000			
p-value	1.0000	0.9993	1.0000	0.3146	0.4116				
Vol2	0.0053	-0.0195	-0.0302	-0.1171	-0.1106	0.2504	1.0000		
p-value	1.0000	1.0000	0.9939	0.0000	0.0000	0.0000			
GO	-0.2187	-0.3245	-0.0809	0.0126	-0.1099	0.0442	0.0462	1.0000	
p-value	0.0000	0.0000	0.0007	1.0000	0.0000	0.5658	0.4629		
ETR	-0.0320	-0.0251	-0.0306	0.1649	0.1625	-0.0435	-0.0812	0.0085	1.0000
p-value	0.9842	0.9999	0.9923	0.0000	0.0000	0.6016	0.0007	1.0000	

Tang1: Ratio between tangible fixed assets and total assets; Tang2: Ratio between tangible fixed assets plus inventories and total assets; Size: Natural logarithm of total assets; Prof1:Ratio between EBITDA and total assets; Prof2: Ratio between EBIT and total assets; Vol1: Moving standard deviation of the change in EBITDA, computing the current and the previous two years; Vol2: Moving standard deviation of the change in EBIT, computing the current and the previous two years; GO: Ratio between intangible assets and total assets; ETR: Ratio between the effective corporate tax paid and the earnings before tax.

provided by VCs. Finally, the relationship between the effective tax paid and the debt ratio is positive and significant, which is consistent with the existence of tax shields.

Regarding the hypotheses we should focus on the interaction terms. The coefficient of the interaction between tangibility and VC involvement is negative and significant in all models, which implies a reduction in the positive and significant relationship between collateral and debt in the post-investment period. Among the possible reasons underlying this fact, in addition to the increase in the equity base after the initial VC round, we recall the close monitoring implemented after the provision of funds and the certification effect that VCs provide. All these factors increase the likelihood that the VC-backed company will honor debt payments, thus confirming Hypothesis 1.

Hypothesis 2 predicted either a weaker relationship between size and the debt ratio after the VC investment due to the infusion of equity in the short term, or a stronger relationship because of the additional debt that the company could obtain at a later stage attributable to the certification effect of VC involvement. This hypothesis is partially confirmed. In some models this variable shows a positive and significant coefficient after the financing event, whereas in others this variable has no significant effect on the debt ratio. Regarding profitability, the coefficients are negative and significant in all models, confirming Hypothesis 3. This result is also consistent with the descriptive statistics shown in Table 4, since there is a decrease in earnings and an increase in the debt ratio in the post-investment period. Whereas the former may be related to the increase in fixed costs and depreciation, the latter may be explained by the enhanced credibility of the investee firm, which is expected to increase its future cash flows and, thus, its capacity to repay more debt.

The interaction terms of the remaining variables are not significant. In the case of volatility, Hypothesis 4 is confirmed, since arguments in favor of a stronger but also a weaker relationship between these two variables were presented in Section two. Hypothesis 5

predicted the persistence of a positive and significant relationship between growth opportunities and debt after the initial VC round, which is also confirmed by the lack of significance of the related interaction term, thus providing evidence that despite the equity injection the investee company will increase its debt ratio due to the certification effect provided by VCs. Focusing on the effective corporate taxes paid, even though the relationship is positive and significant, no differences between the pre and the post-investment periods are found. As a result, VC involvement does not lead to a greater effect of taxes paid on the debt levels. A possible explanation could be the fact that the increase in revenues may be offset by the increase in expenses that are necessary to support growth. Hypothesis 6 predicted a positive relationship after the VC entry, but it was unclear whether the effect was stronger or weaker. We do, in fact, find no differences between the pre and post-investment periods, thus confirming Hypothesis 6.

4.1 Robustness analyses

As a robustness check, regressions are also carried out separately for the pre and the post-investment periods. The results are reported in Tables 7 and 8, respectively. For the tangibility variable, the results are similar to the ones already shown in Table 6, since the coefficient is positive but lower after the VC investment event, thus reducing the importance of the role of collateral.

The coefficients for size are significant in all models when the pre-investment stage is analyzed, and it is only partially significant in the post-investment stage regressions, with the values being higher in the former. This could be related to the high dispersion in significance found for the interaction term of the size variable in Table 6. In this way, the overall effect of size after the VC investment would not be showing a clear pattern due to the initial effect of

Table 6

Regression results of the capital structure determinants: pre and post-investment periods

	Dependent Variable: Debt ratio							
Variable	**Tang 1**				**Tang 2**			
Tang	0.3679***	0.3715***	0.3889***	0.3909***	0.4022***	0.4004***	0.4153***	0.4126***
	(0.0901)	(0.0890)	(0.0874)	(0.0865)	(0.0632)	(0.0635)	(0.0624)	(0.0628)
Size	0.0901***	0.0906***	0.1006***	0.1010***	0.0906***	0.0911***	0.1012***	0.1015***
	(0.0245)	(0.0244)	(0.0242)	(0.0241)	(0.0241)	(0.0240)	(0.0240)	(0.0238)
Prof1	-0.2474**	-0.2610**			-0.2235*	-0.2352**		
	(0.1206)	(0.1209)			(0.1148)	(0.1149)		
Prof2			-0.1608	-0.1727			-0.1369	-0.1478
			(0.1272)	(0.1289)			(0.1235)	(0.1251)
Vol1	-0.0005		-0.0005		-0.0007		-0.0008	
	(0.0011)		(0.0012)		(0.0011)		(0.0012)	
Vol2		-0.0011		-0.0010		-0.0010		-0.0009
		(0.0013)		(0.0013)		(0.0013)		(0.0013)
GO	0.5799***	0.5806***	0.6238***	0.6231***	0.6440***	0.6445***	0.6932***	0.6926***
	(0.1472)	(0.1466)	(0.1525)	(0.1527)	(0.1471)	(0.1468)	(0.1525)	(0.1530)
ETR	0.1630**	0.1561**	0.1597**	0.1535**	0.1539**	0.1485**	0.1495**	0.1448**
	(0.0718)	(0.0698)	(0.0729)	(0.0708)	(0.0720)	(0.0700)	(0.0730)	(0.0709)
Tang x t_{vc}	-0.1478**	-0.1499**	-0.1725***	-0.1732***	-0.1806***	-0.1789***	-0.1906***	-0.1881***
	(0.0679)	(0.0670)	(0.0625)	(0.0617)	(0.0609)	(0.0611)	(0.0593)	(0.0596)
Size x t_{vc}	0.0044*	0.0041*	0.0038	0.0035	0.0071***	0.0068**	0.0063**	0.0059**
	(0.0024)	(0.0024)	(0.0024)	(0.0024)	(0.0028)	(0.0028)	(0.0027)	(0.0028)
Prof1 x t_{vc}	-0.4421*	-0.4278*			-0.4868**	-0.4738**		
	(0.2311)	(0.2318)			(0.2245)	(0.2251)		
Prof2 x t_{vc}			-0.3690*	-0.3557*			-0.4098*	-0.3967*
			(0.2118)	(0.2134)			(0.2097)	(0.2113)
Vol1 x t_{vc}	0.0001		0.0001		0.0001		0.0001	
	(0.0002)		(0.0002)		(0.0002)		(0.0002)	
Vol2 x t_{vc}		0.0011		0.0011		0.0012		0.0012
		(0.0017)		(0.0017)		(0.0016)		(0.0017)
GO x t_{vc}	-0.0190	-0.0251	-0.0958	-0.1003	-0.0913	-0.0976	-0.1725	-0.1772
	(0.1595)	(0.1580)	(0.1599)	(0.1586)	(0.1620)	(0.1604)	(0.1624)	(0.1612)
ETR x t_{vc}	-0.1323	-0.1265	-0.1374	-0.1320	-0.1287	-0.1236	-0.1331	-0.1285
	(0.0897)	(0.0886)	(0.0890)	(0.0878)	(0.0888)	(0.0877)	(0.0885)	(0.0874)
Median	0.3699*	0.3688*	0.4216*	0.4193*	0.3985*	0.3958*	0.4505**	0.4468**
	(0.2136)	(0.2141)	(0.2179)	(0.2183)	(0.2136)	(0.2143)	(0.2181)	(0.2188)
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes
Constant	-1.2581***	-1.2620***	-1.4430***	-1.4464***	-1.3400***	-1.3410***	-1.5235***	-1.5232***
	(0.3924)	(0.3913)	(0.3902)	(0.3889)	(0.3939)	(0.3928)	(0.3936)	(0.3923)
Obs	2,844	2,844	2,844	2,844	2,844	2,844	2,844	2,844
Firms	265	265	265	265	265	265	265	265
Hausman	59.04	57.17	64.09	62.19	58.96	55.38	63.45	59.72
p-value	0.0005	0.0014	0.0001	0.0003	0.0006	0.0022	0.0001	0.0007

Estimation of Model (1). Regressions are carried out using fixed effects.

Dependent variable: Ratio between long term debt and long term plus total equity. Independent Variables: Tang1: Ratio between tangible fixed assets and total assets; Size: Natural logarithm of total assets; Prof1:Ratio between EBITDA and total assets; Prof2: Ratio between EBIT and total assets; Vol1: Moving standard deviation of the change in EBITDA, computing the current and the two previous years; Vol2: Moving standard deviation of the change in EBIT, computing the current and the two previous years; GO: Ratio between intangible assets and total assets; ETR: Ratio between the effective corporate tax paid and the earnings before tax; Median: median of leverage per group of firms and year; t_{VC} (dummy: 1 from the investment event onwards, 0 otherwise).

Robust standard errors in brackets. Significance at levels *** 1%, ** 5%, * 10%.

the equity provided on the size of the firm. Nevertheless, this effect should fade away as more post-investment observations are considered.

The coefficient of profitability continues to be negative and stronger after the VC investment, which again is consistent with the previous results. The results for volatility are also similar to the ones obtained previously for this variable, since it is neither significant before nor after the initial VC round. Growth opportunities continue to be significant, with similar coefficients, after the VC investment. This is consistent with the insignificance of the interaction term in Table 6, thus confirming that growth opportunities also play a significant role in explaining the level of debt after the initial VC investment. Finally, Table 6 shows that the effective corporate tax paid is positive and significant in the pre-investment period, whereas the interaction term is not significant. Consistently, we should have expected a similar, positive relationship for both periods in Tables 7 and 8. However, this variable is not significant in any of the two subperiods when the time horizon is divided at the time of the initial VC round. However, this could be due to the fact that regressions in Tables 7 and 8 are carried out on a reduced number of observations.

Overall, the regressions carried out on both subsamples separately confirm most of the findings reported in Table 6, except in size (partially) and the effective tax paid, albeit they are based on a smaller number of observations.

Finally, we perform some additional robustness checks. As already commented in Section two, during the post-investment period and for some variables we expect a slightly different impact on the debt ratio if we distinguish between the short-term impact, or the period just immediately after the investment shock occurs, and the long-term impact. It should be taken into account that the VC investor usually stays an average of four to five years after

Table 7

Regression results of capital structure determinants for pre and post investment periods (Tang1)

	Dependent Variable: Debt ratio							
Indep.	**Model 1**		**Model 2**		**Model 3**		**Model 4**	
Variables	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Tang1	0.5896***	0.3204***	0.6055***	0.3227***	0.5626***	0.3034***	0.5773***	0.3061***
	(0.1516)	(0.0686)	(0.1484)	(0.0686)	(0.1464)	(0.0670)	(0.1433)	(0.0671)
Size	0.1104***	0.0265	0.1189***	0.0270	0.1142***	0.0314*	0.1228***	0.0319*
	(0.0347)	(0.0189)	(0.0320)	(0.0191)	(0.0350)	(0.0185)	(0.0321)	(0.0187)
Prof1	-0.3107***	-0.6975***	-0.3259***	-0.6920***				
	(0.1176)	(0.2328)	(0.1166)	(0.2328)				
Prof2					-0.3412***	-0.5139**	-0.3535***	-0.5090**
					(0.1299)	(0.2087)	(0.1321)	(0.2083)
Vol1	-0.0000	-0.0004			-0.0000	-0.0004		
	(0.0007)	(0.0008)			(0.0007)	(0.0008)		
Vol2			-0.0017	0.0012			-0.0017	0.0013
			(0.0017)	(0.0009)			(0.0017)	(0.0009)
GO	0.6581***	0.7082***	0.6285***	0.7041***	0.6370***	0.6595***	0.6061***	0.6559***
	(0.1578)	(0.1418)	(0.1705)	(0.1406)	(0.1527)	(0.1389)	(0.1663)	(0.1376)
ETR	0.1231	0.0426	0.0995	0.0451	0.1238*	0.0311	0.1004	0.0339
	(0.0756)	(0.0726)	(0.0663)	(0.0725)	(0.0752)	(0.0703)	(0.0661)	(0.0702)
Median	0.4283**	0.3460	0.4307**	0.3413	0.4477**	0.4577	0.4501**	0.4518
	(0.2110)	(0.3347)	(0.2117)	(0.3355)	(0.2145)	(0.3500)	(0.2153)	(0.3507)
Time dummies	yes	yes	yes	Yes	yes	yes	yes	yes
Constant	-1.6791***	-0.2131	-1.8108***	-0.2214	-1.7496***	-0.3414	-1.8854***	-0.3494
	(0.5966)	(0.3617)	(0.5479)	(0.3647)	(0.6028)	(0.3618)	(0.5502)	(0.3648)
Obs	1,092	1,752	1,092	1,752	1,092	1,752	1,092	1,752
Firms	265	265	265	265	265	265	265	265
Hausman	42.46	23.10	47.17	20.23	43.28	24.88	46.74	21.68
p-value	0.0010	0.2332	0.0002	0.3806	0.0007	0.1645	0.0001	0.3005

Estimation of Model (2). Regressions are carried out using fixed effects for pre and random effects for post-investment observations.

Dependent variable: Ratio between long term debt and long term plus total equity. Independent Variables: Tang1: Ratio between tangible fixed assets and total assets; Size: Natural logarithm of total assets; Prof1:Ratio between EBITDA and total assets; Prof2: Ratio between EBIT and total assets; Vol1: Moving standard deviation of the change in EBITDA, computing the current and the two previous years; Vol2: Moving standard deviation of the change in EBIT, computing the current and the two previous years; GO: Ratio between intangible assets and total assets; ETR: Ratio between the effective corporate tax paid and the earnings before tax; Median: median of leverage per group of firms and year.

Robust standard errors in brackets.

Significance at levels *** 1%, ** 5%, * 10%.

Table 8

Regression results of capital structure determinants for pre and post investment periods (Tang2)

	Dependent Variable: Debt ratio							
Indep.	**Model 1**		**Model 2**		**Model 3**		**Model 4**	
Variable	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**	**Pre**	**Post**
Tang2	0.3128***	0.2451***	0.3205***	0.2475***	0.2957***	0.2449***	0.3031***	0.2474***
	(0.0911)	(0.0629)	(0.0894)	(0.0631)	(0.0887)	(0.0639)	(0.0869)	(0.0641)
Size	0.1131***	0.0271	0.1206***	0.0276	0.1158***	0.0324*	0.1236***	0.0329*
	(0.0359)	(0.0191)	(0.0334)	(0.0192)	(0.0360)	(0.0187)	(0.0332)	(0.0188)
Prof1	-0.2949**	-0.6865***	-0.3101***	-0.6810***				
	(0.1188)	(0.2315)	(0.1186)	(0.2315)				
Prof2					-0.3506**	-0.5158**	-0.3636***	-0.5108**
					(0.1372)	(0.2084)	(0.1400)	(0.2080)
Vol1	-0.0002	-0.0004			-0.0002	-0.0004		
	(0.0007)	(0.0007)			(0.0007)	(0.0007)		
Vol2			-0.0016	0.0012			-0.0016	0.0013
			(0.0017)	(0.0009)			(0.0017)	(0.0009)
GO	0.6356***	0.7198***	0.6091***	0.7157***	0.6195***	0.6770***	0.5914***	0.6735***
	(0.1574)	(0.1408)	(0.1715)	(0.1396)	(0.1533)	(0.1385)	(0.1680)	(0.1373)
ETR	0.1091	0.0420	0.0878	0.0445	0.1106	0.0312	0.0893	0.0340
	(0.0767)	(0.0724)	(0.0677)	(0.0723)	(0.0763)	(0.0702)	(0.0674)	(0.0701)
Median	0.3726*	0.3241	0.3733*	0.3187	0.3982*	0.4259	0.3993*	0.4194
	(0.2072)	(0.3350)	(0.2086)	(0.3358)	(0.2120)	(0.3497)	(0.2135)	(0.3504)
Time dummies	yes	yes	yes	yes	yes	yes	yes	Yes
Constant	-1.6864***	-0.2317	-1.8024***	-0.2402	-1.7390***	-0.3637	-1.8608***	-0.3720
	(0.6112)	(0.3664)	(0.5648)	(0.3694)	(0.6142)	(0.3660)	(0.5631)	(0.3691)
Obs	1,092	1,752	1,092	1,752	1,092	1,752	1,092	1,752
Firms	265	265	265	265	265	265	265	265
Hausman	42.07	23.95	44.68	20.96	43.25	24.22	47.40	20.91
p-value	0.0011	0.1980	0.0003	0.3391	0.0007	0.1879	0.0002	0.3417

Estimation of Model (2). Regressions are carried out using fixed effects for pre and random effects for post-investment observations.

Dependent variable: Ratio between long term debt and long term plus total equity. Independent Variables: Tang1: Ratio between tangible fixed assets and total assets; Size: Natural logarithm of total assets; Prof1:Ratio between EBITDA and total assets; Prof2: Ratio between EBIT and total assets; Vol1: Moving standard deviation of the change in EBITDA, computing the current and the two previous years; Vol2: Moving standard deviation of the change in EBIT, computing the current and the two previous years; GO: Ratio between intangible assets and total assets; ETR: Ratio between the effective corporate tax paid and the earnings before tax. Median: median of leverage per group of firms and year.

Robust standard errors in brackets.

Significance at levels *** 1%, ** 5%, * 10%.

the initial investment. To test these effects, we run the post-investment regressions again (i.e. model 2) but including only the related observations up to three years and up to four years after the investment event occurs. [5] In this way, these new regressions would be testing the effect in the short term, whereas the post-investment regressions in Tables 7 and 8 would be testing the long-term effect, since all post-investment observations are included in the latter case.

We find some interesting results that confirm the hypotheses. In the short term, collateral are significant but less important than in the long term, especially regarding the first measure of tangibility. This would imply that when the VC investor still has its share in the firm, collateral seems to be less necessary due to the certification role played by VCs. However, in the long term, the level of collateral becomes more relevant than in the short term, but still less important than during the pre-investment period.

Regarding the size variable, the results are even more conclusive. In the short term, this variable does not have a significant impact on the debt ratio due to the effect of the initial equity funding on the size increase. However, in the long term, this variable has a significant and positive impact in some regressions, but is not significant in others, as already seen in Tables 7 and 8. This confirms the intuition behind Hypothesis 2. In the short term, and because of the effect of the shock on equity, the proportion of debt drops while the size of the firm increases and, therefore, no significant effect of size on debt is found. However, in the long term, when the VC-backed company is able to attract new debt, the relationship between size and debt becomes again positive and significant. Overall, the results show that the VC infusion effect differs slightly in the short and long term, and thus this is an area which deserves more research in the future.

[5] These tables are available upon request.

5. *Conclusions and Discussion*

The effect that VCs have on their investee firms has received significant attention in the VC literature, showing the positive impact that VC has on job creation, innovation and performance. However, the study of the determinants of the capital structure after the VC investment event has received little attention. Based on the certification effect that VCs provide, this paper aims to increase our understanding of the financing behavior of companies after the initial VC funding event, showing whether or not the determinants of the debt ratio before and after the VC event change.

We anticipate that the high involvement in management activities, valuable advice, close monitoring and the provision of funds provided by VCs to their investee companies lead to a reduction in information asymmetry problems with debt providers. These value-adding and monitoring services, as well as the financial support, create a sort of certification effect that allows investee firms to obtain more debt. Consequently, we expect that, after the VC investment, the determinants of the capital structure should change accordingly. The results show that debt is less dependent on the tangibility of assets, since VC involvement reduces the need to provide collateral to obtain additional debt. The results of the effect of size after the VC entry, for which there were arguments in favor of a weaker but also of a stronger relationship, are also in line with this, since in some models this variable shows a positive and significant coefficient whereas in others this variable does not have a significant effect on the debt ratio. The effect of profitability is more negative, since the decrease in earnings that follows the VC investment, due to the increase in fixed costs and depreciation, is accompanied by an increase in debt. The latter is based on the monitoring and other value-adding services provided by VCs, which will later help to increase the amount and stability of operational cash flows. We also find that the relationships of volatility, growth opportunities

and effective taxes paid with the debt ratio do not change after the investment. In this sense VCs play a crucial role, given that obtaining debt is essential for future growth.

Our findings have implications for policy makers and entrepreneurs. Regarding the former, this paper provides evidence that VC investors not only contribute to filling the equity gap in unquoted growing companies, but this contribution also facilitates access to long-term funding to fuel their future growth. Therefore, policy makers may find more reasons to justify schemes that favor VCs due to the role they play in helping privately-held firms to obtain additional long-term funding. In this sense, VCs should not be considered only as a source of equity, or quasi-equity, funding. The certification effect, which arises from the reduction of information asymmetry problems, also facilitates access to other long-term sources of finance. This benefit may outweigh the natural reluctance of most entrepreneurs to allow the entry of external equity investors, such as VCs, to avoid losing control of the firm.

Regarding the limitations, the main one relates to the potential endogeneity of the models, since we are dealing with accounting variables that may not be fully exogenous. Focusing on a dynamic model could address this concern, although a considerable amount of important information would be lost. It should be taken into account that the analyses in Tables 7 and 8 are also based on a reduced number of years, since the observations are split into two periods. Additionally, due to unavailability of data, some variables that are sometimes considered in the literature could not be considered in this paper, such as research and development expenditures.

For future research, it would be interesting to distinguish between the short and long-term effects of the VC investment on the capital structure of these companies. Also, an interesting test would be to analyze whether the change in the capital structure of the firm persists when the VC investor, which aims to stay only temporarily, divests its stake. Similarly, it would be interesting to test how the speed of adjustment to a target debt ratio

evolves over time as the VC investor exits the firm. Additionally, testing the effect of the VC investment on the capital structure of firms in more mature VC markets could shed light on whether the effect of VC is related to the stage of development of the market. Similarly, it would be interesting to test the same effect on market-oriented countries (as opposed to bank-oriented countries), such as the US or the UK.

REFERENCES

Akerlof, G. A. (1970). "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism", *Quarterly Journal of Economics* 84(3), 488-500.

Alemany, L., and J. Martí (2005). "Unbiased Estimation of Economic Impact of Venture Capital Backed Firms", paper presented at the 2005 EFA Annual Meeting, Moscow.

Amit, R., J. Brander, and C. Zott (1998). "Why Do Venture Capital Firms Exist? Theory and Canadian Evidence", *Journal of Business Venturing* 13(6), 441-466.

Baeyens, K., and S. Manigart (2003). "Dynamic Financing Strategies: The Role of Venture Capital", *Journal of Private Equity* 7 (1), 50-58.

Baeyens, K., and S. Manigart (2006). "Follow-on Financing of Venture Capital Backed Companies: the Choice between Debt, Equity, Existing and New Investors", *WP 2006/05*, Vlerick Leuven Gent Management School.

Balboa, M., J. Martí, and A. Tresierra (2009). "Capital Structure Determinants in Growth Firms Accessing Venture Funding",, *Working Paper 489*, Fundación de las Cajas de Ahorros de España.

Baum, J., and B. Silverman (2004). "Picking Winners or Building Them? Alliance, Intellectual, and Human Capital as Selection Ccriteria in Venture Financing and Performance of Biotechnology Startups", *Journal of Business Venturing* 19 (3), 411-436.

Berger, A., and G. Udell (1998). "The Economics of Small Business Finance: The Roles of Private Equity and Debt Markets in the Financial Growth Cycle", *Journal of Banking & Finance* 22 (6-8), 613-673.

Bertoni, F., M.A. Ferrer and J. Marti (2012). "The different role played by venture capital and private equity investors on the investment activity of their portfolio firms", *Small Business Economics*, forthcoming.

Brander, J., R. Amit, and W. Antweiler (2002). "Venture-capital Syndication: Improved Venture Selection vs. the Value-added Hypothesis", *Journal of Economics and Management Strategy* 11 (3), 423-452.

Bygrave, W. (1988). “The Structure of Investment Networks of Venture Capital Firms”, *Journal of Business Venturing* 3 (2), 137-157.

Carey, M., M. Post and S. Sharpe (1998). “Does Corporate Lending by Banks and Finance Company Differ? Evidence on Specialization in Private Debt Contracting”, *The Journal of Finance* 53 (3), 845-878.

Carpenter, R. E., and B.C. Petersen (2002). “Is the Growth of Small Firms Constrained by Internal Finance?”, *The Review of Economics and Statistics* 84 (2), 298-309.

Casamatta, C., and C. Haritchabalet (2007). “Experience, Screening and Syndication in Venture Capital Investments”, *Journal of Financial Intermediation* 16, 368-398.

Chan, Y. (1983). “On the Positive Role of Financial Intermediation in Allocation of Venture Capital in a Market with Imperfect Information”, *The Journal of Finance* 38 (5), 1543-1568.

Chan, Y., and A. V. Thakor (1987). “Collateral and Competitive Equilibria with Moral Hazard and Private Information”, *The Journal of Finance* 42 (2), 345-363.

Croce, A., Marti, J., and S. Murtinu (2010). “The Impact of Venture Capital on the Productivity of European High-Tech Firms: Screening or Value Added Effect?” (November 14, 2010). Available at SSRN: http://ssrn.com/abstract=1705225.

Davila, A., G. Foster, and M. Gupta (2003). “Venture Capital Financing and the Growth of Startup Firms”, *Journal of Business Venturing* 18 (6), 689-708.

De Clercq, D., Sapienza, H. and Zaheer, A. (2008). “Firm and Group Influences on Venture Capital Firms’ Involvement in New Ventures”, *Journal of Management Studies* 45 (7), 1169-1194.

De Miguel, A., and J. Pindado (2001). “Determinants of Capital Structure: New Evidence from Spanish Panel Data“, *Journal of Corporate Finance* 7 (1), 77-99.

Engel, D., and M. Keilbach (2007). “Firm-level Implications of Early Stage Venture Capital Investment - An empirical investigation“, *Journal of Empirical Finance* 14 (2), 150-167.

Fama, E., and K. French (2002). “Testing Trade-Off and Pecking Order Predictions about Dividends and Debt”, *The Review of Financial Studies* 15 (1), 1-33.

Flannery, M., and K. Rangan, K. (2006). “Partial Adjustment Toward Target Capital Structures”, *Journal of Financial Economics* 79 (3), 469-506.

Frank, M., and V. Goyal (2003). “Testing the Pecking Order Theory of Capital Structure”, *Journal of Financial Economics* 67 (2), 217-248.

Frank, M., and V. Goyal (2009). “Capital Structure Decisions: Which Factors are Reliably Important”, *Financial Management* 38 (1), 1-37.

Fried, V. and R. Hisrich (1994). “Towards a Model of Venture Capital Investment Decision Making”, *Financial Managemen*t 23 (3), 28-37.

Gompers, P. A. (1995). “Optimal Investment, Monitoring, and the Staging of Venture Capital”, *The Journal of Finance* 50 (5), 1461-1489.

Gompers, P.A. and J. Lerner (2001). “The Venture Capital Revolution”, *The Journal of Economic Perspectives* 15 (2), 145-168.

Gorman, M., and W. Sahlman (1989). “What do venture capitalists do?”, *Journal of Business Venturing* 4 (4), 231-248.

Graham, J. (1996). “Debt and the Marginal Tax Rate”, *Journal of Financial Economics* 41 (1), 41-73.

Hall, G., P. Hutchinson, and N. Michaelas (2000). “Industry Effects on the Determinants of Unquoted SME´s Capital Structure”, *International Journal of the Economics of Business* 7 (3), 297-312.

Harris, M., and A. Raviv (1991). “The Theory of Capital Structure”, *The Journal of Finance* 46 (1), 297-355.

Hassan, A., and D. Leece (2008). “The Influence of Venture Capitalists' Source of Finance on their Post-Investment Behavior in Investee Companies”, *The Journal of Private Equity* 11 (3), 69-84.

Hausman, J. (1978). “Specification Tests in Econometrics”, *Econometrica*, 46 (6), 1251-1271.

Hellmann, T. and Puri, M. (2000). “The Interaction between Product Market and Financing Strategy: The Role of Venture Capital”, *The Review of Financial Studies* 13 (4), 959-984.

Hellmann, T., and M. Puri (2002). “Venture Capital and the Professionalization of Start-up Firms: Empirical Evidence”, *The Journal of Finance* 57 (1), 169-197.

Heyman, D., M. Deloof and H. Ooghe (2008). “The Financial Structure of Privately Held Belgian Firms”, *Small Business Economic* 30 (3), 301-313.

Hopp, C., and F. Rieder (2010). “What Drives Venture Capital Syndication”, *Applied Economics*, forthcoming.

Hovakimian, A., T. Opler, and S. Titman (2001). “The Debt-Equity Choice”, *The Journal of Financial and Quantitative Analysis* 36 (1), 1-24.

Ibrahim, D. M. (2010). “Debt as Venture Capital”, *University of Illinois Law Review* 4, 1169-1210.

Kaplan, S., and P. Strömberf (2004). “Characteristics, Contracts, and Actions: Evidence from Venture Capitalist Analyses”, *The Journal of Finance* 59 (5), 2177-2210.

Kortum, S., and J. Lerner (2000). “Assessing the Contribution of Venture Capital to Innovation”, *The RAND Journal of Economics* 31 (4), 674-692.

Lemmon, M. L., M. Roberts, and J. Zender (2008). “Back to the Beginning: Persistence and the Cross-Section of Corporate Capital Structure”, *The Journal of Finance* 63 (4), 1575-1608.

Lerner, J. (1994). “The Syndication of Venture Capital Investments”, *Financial Management* 23 (3), 16-27.

Lerner, J. (1995). “Venture Capitalists and the Oversight of Private Firms”, *The Journal of Finance* 50 (1), 301-318

López-Gracia, J., and F.Sogorb-Mira (2008). “Testing Trade-off and Pecking Order Theories Financing SMEs”, *Small Business Economics* 31 (2), 117-136.

Manigart, S., K. Baeyens, and I. Verschueren (2002). “Financing and Investment Interdependencies in Unquoted Belgian Companies: The Role of Venture Capital”, National Bank of Belgium Working Paper 29.

Manigart, S., and W. van Hyfte (1999). “Post-investment Evolution of Belgian Venture Capital Backed Companies: an Empirical Study”, paper presented at the *Babson Entrepreneurship Conference Working Paper*.

Manigart, S., A. Lockett, M. Meuleman, M. Wright, H. Landström, H. Bruining, P. Desbrières, and U. Hommel (2006). “Venture Capitalists’ Decision to Syndicate”, *Entrepreneurship Theory and Practice* 30 (2), 131-153.

Manigart, S., M. Wright, K. Robbie, P. Desbrières, and K. De Waele (1997). “Venture Capitalists' Appraisal of Investment Projects: An Empirical European Study”, *Entrepreneurship Theory and Practice* 21 (4), 29-43.

Martí, J., M. Salas, and D. Barthel (2010). Economic and Social Impact of Venture Capital & Private Equity in Spain, Spanish Venture Capital & Private Equity Association, Madrid.

Megginson, W., and K. Weiss (1991). "Venture Capitalist Certification in Initial Public Offerings", *The Journal of Finance* 46 (3), 879-903.

Michaelas, N., F. Chittenden, and P. Poutziouris (1999). "Financial Policy and Capital Structure Choice in U.K. SMEs: Empirical Evidence from Company Panel Data", *Small Business Economics* 12 (2), 113-130.

Muzyka, D., S. Birley, and B. Leleux (1996). "Trade-offs in the Investment Decisions of European Venture Capitalists", *Journal of Business Venturing* 11 (4), 273-287.

Myers, S. (1984). "The Capital Structure Puzzle", *The Journal of Finance* 39 (3), 575-592.

Ozkan, A. (2000). "An Empirical Analysis of Corporate Debt Maturity Structure", *European Financial Management* 6 (2), 197-212.

Ozkan, A. (2001). "Determinants of Capital Structure and Adjustment to Long Run Target: Evidence from UK Company Panel Data", *Journal of Business Finance & Accounting* 28 (1&2), 175-198.

Rajan, R., and L. Zingales (1995). "What do we Know about Capital Structure? Some Evidence from International Data", *The Journal of Finance* 50 (5), 1421-1460.

Sahlman, W.A. (1990). "The Structure and Governance of Venture Capital Organizations", *Journal of Financial Economics* 27 (2), 473-521.

Sapienza, H., and A. Gupta (1994). "Impact of Agency Risks and Task Uncertainty on Venture Capitalist - CEO Interaction", *Academy of Management Journal* 37 (6), 1618-1632.

Sheperd, D., R. Ettenson and A. Crouch (2000). "New Venture Strategy and Profitability: A Venture Capitalist's Assessment", *Journal of Business Venturing* 15 (5-6), 449–467.

Sogorb-Mira, F. (2005). "How SME Uniqueness Affects Capital Structure: Evidence From A 1994–1998 Spanish Data Panel", *Small Business Economics* 25 (5), 447-457.

Titman, S., and R. Wessels (1988). "The Determinants of Capital Structure Choice", *The Journal of Finance* 43 (1), 1-19.

Tyebjee, T., and A. Bruno (1984). “A Model of Venture Capitalist Investment Activity”, *Management Science* 30 (9), 1051-1066.

Tykvová, T. (2007). ‘What do economists tell us about Venture Capital contracts?”, *Journal of Economic Surveys* 21 (1), 65-89.

Ueda, M. (2004). “Banks versus Venture Capital: Project Evaluation, Screening, and Expropriation”, *The Journal of Finance* 59 (1), 601-621.

Wright, M. and K. Robbie (1996). “Venture Capitalist, Unquoted Equity Investment Appraisal and the Role of Accounting Information”, *Accounting and Business Research* 26 (2), 153-168.

Zacharakis, A. and G. Meyer (2000). “The Potential of Actuarial Decision Models: Can they Improve the Venture Capital Investment Decision?”, J*ournal of Business Venturing* 15(4), 323–346.

Ivie

Guardia Civil, 22 - Esc. 2, 1º
46020 Valencia - Spain
Phone: +34 963 190 050
Fax: +34 963 190 055

Website: http://www.ivie.es
E-mail: publicaciones@ivie.es