FINANCIAL MARKET IMPERFECTIONS, CONTROL AVERSION AND VENTURE CAPITAL IN SPANISH SMEs*

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Abstract

Information asymmetries and control aversion limit the capacity of Small and Medium Enterprises (SMEs) to take advantage of growth opportunities. In this work we analyse to what extent Venture Capital (VC) can play a positive role by allowing a temporary shareholder to reduce the investment dependency on internally generated funds. We study a sample of 322 Spanish VC-backed SMEs at the expansion stage, and a one-by-one matched sample of non-VC-backed firms. We find that both groups of firms exhibit a significant sensitivity of investments to cash flows before the initial VC investment. VC, however, is effective in reducing investment cash flow sensitivity in the post-investment period in the group of VC-backed companies.

Keywords: Venture Capital, Small and Medium Enterprises, control aversion, investment sensitivity to cash flow
JEL codes: G32, G24

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Introduction

Access to external financing is particularly difficult for Small and Medium Enterprises (SMEs, hereafter). Due to information asymmetries and control aversion, internal and external finance are not perfect substitutes and the former is usually preferred to the latter. On the one hand, SMEs are particularly exposed to information asymmetries which make external financing more costly (Ang, 1991; Chittenden *et al.*, 1996; Berger and Udell, 1998; Carpenter and Petersen, 2002a). On the other, most SMEs are owned and managed by entrepreneurs who are reluctant to dilute their ownership and lessen their control (Holmes and Kent, 1991; Chittenden *et al.*, 1996) and prefer to rely upon internal finance rather than be subject to scrutiny and interference by external investors (López-Gracia and Aybar-Arias, 2000; Hogan and Hutson, 2005; Chittenden *et al.*, 1996). As a consequence, investment expenditures of SMEs rely primarily on internally generated resources. Under some circumstances, however, SMEs find it optimal to seek external financing. This occurs when the expected return of investment opportunities which would be unattainable without external financing offsets both the additional cost of external money due to information asymmetries and the loss in control which is implied by the involvement of external investors. As to this latter aspect, it should be noted that entrepreneurs differ both in terms of their attitude towards interference from external stakeholders (Berggren *et al.*, 2000) and in their strong ambition to grow (Olofsson, 1994) so that when the former is low and the latter high, they will exhibit a stronger propensity to look for financial intermediaries able to alleviate and manage information asymmetries (Gompers, 1995; Wright and Robbie, 1998; Gompers and Lerner, 2001; Hsu, 2004).

As specialised investors, Venture Capital (VC, hereafter) institutions are the best option for fast-growing firms (Carpenter and Petersen, 2002a). In addition to financial resources, VC investors provide value added services that help firms to raise additional long-term funds to finance their growth and add value through monitoring and mentoring initiatives (Sahlman, 1990; Gompers and Lerner, 1998).

As a consequence, VC-backed SMEs should be able to reduce their natural dependency on internally generated funds to finance their growth opportunities. The aim of this work is to verify the positive role

played by VC on investee firms by testing the relationship between investments and cash flows on a sample of unlisted Spanish SMEs. We study the extent to which VC changes the sensitivity to cash flows of firm's investments in a sample composed of 322 SMEs that received VC between 1995 and 2004 and on a one-by-one matched sample of similar SMEs that did not receive VC in that period.

Only a few papers have focused on the investment sensitivity to cash flow in VC-backed firms and they obtained mixed results about the actual impact of VC (Manigart *et al.*, 2003; Bertoni *et al.*, 2008; Engel and Stiebale, 2009). Notably, this is the first paper that analyses the change in the investment sensitivity to cash flow in Spanish growing SMEs, including both VC and comparable non-VC-backed firms.

Our results strongly confirm that VC does reduce SME's investment dependency on internally generated funds. We find consistent results across different specifications that SMEs at the expansion stage exhibit a positive and significant relationship between investments expenditures and cash flow prior to the VC deal. This investment dependency on cash flows becomes less significant in the post-investment period. VC-backed firms show a positive, significant relationship between investment and intangible assets, as a proxy of growth opportunities. By splitting the sample across sectors, we find that results are particularly strong for low and medium tech manufacturing and services firms.

The rest of the paper is organised as follows. Section 2 presents a brief review of the literature and develops our research hypotheses. Section 3 describes the sampling process and the econometric methodology. Section 4 reports descriptive statistics and preliminary evidence of the evolution of investment patterns due to VC investment. Results of econometric models are presented in Section 5. Finally, the main findings are highlighted and discussed in Section 6.

Literature review and research hypotheses

SMEs are typically owner-managed (Ang, 1991; Cressy, 1995). For many entrepreneurs, the primary motive for starting a business is the desire for 'independence' (Cressy, 1995; Paul *et al.*, 2007). Since the key source of financing for these firms comes from the entrepreneur's savings (Ang, 1992; Berger and Udell, 1998), the distinction between entrepreneur's and firm's resources fades and, at the same time, business risk is no longer separable from personal risk (Ang, 1992). In addition to personal wealth of the entrepreneurs, financing is often provided by their family and friends (Berger and Udell, 1998).

As firms grow, additional funds are required. Nevertheless, entrepreneurs tend to be reluctant to take on external finance (Cressy, 1995; Reid, 1996). Equity financing is often considered as an intrusion into the business (Paul *et al.*, 2007), whereas debt is usually available only against personal collateral and guarantees given by the entrepreneurs (Berger and Udell, 1998). Once personal resources are exhausted, investment opportunities depend on available internally generated funds (Chittenden *et al.*, 1996; Michaelas *et al.*, 1999; Carpenter and Petersen, 2002b; Watson and Wilson, 2002; among others). These resources may still not be sufficient, especially when growth opportunities are significant, in which case SME's growth and, sometimes, survival depend on their access to external funds (Cressy, 1995) which, in turn, depend on information asymmetries and control aversion. Whereas conservative entrepreneurs remain independent to external control, at the expense of limiting firm growth (Cressy, 1995), entrepreneurs that believe that a firm's growth is necessary (or who perceive a firm's investment opportunities as above-average) will do whatever is necessary to grow (Berggren *et al.*, 2000). This group of entrepreneurs is less reluctant to raise funds from external sources. Control aversion typically decreases over time, and, alongside, the level of external financing increases (Cressy, 1995).

VC is a source of long term financing, usually supplied in the form of equity, or quasi-equity, instruments that involves holding minority stakes in growing SMEs (Sahlman, 1990). Venture capitalists do not aim to become permanent shareholders in investee firms but, rather, help entrepreneurs in developing their growth potential and, then, sell the shares received at the time of the investment (hopefully realising a capital gain). This minority and temporary approach may limit an entrepreneur's reluctance to let an external investor become a permanent shareholder of the firm.

Nevertheless, prior to the entry of VC investors, the dependency of investments on internally generated funds would apply in all growing SMEs, regardless of the future involvement, or not, of a VC investor. Accordingly, we expect the following.

Hypothesis 1: The relationship between investments and cash flows should be positive and significant in all non-VC-backed SMEs, regardless of whether they will eventually receive VC or not.

Once entrepreneurs decide to access external funds, they actively seek for investors that provide both financial resources and value added (Paul *et al.*, 2007; Hsu, 2007). In presence of asymmetries in information, venture capitalists are the best agents to address adverse selection and moral hazard problems found in SMEs (Carpenter and Petersen, 2002a). Hogan and Hutson (2005) and Paul *et al.* (2007) find that equity issues are the main source of external financing for VC-backed companies, rather than debt. VC is an alternative financing source for small and

young fast-growing firms, which typically posses few tangible assets, operate in markets that change very rapidly, are plagued by high levels of uncertainty, and have large information asymmetries between entrepreneurs and investors (Gompers and Lerner, 2001). VC investors also provide non-financial services which contribute significantly in the development and success of the investee firm (Tyebjee and Bruno, 1984; Sahlman, 1990; Gompers and Lerner, 1998; Wright and Robbie, 1998; Hellmann and Puri, 2000). After the initial investment, VC investors monitor a firm's performance, help in recruiting managers, and providing strategic financial and legal advice (Gorman and Sahlman, 1989; Kaplan and Strömberg, 2001). Besides, VC makes it easier for investee firms to find additional long-term resources (Sahlman, 1990; Admati and Pfleiderer, 1994; Wright and Robbie, 1998; Gompers and Lerner, 2001, Tykvová, 2007). With access to external financial funds, the level of liquidity of small and medium sized fast-growing firms increases and the investment dependency on their internally generated funds diminishes. On these grounds, our second hypothesis is the following.

Hypothesis 2: After VC financing the relationship between investments and cash flows should be significantly reduced, or even disappear, in VC-backed growing SMEs.

The empirical evidence of investment-cash flow sensitivity on VC-backed firms is very limited and shows mixed results. Manigart *et al.* (2003) study the investment-cash flow sensitivity in unquoted Belgian VC-backed firms and a matched sample of non-VC-backed firms. Contrary to expectations, their results provide evidence of an increase in the sensitivity after the initial VC investment. Nevertheless, their results might be affected by the heterogeneous nature of VC investments included in their sample, ranging from early stage financing to buyouts. Furthermore, financial constraints faced by all firms during the 1991-1995 economic crisis may affect most of their post-VC investment observations and, thus, their empirical results.

Bertoni *et al.* (2008) analyse the dependency of investment on cash flows on VC-backed and non-VC-backed unlisted Italian high-tech firms. They find that, before receiving VC money, firms suffer from appreciable financial constraints. Nevertheless, after receiving VC financing, firms exhibit low and statistically not significant investment-cash flow sensitivity when the investor involved is an independent VC firm. Their results are similar to what we expect to find. Conversely, in firms backed by a corporate VC, investment remains sensitive to shocks in cash flow, indicating that investment constraints are not completely removed.

More recently, Engel and Stiebale (2009) find that UK and French portfolio firms display positive and significant investment sensitivity to cash flow before expansion financing. On the other hand, investee firms display higher investment levels and a lower dependence on internal funds after VC investment. These findings are in line with our hypotheses.

Data and methodology

The sampling process

The presence of investment-cash flow sensitivity on SMEs is tested in a sample of unlisted Spanish SMEs at the expansion stage. The sample includes firms which received VC expansion investments during the period 1995-2004 and a matched sample of non invested firms.

In accordance with data obtained from the Spanish Private Equity and Venture Capital Association (ASCRI), between 1995 and 2004, 1,572 VC investments were recorded in Spain, including all stages but excluding financial and real-estate sectors (Martí *et al.*, 2010). For 259 firms we could not find any accounting information, which reduces the accessible population to 1,313 VC-backed firms (83.5% of the initial population). Out of these, we drop 575 early stage deals and 159 buyouts and are left with 579 expansion investments. Some 6 companies operating in the primary industry are excluded from the analysis since they would constitute a very different category from the rest of the sample which would however be characterised by too few observations to be studied separately. From the remaining 573 companies in this latter group, we gather accounting information from the AMADEUS database, which records information on 1,064,570 Spanish firms. In order to make estimation more robust, we select only firms for which at least three consecutive years of accounting data, including the year in which VC investment occurs, are available. This leads us to a sample of 322 firms, accounting for 56% of the fully identified firms that were financed at the expansion stage in Spain between 1995 and 2004.

A one-by-one matched sample of 322 firms with no VC funding was then created. Comparable firms were drawn from the AMADEUS database among those matching the investee company sector (NACE Rev2 4-digit code). Among this cohort of firm-year observations, we select the one which is closer to the characteristics of the investee company in the year before VC investment (number of employees, revenues, total asset, age). When possible we also selected companies incorporated in areas with the same level of local development (Objective 1 region[8] or not). To check the robustness of the matching process we control ex post that the characteristics in the year before VC investment are the same between the two cohorts. We perform t-tests on number of

[8] Objective 1 regions are defined as those regions that exhibit an average income below 75 per cent of the European Union average.

employees, revenues, total asset, age and a dummy indicating whether the company is incorporated in an Objective 1 region, and in no case did we find any significant difference between the two groups.[9] For further robustness we also perform a joint test by estimating a probit model where the dependent variable is a dummy indicating whether a firm is in the VC-backed group or in the control group and the dependent variables are, again, number of employees, revenues, total asset, age and a region Objective 1 dummy. A Wald test reveals that we cannot reject the null hypothesis that all the coefficients are jointly zero ($\chi^2(5)=8.82$; *p-value* 0.14). Table 1 reports the distribution of sample firms across industries.

Methodology

In order to analyse the relationship between investments and cash flows in VC- and non-VC-backed firms we build on the classical approach by Fazzari *et al.* (1988). Models to estimate investment sensitivity to cash flows (see Fazzari *et al.*, 1998 and Bond and Van Reenen, 2007 for a review and in-depth discussion) consider investments as a dependent variable and internally generated resources and growth opportunities as key independent variables (alongside other control variables). Broadly speaking these models differ in the way in which they measure unobserved growth opportunities. When using panel data with a sufficiently long time span, dynamic models (e.g. Euler equation and sales accelerator) can be used to control for unobserved growth opportunities. However when data are cross-sectional or, as in our case, do not have a sufficient time breadth, static models have to be used, as in the original work by Fazzari *et al.* (1988). Investments are normally measured by changes in fixed assets, and the capacity to generate resources internally is proxied by cash flows. Fazzari *et al.* (1988) measure growth opportunities by including in the estimates firm Tobin's Q. The use of Tobin's Q (which is also criticised by many, see for instance Bond and Van Reenen, 2007) is impossible in our sample since it only includes unlisted firms. We thus need to rely upon an alternative measure of growth opportunities. Fama and French (2002) argue that Research and Development (R&D) expenditures signal firm's unobserved growth opportunities. Building on this idea, and following Michaelas *et al.* (1999) and Manigart *et al.* (2003), we use the volume of intangible assets (normalised by total assets) as a proxy of growth opportunities.[10]

We include, as control variables, firm size and age.[11] The model that we estimate is then the following:

$$I_{it} = \beta_0 + \beta_1 CF_{it} + \beta_2 Intang_{it} + \beta_3 Size_{it} + \beta_4 Age_{it} + \beta_5 VC_i + \beta_6 VC_i * CF_{it} + D_{it} + \varepsilon_{it} \quad (1)$$

where i is the firm's indicator while t is a time indicator which is set to 0, for VC-backed firms, in the year of VC investment and, for control group firms, in the year in which they are matched to their VC-backed 'twin' company. Negative (positive) values of t indicate years before (after) the investment event occurs. I_{it} is the ratio between investments (i.e. increase in net fixed assets of the firm i in year t plus depreciation in year t) and beginning-of-period total assets of the firm. CF_{it} is the ratio between firm's cash flows (i.e. net earnings plus depreciation) in year t and beginning-of-period total assets. $Intang_{it}$ measures the ratio between intangible assets and total assets in year t. $Size_{it}$ is measured by the natural logarithm of firm's employees in year t. Age_{it} is the firm's age in year t. D_{it} is a set of year dummies; formally $D_{it}=\tau_y d_{ity}$ where τ_y is a parameter capturing calendar year-specific shocks in investments (i.e. the fact that, other things being equal, aggregate investments fluctuate over time according to changes in expectations about, for instance, future economic growth of the economy as a whole) and $d_{ity}=1$ if year t for firm i corresponds to calendar year y.

The most important variable in equation (1), for the purpose of this work, is VC_i: a dummy variable that takes value 1 if firm i is in the VC-backed group. The dummy is included both in level and in interaction with cash flows, to control respectively for a different intercept and slope of investment-cash flow sensitivity relationship. Specifically β_5 captures the extent to which firms in the VC-backed group invest more than firms in the control group, other things being equal. Coefficient β_6, instead, captures the difference in the sensitivity to cash flows of investments for firms in the two subsamples, with negative values indicating that sensitivity is lower for firms in the VC-backed group.

We also estimate an augmented version of equation (1) in which we control for possible differences between investment patterns in high tech and non high tech (i.e. medium and low tech) companies. This control is particularly crucial since VC investments span a wide variety of sectors characterised by substantially different levels of

[9] T-tests are performed under the conservative assumption of unequal variances. *p-values* for the null hypothesis that the mean is equal between the two samples are the following: number of employees 0.17; revenues 0.39; total asset: 0.20; age 0.91; region Objective 1 0.62.

[10] Several other measures for growth opportunities exist. Following Titman and Wessels (1988), we also consider asset growth as a measure of future growth opportunities (this approach is however criticised by Balboa *et al.*, 2009). Results are qualitatively similar to the ones presented here and are available from authors upon request.

[11] Firm investments could also be affected by leverage, as argued by Lang *et al.* (1996) and Hovakimian (2009). However, leverage (i.e. total debt over total assets) proves to be excessively correlated with other regressors (especially cash flows and intangible assets) to be included in the analysis.

information asymmetry which might also differ in the extent of financial frictions. Moreover, in continental Europe, the fraction of VC investments in low and medium technology sectors is not negligible. We then add to equation (1) a dummy variable (TMT_i), both in level and in interaction with cash flows, which takes value 1 if the firm operates in technology, media & telecommunications (TMT) sector, and 0 otherwise. Finally, we also estimate equation (1) separately on different sectors.

Table 2 summarises the definition of the variables to be used.

TABLE 1
DISTRIBUTION OF SAMPLE FIRMS ACROSS SECTORS

SECTOR	TOTAL SAMPLE		VC BACKED FIRMS		NON-VC BACKED FIRMS	
	n	%	*n*	%	*n*	%
Technology, media & telecommunications	92	14	46	7	46	7
Medium and Low Tech Manufacturing	336	51	168	26	168	26
Medium and Low Tech Services	216	33	108	17	108	17
Total	**644**	**100**	**322**	**50**	**322**	**50**

The table reports the distribution according to industry of a sample of 656 unlisted Spanish firms. Percentages in the 'Total sample', 'VC backed firms' and 'Non-VC backed firms' columns are related to the total number of sample firms.

TABLE 2
DEFINITION OF THE VARIABLES

VARIABLE	DESCRIPTION
I_{it}	Increase in book value of net fixed asset plus depreciation divided by beginning-of-period total assets.
CF_{it}	Net earnings plus depreciation divided by beginning-of-period total assets.
$Intang_{it}$	Intangible fixed assets normalised by beginning-of-period total assets.
$Size_{it}$	Natural logarithm of the number of employees in year *t*.
Age_{it}	Age of the firm at time *t*.
TMT_i	Dummy variable indicating firms which operate in the Technology, Media & Telecommunications.
VC_i	Dummy variable indicating firms in the VC-backed group (i.e. 0 for firms in the control group).

We estimate equation (1) separately for $t<0$ (pre-investment period) and $t\geq 0$ (post-investment period). Let us indicate with a '-' and '+' superscript the parameters estimated in the two time subsamples. We can translate hypotheses 1 and 2 reported above in terms of parameters in (1) estimated in the two subsamples. First, according to Hypothesis 1, cash flow sensitivity should be positive in both groups leading to $\beta_1^- > 0$ and β_6^- not significantly different from zero. Note that we have no hypothesis on β_5^- (i.e. the extent to which investment of firms which eventually receive VC is higher, other things being equal, than those of control group companies). However, if firms which receive VC are characterised by better investment opportunities, which are not completely captured by their level of intangible assets, this parameter should be positive. When estimating equation (1) on the post-investment period, instead, we should find, according to Hypothesis 2, that $\beta_6^+ < 0$, which means that the reliance upon internally generated funds is lower for VC-backed companies than for control group companies after VC is received.

Equation (1) is estimated on a panel dataset, which means that error terms ε_{it} should not be considered i.i.d. but, rather, potentially correlated over *i*. As regards the estimation method, we opt for a

random effects model which splits the error term into two components $\varepsilon_{it} = \eta_i + \mu_{it}$, where η_i is a firm-specific error term and μ_{it} is an idiosyncratic white noise. Provided that η_i is independent from the vector of covariates, the estimator is consistent and does not require individual fixed effects to be estimated (see Mundlak, 1978; Arellano and Bover, 1990). Including fixed effects would shrink the time dimension even further (if using first-differences) or, similarly, increase the number of parameters to estimate by an order of magnitude (if using firm-specific dummies). Moreover we would not be able to directly observe the impact of time-constant firm characteristics on firm's investments.

Descriptive statistics

Table 3 shows the descriptive statistics for the whole sample, the subsample of VC-backed firms, and the non-VC-backed firms selected as control group distinguishing between the pre-investment (Panel A) and the post-investment (Panel B) period. All ratios are winsorised with a 2 per cent threshold cut-off for each tail, to reduce the potential influence of outliers. All accounting information is converted in real terms (constant 2005 Euro) using the Harmonised Consumer Price Index as deflator. Accounting information includes data from 1991 up to 2007 whenever possible. On average, we have about 5 years of observation in both the pre- and the post-investment period per company.

Focusing on Panel A, we observe that during the pre-investment period, for the pooled sample, investments are on average 0.1245, which is higher than cash flows 0.968. This indicates that firms in our sample have recourse to external financing only marginally since internal cash flows can potentially cover more than three quarters of firm's investments. On average, the investment ratio of firms that eventually become VC-backed is 0.1444, which is significantly larger than that of firms in the control group 0.1039. This may well be a sign that firms which receive VC have better investment opportunities.

TABLE 3
DESCRIPTIVE STATISTICS BY PERIOD

PANEL A: PRE-INVESTMENT PERIOD (t<0)

VARIABLES	OBSERVATIONS	FIRMS	MEAN	STD. DEVIATION
Investment				
All firms	3,115	643	0.1245	0.2175
VC-backed firms	1,584	322	0.1444	0.2344
Non-VC-backed firms	1,531	321	0.1039	0.1965
Difference	3,115	643	0.0404***	0.0078
Cash flow				
All firms	3,115	643	0.0968	0.1152
VC-backed firms	1,584	322	0.0908	0.1187
Non-VC-backed firms	1,531	321	0.1031	0.1112
Difference	3,115	643	-0.0122**	0.0041
Intangible assets				
All firms	3,113	643	0.0637	0.1077
VC-backed firms	1,584	322	0.0800	0.1191
Non-VC-backed firms	1,529	321	0.0467	0.0915
Difference	3,113	643	0.0333***	0.0038

PANEL B: POST-INVESTMENT PERIOD (t≥0)

VARIABLES	OBSERVATIONS	FIRMS	MEAN	STD. DEVIATION
Investment				
All firms	3,345	644	0.1026	0.1841
VC-backed firms	1,629	322	0.1307	0.2115
Non-VC-backed firms	1,716	322	0.0759	0.1487
Difference	3,345	644	0.0548***	0.0064
Cash flow				
All firms	3,345	644	0.0776	0.1076
VC-backed firms	1,629	322	0.0619	0.1101
Non-VC-backed firms	1,716	322	0.0924	0.1029
Difference	3,345	644	-0.0305***	0.0037
Intangible assets				
All firms	3,346	644	0.0695	0.1110
VC-backed firms	1,630	322	0.0913	0.1231
Non-VC-backed firms	1,716	322	0.0489	0.0936
Difference	3,346	644	0.0423***	0.0038

The table reports descriptive statistics on winsorised (2% each tail) values of the variables. All variables are normalised by using beginning-of-period stock of total assets. We test the null hypothesis that means are equal between VC-backed and Non-VC-backed groups assuming unequal variance. ***, ** and * indicate, respectively, significance levels <1%, <5% and <10%.

Interestingly, on average, cash flows to total assets are significantly larger for firms in the control group (0.1031) than for those in the VC-backed group (0.0908). In other words, firms in the VC-backed sample invest more and with lower cash flows in the pre-investment window, which means they have to rely more heavily on external financing. This could lead to both lower control aversion of entrepreneurs and higher benefit from VC, making these companies more prone to seek VC in the first place. Intangible assets are also significantly larger for companies in the VC-backed groups (0.800 against 0.467 for the control group) and this, again, supports the idea that these companies have better investment opportunities.

Moving to the post-investment period (Table 3, Panel B) we see that VC-backed companies are still investing significantly more than control group companies (0.1307 against 0.0759) and that the wedge between the two groups has actually widened (from 0.0404 to 0.0548). Moreover, cash flows to total assets of VC-backed companies continue to be significantly lower than those of control group companies (0.0619 against 0.0924) and, again, the difference is wider than before the investment event (-0.0305 vs. -0.0122). A similar pattern is found for the ratio of intangible assets, which is still significantly higher in VC backed companies (0.0913 against 0.0489) and even higher than before investment (0.0423 vs. 0.0333). VC seems to amplify the differences in the investment pattern between VC-backed and matched firms.

To have more robust, yet still descriptive, evidence on this, we estimate a difference-in-difference (diff-in-diff) model on investments, cash-flows, and intangible assets. The diff-in-diff approach consists of comparing the different change in one variable between the pre- and post-investment period across the two groups. To avoid potential underestimation of standard errors due to serially correlated outcomes (see Bertrand *et al.*, 2004), we average figures in the pre- and post-investment windows for each firm and then estimate diff-in-diff on these averaged values. Results are reported in Table 4.

Diff-in-diff regression broadly confirms the intuition obtained by comparing the descriptive statistics across groups. The diff-in-diff coefficient (*Post*VC*), which indicates the different change in the outcome (namely investments, cash flows or intangible assets), always exhibits the same sign as the *VC* coefficient, which indicates the average difference between the two groups. In other words, between the pre- and post-investment period differences between the two groups are amplified. The coefficient is significantly different from zero at conventional levels only in the cash-flow and intangible asset regressions, while it is not significant for investments.

TABLE 4
DIFFERENCE-IN-DIFFERENCE OF KEY PARAMETERS

Independent variables	*Investment*	*Cash flows*	*Intangible assets*
VC	0.0487 ***	-0.0091	0.0326 ***
	(0.0154)	(0.0080)	(0.0082)
Post	-0.0579 ***	-0.0121 **	-0.0065
	(0.0098)	(0.0051)	(0.0044)
*Post*VC*	0.0082	-0.0237 ***	0.0133 *
	(0.0155)	(0.0078)	(0.0072)
Constant	0.1312 ***	0.1031 ***	0.0542 ***
	(0.0102)	(0.0051)	(0.0053)
N° observations	1,311	1,311	1,311

The table reports OLS diff-in-diff regression on firm's investments, cash flows and intangible assets. VC and Post are dummy variables which identify respectively firms in the VC-backed group and observations in the post-investment window. Other variables are defined in Table 2. All ratios are winsorised at the 2% threshold. Each observation in the regression is the average of the respective variable in the relative (i.e. pre- or post-investment) period. Standard errors are robust and clustered by firm. ***, ** and * indicate, respectively, significance levels <1%, <5% and <10%.

Overall these results are consistent with the idea that VC does allow VC-backed firms to maintain their above-average investment level and to grow in assets far quicker than their growth in cash flows (which explains why cash flow ratio to total assets *decreases* in the post-investment window for VC-backed companies); this increase in investments seems to be relatively more concentrated in R&D, which is consistent with the increase in the fraction of intangible assets in the post-investment window.

It is also worth analysing whether some differences across sectors can be found. Descriptive statistics by sector, period and group are reported in Table 5.

Figures in Table 5 confirm that results shown in Table 3 are robust across sectors. In all sectors firms in the VC-backed group invest more that control group firms despite their having lower cash flows to total assets and the differences grow larger after the investment event. We observe, however, that *TMT* firm exhibit more extreme behaviour.

TABLE 5
DESCRIPTIVE STATISTICS BY SECTOR AND PERIOD

Panel A: Pre-investment period (t<0)

	Sector					
	Technology, media & telecommunications		*Medium and low tech Manufacturing*		*Medium and low tech Services*	
Variables	N	Mean	N	Mean	N	Mean
Investment						
All firms	66	0.1471	300	0.1165	190	0.1202
VC-backed firms	33	0.1725	150	0.1328	95	0.1419
Non-VC-backed firms	33	0.1188	150	0.0992	95	0.0987
Difference	66	0.0537**	300	0.0336***	190	0.0432***
Cash flow						
All firms	66	0.1325	300	0.0936	190	0.0923
VC-backed firms	33	0.1240	150	0.0904	95	0.0870
Non-VC-backed firms	33	0.1420	150	0.0969	95	0.0976
Difference	66	-0.0180**	300	-0.0065**	190	-0.0106**
Intangible Assets						
All firms	66	0.1020	300	0.0560	190	0.0596
VC-backed firms	33	0.1291	150	0.0742	95	0.0730
Non-VC-backed firms	33	0.0718	150	0.0370	95	0.0462
Difference	66	0.0573***	300	0.0372***	190	0.0268***

PANEL B: POST-INVESTMENT PERIOD (t≥0)

	SECTOR					
	TECHNOLOGY, MEDIA & TELECOMMUNICATIONS		MANUFACTURING		SERVICES	
VARIABLES	N	MEAN	N	MEAN	N	MEAN
Investment						
All firms	66	0.1293	300	0.0901	191	0.0985
VC-backed firms	33	0.1615	150	0.1177	95	0.1184
Non-VC-backed firms	33	0.0979	150	0.0637	96	0.0799
Difference	66	0.0636***	300	0.0540***	191	0.0385***
Cash flow						
All firms	66	0.0948	300	0.0760	191	0.0710
VC-backed firms	33	0.0746	150	0.0668	95	0.0507
Non-VC-backed firms	33	0.1144	150	0.0847	96	0.0899
Difference	66	-0.0398**	300	-0.0179***	191	-0.0392***
Intangible Assets						
All firms	66	0.1274	300	0.0530	191	0.0688
VC-backed firms	33	0.1689	150	0.0736	95	0.0936
Non-VC-backed firms	33	0.0871	150	0.0334	96	0.0456
Difference	66	0.0818***	300	0.0402***	191	0.0480***

The table reports descriptive statistics on winsorised (2% each tail) values of the variables. All variables are normalised by using beginning-of-period stock of total assets. We test the null hypothesis that means are equal across different Period subsamples. ***, ** and * indicate, respectively, significance levels of <1%, <5% and <10%.

While investment ratios are higher for VC-backed firms in all sectors, the wedge between the two groups is particularly wide in the TMT sector (0.0537 pre-investment which increases to 0.0637 post-investment). At the same time TMT companies are those for which the difference in the (negative) cash flow ratio between VC-backed and control group companies is larger in absolute terms and becomes sizeably larger after-investment (-0.0180 vs. -0.0398). The intangible assets ratio for VC-backed firms is always higher than for control group companies, regardless of the sector, and again *TMT* sectors show the most extreme difference (0.0573 and 0.0818 in the pre- and post- investment periods respectively).

Results

Table 6 shows the results obtained from the estimation of the models described in Section 3.2 on the whole sample, splitting the pre- and post-investment period.

Consistently with Hypothesis 1, we find evidence of a positive and significant relationship between investments and cash flows in both specifications and sub-periods. Non-VC-backed firms in our sample, thus, seem to be significantly financially dependent on internally generated cash flows. In the pre-investment period the *VC* coefficient is positive and significant while the *VC*CF* interaction term is not significant. Firms which eventually receive VC, thus, invest more but do not appear to be more sensitive to their level of cash-flows than control group companies.

In the post-investment period, instead, VC backed firms continue to invest more than control group companies (and the wedge seems to have widened, consistently with preliminary evidence presented in Section 4) and, more interestingly, their investment level is less sensitive to current cash flows, as shown by the negative and significant coefficient of the *VC*CF* covariate. This is consistent with our Hypothesis 2: after VC financing the relationship between investments and cash flows is significantly reduced.

Our control for growth opportunities, the ratio of intangible assets, is always positive and significant, reassuring us on the fact that it captures firm's investment opportunities as suggested by Manigart *et al.* (2003). *Age* and *Size* are, as expected, negative (older and larger companies invest relatively less) despite only *Age* being significant at usual confidence levels.

TABLE 6
REGRESSION RESULTS OF THE INVESTMENT-CASH FLOW SENSITIVITY FOR PRE- AND POST-INVESTMENT PERIOD: WHOLE SAMPLE DIVIDED BY INVESTMENT PERIOD

	DEPENDENT VARIABLE: INVESTMENT			
INDEPENDENT VARIABLES	*PRE-INVESTMENT PERIOD*		*POST-INVESTMENT PERIOD*	
CF_{it}	0.4335 *** (0.0602)	0.4598 *** (0.0621)	0.2339 *** (0.0465)	0.2384 *** (0.0454)
$Intang_{it}$	0.8930 *** (0.0688)	0.8990 *** (0.0685)	0.5946 *** (0.0519)	0.5986 *** (0.0534)
$Size_{it}$	-0.0093 (0.0063)	-0.0084 (0.0063)	-0.0010 (0.0030)	-0.0009 (0.0030)
Age_{it}	-0.0022 *** (0.0007)	-0.0023 *** (0.0007)	-0.0008 ** (0.0003)	-0.0008 ** (0.0003)
TMT_i		-0.0236 (0.0215)		-0.0112 (0.0115)
$TMT_i * CF_{it}$		-0.0435 (0.0400)		0.0375 (0.0341)
VC_i	0.0252 * (0.0137)	0.0234 * (0.0137)	0.0403 *** (0.0081)	0.0421 *** (0.0081)
$VC_i * CF_{it}$	0.0001 (0.0063)	0.0018 (0.0046)	-0.0472 ** (0.0224)	-0.0762 *** (0.0295)
Intercept	0.1096 *** (0.0260)	0.1084 *** (0.0269)	0.0849 *** (0.0182)	0.0855 *** (0.0185)
N° observations	3,088	3,088	3,324	3,324
N° groups	639	639	643	643

The table reports the Generalised Least Squares, random effects, estimation of the model. Variables are defined in Table 2. All ratios are winsorised at the 2% threshold. Robust standard errors are reported in parenthesis. ***, ** and * indicate, respectively, significance levels of <1%, <5% and <10%.

Surprisingly the coefficients of *TMT* and *TMT***CF* are negative, although not significant. TMT companies, contrary to expectations, do not seem to invest more than medium and low tech firms once investment opportunities have been controlled for, and they do not seem to be more dependent on cash flows. This might be reflecting easier access to alternative sources of money, such as innovation subsidies provided by public-sector-related bodies, as argued by Di Giacomo (2004).

To control for possible biases in our results due to possible imperfections in the matching process (which is by definition only made on observable characteristics), we also estimate equation (1) (and its augmented version including *TMT* and *TMT***CF*) on the restricted sample of VC-backed companies, excluding the control group (Table 7). We find that the *CF* coefficient is positive and highly significant before VC investment (consistently with Hypothesis 1), and that, while it is still positive after VC investment, it shows a sharp reduction, consistently with Hypothesis 2. Other variables follow a similar pattern to that shown in Table 6, thus confirming that our results should not be driven by unobservable and uncontrolled differences between the two samples.

TABLE 7
REGRESSION RESULTS OF THE INVESTMENT-CASH FLOW SENSITIVITY FOR VC BACKED FIRMS FOR PRE- AND POST-INVESTMENT PERIOD

	DEPENDENT VARIABLE: INVESTMENT			
INDEPENDENT VARIABLES	*PRE-INVESTMENT PERIOD*		*POST-INVESTMENT PERIOD*	
CF_{it}	0.4274 *** (0.0847)	0.5088 *** (0.0857)	0.2073 *** (0.0646)	0.2394 *** (0.0643)
$Intang_{it}$	0.9383 *** (0.0847)	0.9247 *** (0.0825)	0.6864 *** (0.0718)	0.6928 *** (0.0734)
$Size_{it}$	-0.0156 * (0.0090)	-0.0123 (0.0091)	-0.0096 * (0.0056)	-0.0102 * (0.0056)
Age_{it}	-0.0026 * (0.0008)	-0.0027 *** (0.0008)	-0.0011 ** (0.0005)	-0.0010 ** (0.0005)
TMT_i		-0.0427 (0.0268)		-0.0161 (0.0195)
TMT_i*CF_{it}		-0.1211 *** (0.0209)		-0.0382 ** (0.0177)
Intercept	0.1617 *** (0.0387)	0.1468 *** (0.0399)	0.1671 *** (0.0337)	0.1670 *** (0.0341)
N° observations	1,572	1,572	1,614	1,614
N° groups	320	320	321	321

The table reports the Generalised Least Squares, random effects, estimation of the model. Variables are defined in Table 2. All ratios are winsorised at the 2% threshold. Robust standard errors are reported in parenthesis. ***, ** and * indicate, respectively, significance levels of <1%, <5% and <10%.

The significance of the *TMT*CF* term in Table 7 suggests that investment patterns, as well as cash flow sensitivity, might be substantially different across industries. Accordingly, we re-estimate equation (1) splitting by sectors on the whole sample (Table 8) and on the VC-backed sample only (Table 9).

The pattern found in firms belonging to the manufacturing and service sectors shown in Table 8 is similar to that shown in Table 6. Firms included in those two groups experience a sharp reduction in the cash flow coefficient after the investment occurs even though with a different dynamic: VC-backed manufacturing firms are more dependent on cash flows before VC investment than control group companies while this difference disappears after the initial VC investment; VC-backed service companies do not exhibit a different sensitivity before investment but a lower sensitivity after the VC investment. In either case, though, VC reduces investment sensitivity. These results are confirmed by figures shown in Table 9, where a substantial reduction in the cash flow coefficient is found in the period after the investment in both groups.

As regards *TMT*, results are, again, different from those found in the other two sectors and somewhat less clear-cut. In Table 8, results show that the cash flow coefficient is only significant in the period before the investment and becomes insignificant after the investment. When only the TMT VC-backed group is considered, in Table 9 however, in neither of the two periods is the cash flow coefficient significant; yet, the limited number of observations of this group limits the validity of this result. The interaction term between VC and cash flow shows a negative sign in both periods in Table 8. This result may reinforce evidence shown in Table 7, and could be compatible with TMT companies getting sizeable subsidies that distort investment sensitivity to cash flows. An alternative explanation could be related to the low cash flow generation of TMT firms in the early stages, when these companies rely much more on entrepreneur's personal resources than on firm's cash flows. In this phase cash flows could not be a valid proxy for the availability of financial resources.

TABLE 8
REGRESSION RESULTS OF THE
INVESTMENT-CASH FLOW SENSITIVITY FOR PRE- AND POST-INVESTMENT PERIOD:
WHOLE SAMPLE DIVIDED BY SECTOR

	Dependent Variable: Investment					
	Technology, media & telecommunications		*Manufacturing*		*Services*	
Independent variables	*Pre-investment period*	*Post-investment period*	*Pre-investment period*	*Post-investment period*	*Pre-investment period*	*Post-investment period*
CF_{it}	0.2850 *** (0.1077)	0.1297 (0.0881)	0.5791 *** (0.1023)	0.1623 * (0.0917)	0.5076 *** (0.1013)	0.2780 *** (0.0672)
$Intang_{it}$	0.8891 *** (0.1376)	0.7313 *** (0.0801)	0.7042 *** (0.0956)	0.4867 *** (0.0865)	1.1312 *** (0.1083)	0.6223 *** (0.1011)
$Size_{it}$	0.0072 (0.0148)	-0.0023 (0.0113)	-0.0279 *** (0.0098)	-0.0084 ** (0.0048)	0.0040 (0.0096)	0.0046 (0.0039)
Age_{it}	-0.0035 ** (0.0016)	-0.0001 (0.0012)	-0.0017 ** (0.0007)	-0.0006 (0.0004)	-0.0020 (0.0014)	-0.0012 ** (0.0006)
VC_i	0.0126 (0.0376)	0.0248 (0.0253)	0.0282 (0.0173)	0.0416 *** (0.0133)	0.0355 (0.0250)	0.0273 ** (0.0134)
VC_i*CF_{it}	-0.1030 *** (0.0226)	-0.0299 ** (0.0137)	0.0080 *** (0.0028)	0.1304 (0.1182)	-0.0837 (0.0666)	-0.0935 *** (0.0166)
Intercept	0.0664 (0.0583)	0.0979 * (0.0511)	0.1672 *** (0.0416)	0.1018 *** (0.0251)	0.0334 (0.0400)	0.0926 *** (0.0350)
N° observations	356	473	1,674	1,732	1,048	1,119
No groups	91	92	334	335	212	216

The table reports the Generalised Least Squares, random effects, estimation of the model. Variables are defined in Table 2. All ratios are winsorised at the 2% threshold. Robust standard errors are reported in parenthesis. ***, ** and * indicate, respectively, significance levels of <1%, <5% and <10%.

TABLE 9
REGRESSION RESULTS OF THE
INVESTMENT-CASH FLOW SENSITIVITY FOR PRE- AND POST-INVESTMENT PERIOD:
SAMPLE OF VC-BACKED FIRMS DIVIDED BY SECTOR

	Dependent Variable: Investment					
	Technology, media & telecommunications		*Manufacturing*		*Services*	
Independent variables	*Pre-investment period*	*Post-investment period*	*Pre-investment period*	*Post-investment period*	*Pre-investment period*	*Post-investment period*
CF_{it}	0.0463 (0.1445)	0.0957 (0.1091)	0.5839 *** (0.1337)	0.2809 ** (0.1178)	0.4210 *** (0.1447)	0.2850 *** (0.1010)
$Intang_{it}$	1.1362 *** (0.1502)	0.9093 *** (0.1114)	0.7344 *** (0.1195)	0.5554 *** (0.1062)	1.1973 *** (0.1418)	0.7677 *** (0.1493)
$Size_{it}$	-0.0093 (0.0213)	-0.0098 (0.0248)	-0.0351 ** (0.0148)	-0.0204 ** (0.0092)	-0.0024 (0.0124)	-0.0025 (0.0068)
Age_{it}	-0.0011 (0.0019)	0.0003 (0.0020)	-0.0019 ** (0.0009)	-0.0006 (0.0006)	-0.0042 ** (0.0019)	-0.0023 *** (0.0009)
Intercept	0.1646 * (0.0832)	0.1266 (0.0933)	0.2319 *** (0.0638)	0.1746 *** (0.0482)	0.0991 * (0.0561)	0.1963 *** (0.0623)
N° observations	188	230	853	842	531	542
No groups	46	46	167	167	107	108

The table reports the Generalised Least Squares, random effects, estimation of the model. Variables are defined in Table 2. All ratios are winsorised at the 2% threshold. Robust standard errors are reported in parenthesis. ***, ** and * indicate, respectively, significance levels of <1%, <5% and <10%.

To sum up, we find firm evidence that investments are sensitive to cash flows in all SMEs, including firms that are later invested by VC, consistently with Hypothesis 1. Regarding the period after the investment, we find that the investment-cash flow sensitivity is significantly reduced in the VC-backed group, with the interaction term showing a significantly smaller dependency in that group when compared with the control group, consistently with our Hypothesis 2. VC institutions thus effectively alleviate the investment dependency on internally generated funds in growing SMEs. Finally, all the results shown in this section are robust to an alternative measure of growth opportunities, namely growth of sales. The regressions are available upon request to authors.

Conclusions

SMEs have a difficult access to external funding due to both problems stemming from information asymmetries, which limit the supply of external capital towards them, and problems deriving from control aversion of entrepreneurs, which limit their own demand for external capital in the first place. Information asymmetries cause suppliers of financial resources to demand enough assets as to be used as collateral and high interest rates, thus conditioning the ability of SMEs to take advantage of their growth

opportunities. The fear of losing control on their businesses also limits the interest of entrepreneurs in finding external equity. As a result, most SMEs basically rely on their internally generated funds to finance growth.

VC is a long term source of external equity, which also brings value added in the form of corporate governance and mentoring activities. Those value added activities enhance the reliability of investee's financial statements and of the business itself. The increased equity base and the more solid accounts help entrepreneurs to raise long term resources, thus reducing the investment dependency on internally generated funds. Additionally, the temporary nature of the holding period of minority stakes by VC investors, also diminishes the control aversion shown by entrepreneurs.

In this work we analyse to what extent VC investors reduce the investment dependency on cash flow in fast growing SMEs. We carry out our analyses on a sample of 322 growing Spanish SMEs that received a VC investment over the period 1995-2004. Our results are compared with a one-by-one matched sample of similar SMEs with no VC involvement.

After controlling for growth opportunities, size, age and sector, we find evidence of a positive and significant relationship between investment and cash flow when all firms, both VC-backed and not, are included in the analysis. As regards VC-backed firms, a significant reduction in the investment dependency on cash flows is found after the initial VC investment event. Although the relationship between investment and cash flow is positive and significant in both pre- and post-investment periods, except in the group of TMT firms, the value of the coefficient decreases sharply after the entry of venture capitalists.

Our contribution to the literature is threefold. First, we provide new evidence to the scarce and mixed results found in this field (Manigart *et al.*, 2002; Bertoni *et al.*, 2008; and Engel and Stiebale, 2009). Second, we provide a separate view in different sectors, highlighting the role of VC investors in low and medium technology sectors such as manufacturing and general services, while the sectoral dimension is often neglected in the literature. Finally, this is, to our knowledge, the first study about the investment behaviour of VC- and non-VC-backed Spanish SMEs and, as such, it is based on a totally unexplored population.

Regarding our limitations, we base our analyses on a static random effects model, building on the classical model by Fazzari *et al.* (1988), and using an alternative measure of growth opportunities. Since we aim to fully separate the pre- and post-investment periods, the lack of data prevents us from using other approaches, such as the sales accelerator model (Abel and Blanchard, 1988) or the Euler equation model (Bond and Meghir, 1994), which require a larger time window to converge. However, our results are consistent across estimates and are not significantly affected when we estimate the models on difference sub-samples, which reassures us on their robustness.

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