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The different roles played by venture capital and private equity investors on the investment activity of their portfolio firms

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Abstract Venture capital (VC) and private equity (PE) investors play different roles in their portfolio companies. We argue that this will translate in a recognizable difference in the investment sensitivity to cash flows of portfolio companies and its evolution after the first investment round. We hypothesise that VC, thanks to its ability in overcoming asymmetries in information, will entail a reduction in the financial constraints which hampered the growth of investee firms. We predict, instead, a greater dependency of investments to cash flow for PE-backed companies, driven by the renewed interest for growth of their management combined with higher leverage. We find evidence confirming our hypotheses on a large panel of Spanish unlisted firms in low and medium technology sectors, where both VC and PE firms are active.

Keywords Venture capital · Private equity · Buyouts · Investment sensitivity to cash flow

JEL Classifications G32 · G24 · L26

1 Introduction

Venture capital (VC, henceforth) can be defined as the investment by professional investors of long-term, unquoted, risk equity finance in new firms (Wright and Robbie 1998). The origins of VC as an industry can be traced back in the United States as far as the mid 1940s (Bygrave and Timmons 1992). Its introduction in Europe occurred almost four decades later and resulted in a very different outcome. From the very beginning the investment scope of VC investors in Europe moved away from the traditional young fast-growing companies, and shifted towards buyouts in mature firms, mostly related to low and medium technology sectors. These deals are often classified as a distinct category from VC, known as private equity (PE, hereafter).[1] The distinction between VC and PE is

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[1] The distinction between PE and VC is, however, ambiguous. PE should, generally speaking, be a broader conceptual category than VC, including all professional investors focusing on unlisted firms (i.e. comprising VC as a special case). This is, for instance, the definition given by the EVCA in its glossary: '*Private Equity provides equity capital to enterprises not quoted on a stock market. Private equity can be used to develop new products and technologies (also called venture capital), to*

not merely terminological. The two forms of investments are well-known to differ in their modes and rationale, and in this paper we will show how they also differ dramatically in their impact on the investment activity of portfolio companies, an aspect that has received limited attention in the literature so far.

VC has its theoretical underpinning in the existence of information asymmetries that make it difficult for small and medium-sized enterprises (SMEs, henceforth) to access capital markets. Due to information asymmetries, SMEs rely on the founders' personal wealth and the internally generated resources to fund their operations, finance their investment opportunities, and sustain their growth (Carpenter and Petersen 2002a). VC plays a critical role for these companies, which might otherwise forgo their growth and investment opportunities. Moreover, VC represents more than a financial source for SMEs, and provides many value-added services to investee firms, such as monitoring, advisory services and reputational capital (Sahlman 1990; Gompers and Lerner 1998; Sørensen 2007). The empirical evidence is consistent in confirming that VC plays a positive role on employment (Wasmer and Weil 2000; Belke et al. 2006; Bertoni et al. 2007), sales (Bertoni et al. 2011), innovation (Kortum and Lerner 2000), and productivity (Alemany and Martí 2006; Chemmanur et al. 2011; Croce et al. 2010). Less attention has instead been devoted to the role played by VC investors in the reduction of financial constraints in investee firms, overcoming the financial barriers that limit their investment activity (Manigart et al. 2003; Engel and Stiebale 2009; Bertoni et al. 2010a). This limited literature has, moreover, reached mixed results.

The role played by PE investors in buyout deals has, instead, a totally different rationale. PE institutions invest in companies at a late stage of their evolution in which fulfilling an unexpressed internal growth potential was not the highest priority. Most of those deals are buyouts in which target firms suffer from agency problems of different nature before being acquired (e.g. separation between ownership and control) but seem to have a solid cash flow generation process that does not impose a relevant stress on firm's investments. In this regard, the contribution of a PE firm to investee companies is in refocusing their strategic activities (e.g. Robbie et al. 1993; Smart and Waldfogel 1994; Wiersema and Liebeskind 1995) and supporting their added-value strategies (Bruining and Wright 2002). PE brings particularly important economic and social benefits (Wright et al. 2009) and, to a large extent, improves firm's efficiency and performance (Cumming et al. 2007). Moreover, the role of PE goes beyond what could be captured by a pure agency perspective (Wright et al. 2001b). The upside potential of buyouts can be better captured by complementing the agency view with a strategic entrepreneurship perspective that highlights how new management resources contribute to firm's 'rebirth' (Wright et al. 2001a; Meuleman et al. 2009). Nevertheless, evidence on this mixed perspective of more constraints, due to the increase in debt and monitoring, but increased willingness to grow is still limited in the PE literature. In the case of Spain, the country on which this work is focused, there are a number of firms that grew substantially, even internationally, after a PE-sponsored buyout.

The aim of this paper is thus to understand the different role played by VC and PE investors in supporting the investment activity of their portfolio companies, which are mostly low or medium technology firms. Regarding VC, we aim to verify if the positive impact on growth and efficiency is grounded on the reduction in financial constraints of investee firms. As regards PE buyouts, we aim to verify if they are associated, as we expect, to a rise of financial constraints in previously unconstrained firms; moreover we want to assess whether this is in turn associated with an enhanced interest for growth, which would confirm that PE goes well beyond what can be captured by a pure agency perspective.

We based the study on a very large sample of Spanish low and medium technology firms that were subject to a VC/PE investment between 1995 and 2004. We decided to focus on a sample of firms operating in low and medium technology industries for two reasons. First, because they receive surprisingly little attention from the literature. High-tech investments represent a very small fraction of the activity of VC and PE investors in Europe. Nevertheless, due to the more policy-sensitive nature of high-tech firms in general, these firms have received a

Footnote 1 continued
expand working capital, to make acquisitions, or to strengthen a company's balance sheet'. However, often, a narrower definition of PE is used, which includes only non-VC (i.e. only late stage) deals. Incidentally this ambiguity is also present in the full name of the EVCA, which is 'European Private Equity and Venture Capital Association', suggesting that the latter does not include the former as a special case.

disproportionate attention in the literature, whereas low and mid-tech have been almost neglected. Second, since the objective of this work is to determine and compare the role of VC and PE on firm's investment activity we need a sample that provides a common support for both VC and PE investments. To this extent, high-tech is not very helpful, since in this sector very few buyouts are conducted, compared to the number of VC deals.

Our results are quite robust in indicating that growth in low and medium technology firms at the expansion stage is constrained to internally generated resources before the first VC investment. In the post-investment period, however, this limitation fades away, thus explaining why investee firms are able to grow faster thereafter. Conversely, we find that investments in mature low and medium tech firms were not significantly held back by internal cash flow generation before they were acquired by a PE investor. We also provide evidence that after the acquisition the increase in financial constraints is accompanied by further growth, thus resulting in a significant dependency of investments to cash flow generation.

As a first contribution we should mention this latter piece of evidence, which is particularly new to the literature and is consistent with our hypotheses (see the discussion in Sect. 2). This is particularly important in the light of the heavy criticism of the purely financial focus of buyouts, which is sometimes found in the media. As a second contribution, and beyond the evidence found in other papers about how fast VC-backed firms grow, this work provides an explanation on why those firms are able to grow. VC institutions invest in firms whose investments were heavily dependent on the internally generated resources and their involvement eases that dependency. The third contribution of our study is related to the industry focus on low and medium technology firms, which is frequently neglected in the VC literature.

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 econometric methodology we use to investigate the investment sensitivity to cash flow generation and its evolution. Section 4 describes the sampling process and the sample. Results are presented and discussed in Sect. 5. Finally, the main findings are highlighted and discussed in Sect. 6.

2 Literature review and research hypotheses

Firm's investment decisions are affected by several factors. In a world characterised by frictionless capital markets, investments are driven by current (and expectations about future) conditions of the market for goods, cost of factors of production, technology and adjustment costs (see Jorgenson 1963). Frictions in the capital market cause additional factors to influence firm's investment decisions. The importance of these additional factors varies on a case-by-case basis, depending upon which typology of market friction dominates. This, in turn, is influenced by factors such as firm's age, size, industry, productivity, capital structure, and ownership structure (for a review, see Hubbard 1998). While most of these characteristics are relatively stable over time, others, such as capital and ownership structure, may be subject to abrupt variations, causing changes in firm's investment patterns sizeable enough to be discernible to an external observer. VC and PE investments are a noteworthy example of this general research approach. In the remainder of this section we develop the theoretical hypotheses about how investments change in investee firms before (Sect. 2.1) and after (Sect. 2.2) VC and PE investments.

To measure the effect of VC or PE involvement on the investments of the investee firms we resort to the investment sensitivity to internally generated cash flows. Investment dependency to cash flow is almost unanimously found to vary across groups of firms exhibiting different characteristics, even though authors disagree about why this occurs. Fazzari et al. (1988) were the first to use investment sensitivity to cash flows as a signal for the existence of financial constraints. In their seminal work they analysed a sample of listed manufacturing US firms and, after controlling for growth opportunities using Tobin's q, their results showed a significant and positive investment–cash flow relationship, which was higher in firms with low dividend payouts (used here as a proxy for the degree of financial constraints). The authors conclude that the strong positive effect of internal funds on investments is caused by liquidity constraints. In line with the idea of Fazzari et al. (1988), a number of works support their main conclusions. Higher investment–cash flow sensitivity is also observed in firms that are young or small (Shin and Kim 2002), or in independent firms, as opposed to

firms affiliated with industrial groups (Hoshi et al. 1991). Some of them focused also on investment in inventory (Carpenter et al. 1998), R&D investment (Himmelberg and Petersen 1994; Carpenter and Petersen 2002b), cash savings (Almeida et al. 2004) and total assets (Carpenter and Petersen 2002a).

Kaplan and Zingales (1997) criticised empirically and theoretically the approach of Fazzari et al. (1988). First, they show, using a simple theoretical model, that the investment–cash flow sensitivity does not necessarily increase monotonically with firm's financial constraints, especially for companies which are close to bankruptcy. Then, they empirically test this prediction on a subset comprising the lowest dividend payout firms used by Fazzari et al. (1988), using both quantitative and qualitative information to rank them according to their financial constraints. The sensitivity of investments to cash flows is found to be higher for those companies which are less financially constrained. Cleary (1999, 2006), Kadapakkam et al. (1998), and Almeida and Campello (2007), all support the findings of Kaplan and Zingales (1997).

This suggests that investment–cash flow sensitivity should not be used as a direct signal of the severity of financial constraints. However, it may still be used as an indicator of the *existence* of financial constraints: investment–cash flow sensitivity will not be significantly different from zero for non-financially constrained firms but it will be positive and significant for financially constrained ones. The Kaplan and Zingales (1997) critique is, indeed, only about the monotonicity of the relationship (which was implicitly assumed by Fazzari et al. 1988), not about its sign.

2.1 The sensitivity of investment to cash flow in firms before a VC/PE investment

The problems stemming from information asymmetries, described, among others, by Jensen and Meckling (1976) and Myers and Majluf (1984), for the equity market, and by Stiglitz and Weiss (1981) for the credit market, imply that stakeholders do not have the same access to information. The lack of sufficient information to assess the quality of different investment projects in the firm (adverse selection problems), or to ensure that the funds will not be diverted (moral hazard problems), determines the level of risk that creditors and/or equity investors face. A higher level of risk results in a higher cost of external capital. Thus, information asymmetries between stakeholders and entrepreneurs condition the choice of financing between outside sources and internally generated funds. Information asymmetries may lead to the rejection of positive net present value investment opportunities in order to avoid the excessive cost of external financial resources. SMEs are particularly affected by information asymmetries in their relationship with external sources of capital (Carpenter and Petersen 2002a). These problems become more acute due to the lack (or the low level) of tangible assets to pledge as collateral and of a track record of past performance (Ang 1991; Chittenden et al. 1996; Berger and Udell 1998). SMEs are then more likely than other companies to be financially constrained and to be limited in their investments to using internally generated resources (Vogt 1994; Carpenter and Petersen 2002a).

VC arises as the ideal source of external equity for a number of fast growing SMEs. VC investors are characterised by their ability to efficiently screen and monitor their investee firms, thus reducing the problems deriving from information asymmetries (see e.g. Sahlman 1990). VC managers apply a structured screening process aimed at selecting those projects with better growth prospects that are run by outstanding management teams (see e.g. Tyebjee and Bruno 1984; Shepherd and Zacharakis 2002) and designing contracts to reduce moral hazard (see e.g. Hellmann 1998; Tykvová 2007).

Firms that are later selected by VC institutions, like those in our sample, are not a random extraction from the population but they are the ones that are most likely to be financially constrained in the pre-investment period. Looking for VC requires a substantial effort from the entrepreneurial team (see Bertoni et al. 2010b) and obtaining VC entails giving up some private benefits of control or, put differently, overcoming the reluctance of most entrepreneurs to allow external investors in 'their' company (Mason and Harrison 2001). Therefore, only a subset of entrepreneurs/SMEs whose forgone investment opportunities might be large enough to offset these two 'costs' of VC financing will eventually seek (and sometimes obtain) it, thus raising the required external funding to carry out the projected investments.

The analysis of financial constraints based on firm's investment sensitivity to cash flow in firms that were later subject to a VC investment has already been

addressed in several European countries. Manigart et al. (2003) analysed the investment–cash flow sensitivity on a sample of unquoted Belgian VC-backed and a matched sample of non-VC-backed firms. They found that VC-backed firms showed a positive and significant relationship between investment and cash flow before the initial VC investment. Engel and Stiebale (2009) also found that UK and French portfolio firms display positive and significant investment sensitivity to cash flow before receiving expansion financing. Similarly, Bertoni et al. (2010a) provide evidence on the dependency of investment to cash flow in VC and non-VC-backed Italian unlisted new-technology-based firms. This discussion leads us to formulate the following hypothesis.

Hypothesis 1a Investments of SMEs are substantially conditioned by internally generated cash flows before they obtain the first round of VC.

In contradiction with this restriction found in VC-backed firms before obtaining VC funding, the investment dependency to internally generated cash flows is likely to exhibit a very different pattern in mature firms that are later subject to a buyout sponsored by a PE house. Buyouts are usually carried out in the form of highly leveraged transactions (Kaplan 1989; Thompson et al. 1992; Kaplan and Strömberg 2009). Target companies in those deals show totally different characteristics from those described in previous paragraphs. These firms have a relatively longer operating history (Jelic et al. 2005), assets that can be used as collateral (Harris and Raviv 1991), low gearing (Smith 1990; Evans et al. 2005; Borell and Tykvová 2011), stable cash flows, and more limited investment opportunities (Smith 1990; Wright et al. 2001b; Jelic et al. 2005). Target firms exhibit greater capacity to generate financial resources, albeit with limited growth prospects (Wright et al. 1992) or growth rates (Evans et al. 2005). Therefore, mature firms that are later subject to a buyout usually exhibit a stable stream of cash flows and may allocate it inefficiently (Jensen 1986), thus affecting performance. In this line, Morck et al. (1989) and Denis and Kruze (2000), among others, find that poor performance increases the likelihood of a firm being acquired.

Heterogeneity among leveraged buyouts is increasingly considered to be important (Cumming et al. 2007), and the literature identifies different types of deals. In particular, Wright et al. (2009) identify the following types of deals: public to private buyouts (PTPs), buyouts involving subsidiaries, divisions or plants of corporations (DIV_BOs), buyouts on whole private or family firms (F/P_BOs), buyouts of public sector firms (PS_BOs) and buyouts of firms in receivership (TURN_BOs).[2] This classification allows us to highlight the different agency issues which characterise target companies and in turn affect their investment patterns. Regarding PTPs, shareholder dispersion and large company boards reduce the likelihood of the management being replaced in listed firms (John and Senbet 1998). Agency problems also arise in DIV_BOs, where the complexity of large corporations usually gives rise to a lack of appropriate control mechanisms and incentive schemes (Thompson and Wright 1987). Control mechanisms and, more specifically, incentive schemes would also be lacking in PS_BOs and, to a lesser extent, in TURN_BOs. As regards F/P_BOs, agency problems are apparently lower (Meuleman et al. 2009), since there could be no separation between ownership and control (Howorth et al. 2004). But this situation could be somewhat different in family/private firms in which ownership and management are separated. This may be the case with aging entrepreneurs, or family firms in second or third generation with dispersed ownership (Morck and Yeung 2003), where agency problems could arise among manager-shareholders and shareholders not involved in day-to-day operations. In addition to agency theory in these latter cases, behavioural theory also explains risk aversion in family firms (Gómez-Mejía et al. 2003), which could result in low leverage and poor performance. The wish to protect their socioemotional wealth could lead to avoiding growth oriented strategies (Daily and Dollinger 1992) and limiting the use of debt (Galve-Gorriz and Salas-Fumas 1996; Mishra and McConaughy 1999). Regarding private/family firms with external managers, agency problems stemming from corporate governance would lead to patterns shown in most buyouts,

[2] Wright et al. (2009) also identify secondary buyouts (SBOs) as acquisitions in which both the vendor and the acquirer are PE firms. Even though firm's investment-cash flow sensitivity may undergo significant changes across an SBO, this latter category of deals is clearly distinct from all other buyouts, because companies going through an SBO are PE-backed both before and after the investment event. Accordingly, these deals are excluded from our analysis.

as described above. To sum up, firms that are subject to a buyout[3] are all likely to suffer from agency problems between managers and shareholders (or between insider and outsider shareholders) thus allowing us to pool the different buyout types when analysing the investments of their portfolio firms.

In addition to agency problems related to corporate governance in mature target firms (including listed, whole private or family firms or public sector firms), the agency problems regarding the relationship with external financial sources would be, conversely, significantly lower than those found in SMEs.[4] Mature companies are far less dependent on internal sources to finance their investment projects because they are less affected by information asymmetries than firms without any track record (Frank and Goyal 2003). In this vein, the reason why PE investors find these mature companies interesting targets might be the fact that they are not sufficiently 'under pressure' from financial constraints and, hence, end up being managed too conservatively, as hinted by their low pre-investment productivity (Litchenberg and Siegel 1987; Harris et al. 2005).

In sum, more stable cash flows and easier access to debt in mature firms, in addition to management conservatism, should lead to a low dependency of investments to internally generated cash flows in these firms before a PE house is involved. Interestingly, investment sensitivity to cash flow is only tested by Engel and Stiebale (2009) in firms before a PE-backed buyout. In contrast with our reasoning, they find a positive relationship in UK and French firms. The following hypothesis derives from our discussion:

Hypothesis 1b Investments of large mature firms are not conditioned by internally generated cash flows before a PE-sponsored buyout.

2.2 The sensitivity of investment to cash flow in firms after a VC/PE investment

After the initial investment both VC and PE investee firms are expected to show important changes. VC investors can alleviate the problems of information asymmetries (Gompers and Lerner 2001) by gaining private information on projects during pre-investment screening (Rajan 1992; Admati and Pfleiderer 1994; Reid 1996). In order to overcome moral hazard problems, venture capitalists monitor the progress of the investee firm (Admati and Pfleiderer 1994; Lerner 1995). As Mitchell et al. (1997) point out, close supervision enhances available information, early problem detection and effective decision making. In parallel, they add value to the firms they invest in (Sahlman 1990; Gompers and Lerner 1998; Jain 2001; Hellmann and Puri 2002; Chemmanur et al. 2011; among others). As active financial investors (Beuselinck and Manigart 2007), in addition to monitoring, venture capitalists provide other value-added services and reputational capital (Sahlman 1990; Gompers and Lerner 1998; Sørensen 2007). Among the former, Gorman and Sahlman (1989) outline the following: help with obtaining additional financing; strategic planning; management recruitment; operational planning; introductions to potential customers and suppliers; and resolving compensation issues. The value added by VC investors is positively perceived by both entrepreneurs (Hsu 2004) and other stakeholders (e.g. signalling effect: Megginson and Weiss 1991; Stuart et al. 1999; Ou and Haynes 2006; Beuselinck and Manigart 2007), also including investment bankers (Sahlman 1990; Tykvová 2007). Therefore, in addition to the equity or quasi-equity funding provided by VC firms, investee firms are also able to raise additional funds from banks. As a result, VC involvement is expected to cause a significant reduction in the dependency on internally generated cash flows to fund their investments.

Nevertheless, limited empirical evidence is available in the literature and it shows mixed results. Manigart et al. (2003) found that investment–cash flow sensitivity is not reduced, but rather increases, after firms receive VC. Their results might be affected, however, by the heterogeneous nature of VC investments (not reported), since their sample could be including firms at different stages of development. Another reason could be related to the period analysed, which implies that a substantial number of their post-investment observations could be affected by the economic crisis of the early 1990s. In contrast, Bertoni et al. (2010a) observed that Italian unlisted new-technology-based firms exhibit low and statistically non-significant investment–cash flow sensitivity,

[3] Except secondary buyouts.

[4] Only firms in receivership could be an exception to that, since external providers of financing would be reluctant to provide funding to distressed firms.

after receiving VC financing, when the investor involved is an independent VC firm. Nevertheless, financial constraints are not removed in firms backed by a corporate VC institution. Regarding UK and French firms, Engel and Stiebale (2009) found that VC involvement leads to higher investment and lower investment sensitivity to cash flow.

This discussion allows us to formulate the following hypothesis on the investment–cash flow sensitivity of VC-backed firms after the initial VC investment:

Hypothesis 2a Investments of SMEs are not conditioned by internally generated cash flows after they obtain the first round of VC.

The role of PE in acquired mature firms that were subject to a buyout, and its impact on their investment sensitivity to cash flow, is likely to be dramatically different from what we expect from VC. One initial feature that should be remarked is the destination of the amount committed by PE investors, which is devoted to buying the existing shares from incumbent shareholders, with leverage representing 60–90% of the price paid (Kaplan and Strömberg 2009). In contrast to VC investments, this implies that, normally, very few, if any, financial resources are conveyed to the company itself. Nevertheless, as in VC investments, PE-backed buyouts are characterised by the active involvement of PE firms after the acquisition (Amess and Wright 2010).

A buyout deal implies an increased concentration of firm's equity, usually held by PE firms and a group of managers, and an increase in leverage. Therefore, a significant change in corporate governance is anticipated shortly after the acquisition as are agency problems found before the buyout. At this stage, it is relevant to argue about the suitability of agency theory alone to support our hypothesis on the dependency of investments to cash flows after a PE-backed buyout. As Wright et al. (2001b) point out, agency theory underemphasises the upside potential of buyouts. Meuleman et al. (2009) supported a complementary approach of agency theory with a strategic entrepreneurship perspective grounded on the resource-based view of the firm (Wernerfelt 1984; Ireland et al. 2003). Under this perspective the introduction of new management resources adds to the reduction in agency problems after a change in ownership (Makadok 2003). In this vein, Meuleman et al. (2009) found that there is solid evidence on the entrepreneurial attitude after a buyout (e.g. Bull 1989; Wright et al. 1992, among others). Since an important indicator of entrepreneurial attitude is growth (Delmar et al. 2003), the existence of high leverage and growth should lead to a positive and significant dependency of new investment to cash flow after the acquisition.

Again, since leveraged buyouts cannot be considered as a homogeneous group (Cumming et al. 2007), we have to discuss corporate governance, agency problems and the effect of the new bundle of resources added by the PE firm in different types of buyouts, excluding secondary buyouts (SBOs). As regards PTPs, the change in corporate governance should increase post-buyout performance when the original managers are not replaced, but there is little ground to support a strategic entrepreneurship perspective for growth.[5] In fact, those managers did have the chance to implement their strategic entrepreneurial view before the buyout. In contrast, in those cases where the management team is replaced, the incoming managers should be highly motivated to implement a new strategic approach, usually involving growth. It may well be that those managers would have resigned in their previous management positions to get away from first tier management limitations to their entrepreneurial initiatives. Turning to DIV_BOs, even though there is little public information on divisions and plants, evidence from US (Kester and Luehrman 1995; Zahra 1995) and Dutch firms (Wright et al. 1992; Bruining and Wright 2002) suggest that new product development is found in the post-buyout period. This finding is in line with the prediction of the strategic entrepreneurship perspective, in a reduced agency problem setting, whereby former divisional managers are now able to explore innovative opportunities that were originally ignored or delayed by the first tier management of the corporation. Similar reasons could be supported in PS_BOs, since managers appointed by public sector authorities in public-sector-controlled firms usually have limited incentives to take risky decisions. Even in TURN_BOs, Cuny and Talmor (2007) predict that PE-led turnarounds, as opposed to insider managerial or board processes, are more likely to occur when removing management in

[5] In this regard, even if major innovation opportunities exist, managers with more traditional managerial cognition orientations might be unable to take advantage of them (Wright et al. 2000).

bad times becomes personally difficult. They also maintain that PE involvement increases managerial incentives to provide information about the turnaround opportunity, especially in syndicated deals.

Regarding F/P_BOs, target firms are supposed to be less affected by agency problems unless ownership and control are separated or the firm has dispersed ownership (Morck and Yeung 2003; Howorth et al. 2004). Since buyouts are usually carried out in mature firms, agency problems are more likely to be present due to the dispersion of ownership across second or further generations. Moreover, first generation entrepreneurs usually appoint non-family managers when they are close to retirement. In addition, there is ample evidence in the literature on the risk aversion in family firms (see Daily and Dollinger 1992; Morck et al. 2000; Athanassiou et al. 2002, among others), which could prevent managers from making risky decisions, thus limiting their capacity to take advantage of growth opportunities. Therefore, agency problems usually arise in mature family/private firms and are aggravated by shareholders' conservatism to protect their socioemotional wealth (Gómez-Mejía et al. 2003). After the buyout only former firm managers or a few owner/managers usually stay in the company. As a result, they are now able to go ahead with the initiatives they were unable to carry out before. Furthermore, the reputation and management capabilities of the PE managers would complement their own management and industry experiences to take advantage of forgotten growth opportunities.

To sum up, regardless of the type of buyout considered, with the exception of PTPs in which the buyout managers are not replaced, managers in PE-backed buyouts are more likely to put forward their growth projects, in a new corporate governance framework, profiting from the experience and network of contacts of PE managers. Nevertheless, since investee firms would have experienced a high increase in leverage to finance the acquisition,[6] those projects would also be somewhat dependent on the internal cash flow generation process. Therefore, for the purpose of our work, excluding SBOs and PTPs[7] in which the original managers were not replaced, we find comparable attitudes in the remaining types of buyouts regarding the strategic entrepreneurship perspective under tighter corporate governance rules.

The empirical evidence on the role of PE and its impact on firm's investments sensitivity to cash flows are, however, very limited. After a buyout there is evidence that the increase in leverage causes a reduction in firm's investments (Long and Ravenscraft 1993). Moreover, evidence from management buyouts indicates that asset sales are offset by capital investment (Wright et al. 1992). These results are generally consistent with our ideas, albeit only indirectly. Borell and Tykvová (2011) find tighter financial constraints in a sample of European buyouts after the acquisition, which are estimated using different indices applicable to private firms. But only Engel and Stiebale (2009) test the investment sensitivity to cash flow after a buyout in UK and French investee firms. They find that buyouts financed by PE firms are neither associated with a decrease in investment spending nor with an increase in the dependence on internal finance, as opposed to our ideas.

Nevertheless, according to our theoretical development, we expect the following:

Hypothesis 2b Investments of large mature firms are substantially conditioned by internally generated cash flows after a PE-sponsored buyout.

3 Methodology

Several econometric models have been developed and adopted in the past few years to analyse the firm's investment–cash flow sensitivity (for extensive reviews, see Hubbard 1998; Bond and Van Reenen 2007). The main distinction among different models is how they control for unobservable investment opportunities (which determine how much a company should invest if no financial constraints were present). Controlling for investment opportunities is fundamental in this field, since they are likely to be correlated with current cash flows, which are used as a measure of the availability of internal capital. Consequently, a relationship between current investment and cash flow can be nothing but a spurious correlation due to time varying unobserved heterogeneity (e.g. an increase in productivity will increase the profitability

[6] Even though leverage is frequently reduced by selling non-core assets (Easterwood 1998).

[7] Which represent the least frequent type of buyout in the US and the UK, and even more in continental Europe (see Cumming et al. 2007; Meuleman et al. 2009).

of investment opportunities, which will in turn translate into higher investments, and, at the same time, will boost cash flows; thus, a positive correlation between investment and cash flow would be found even in the absence of financial constraints). In theory, investment opportunities could be captured by including in the model the firm's marginal Tobin's q. This is, however, difficult to estimate empirically for listed firms (see Hubbard 1998), and virtually impossible for unlisted firms. Other alternative approaches have been proposed in the literature. For instance, Abel and Blanchard (1988) used a sales accelerator model which, with some modifications, is adopted by Manigart et al. (2003) and by Engel and Stiebale (2009). An alternative approach is to estimate an Euler equation (Bond and Meghir 1994). This latter approach is followed by Whited (1992), Bond and Meghir (1994), Alti (2003), Whited and Wu (2006), and Bertoni et al. (2010a), among others. In addition to the alternative reference to Tobin's q as an estimate of growth opportunities, properly controlling for unobserved growth opportunities, the effects of debt may also be assessed with this latter approach.

We build our estimates on the basic specification of the Euler equation for firm's investments used by Bond and Meghir (1994):

$$\left(\frac{I}{K}\right)_{it} = \beta_1 \left(\frac{I}{K}\right)_{it-1} + \beta_2 \left(\frac{I}{K}\right)^2_{it-1} + \beta_3 \left(\frac{\mathrm{CF}}{K}\right)_{it-1} + \beta_4 \left(\frac{S}{K}\right)_{it-1} + \beta_5 \left(\frac{D}{K}\right)^2_{it-1} + a_i + d_t + \varepsilon_{i.t} \quad (1)$$

where the subscript i refers to the company and t to the time period, I is firm's investment, K is the stock of capital, CF firm's cash flows, S is firm's net output and D firm's debt. The specification also includes firm-specific (a_i) and time-specific (d_t) effects. Equation 1 follows directly from the first-order conditions of the intertemporal investment decision model (for details see Bond and Meghir 1994; Bond and Van Reenen 2007) and may be used to highlight the presence of financial constraints. If, due to capital market imperfections, the external capital supply curve is upward sloping, β_3 will be positive and statistically significant.

Equation 1 includes the lagged value of the dependent variable (and its square) among the regressors and both ordinary least square (OLS) and fixed-effects (FE) panel models would produce biased estimates (Bond et al. 2001). The technique which is most often used to solve this estimation problem is the generalised method of moments (GMM). In this work we will use the two-step System-GMM estimation (Arellano and Bover 1995; Blundell and Bond 1998) with finite-sample correction (Windmeijer 2005). As we will highlight later in this section, GMM has the additional advantage of allowing us to control very efficiently for the endogeneity of other covariates.

The parameters in Eq. 1 are the result of a complex combination of underlying characteristics of the intertemporal investment decision process (e.g. productivity, cost of capital and labour, adjustment costs, demand elasticity). Many of these underlying variables could be affected by the VC or PE investment and, accordingly, β_3 is not necessarily the only parameter in Eq. 1 which could change across the investment event. Accordingly, to understand whether investment–cash flow sensitivity is affected by VC and PE financing, we estimate a set of augmented versions of Eq. 1 in which some parameters are allowed to change between the pre and post-investment period. To distinguish the parameters that are allowed to change in each model we use the self-explaining superscript PRE and POST.

Parameters β_1 to β_5 could potentially change between the pre and post-investment event as well as the firm's FE. The parameter of interest for hypotheses 1a and 1b is β_3^{PRE}, which is expected to be positive and significant in the expansion sample and non-significantly different from zero in the buyout sample. Hypotheses 2a and 2b translate, instead, in tests on β_3^{POST} and the extent to which it is different from zero. According to hypothesis 2a, β_3^{POST} should be close to zero in the VC-backed sample. According to hypothesis 2b, β_3^{POST} should be positive and significant after the buyout.

We pursue three estimation strategies, each with its own advantages and disadvantages, with the idea that results which hold regardless of the estimation strategy chosen are indeed robust. The first, most naive, estimation strategy is to estimate separately Eq. 1 in the pre and post-investment windows, thus allowing all parameters to vary across the investment event. This approach has two significant shortcomings. First, it does not allow us to control properly for the endogeneity of the time of the investment. If VC/PE investment is endogenous, the estimates obtained on the pre and post-investment subsamples are exposed to a sample selection bias. A second drawback of the *split*

estimation is the reduction in the efficiency of estimates. Making no assumptions at all on the coefficients leads to a substantial decrease in the degrees of freedom available. This is true especially for the two sets of parameters which capture firm-specific effects. By allowing firm's FE to differ between the pre and post-investment window, we basically allow *each* firm to change its trend in investment after it receives VC or PE. While this is clearly a more conservative assumption than imposing a fixed structure on the relationship it calls for the estimation of $2N$ intercepts, where N indicates the number of firms in the panel. Imposing more structure, for instance by allowing a common change in trend, would only entail the estimation of $N + 1$ parameters. When N is large (in our case $N = 324$) and T (the time horizon) is short (in our case it averages at 9.5), the loss of efficiency is huge. This is made even worse by the fact that the Euler equation includes the lagged dependent variable among the regressors. This means that in the post-investment period all observations corresponding to the time of investment are dropped from estimation, thus reducing degrees of freedom by a further N.

Our second estimation strategy is the most parsimonious that allows us to test our hypotheses. In particular, we use the same specification as Bertoni et al. (2010a) where only the cash flow coefficient (β_3^{PRE} and β_3^{POST}) is allowed to change across the VC or PE investment and a common change in the intercept (δ) is included. This estimation strategy has two significant advantages over the splitting of the sample. First, it allows a significant improvement in the efficiency of estimation, including only two parameters to estimate on top of those of a pooled equation, and no loss of observations across the investment event. The second, methodologically more interesting advantage is that some control for the endogeneity of the investment itself can be included in the estimates. The main advantage of the GMM approach is that it allows a flexible set of assumptions about the endogeneity of each variable to be included. When variables are considered as endogenous their lagged values are used as instruments in the first differenced equations and their lagged first differences as an instrument for the level equations. This allows us to control, at least partially, for the endogeneity of VC and PE investments.

The most significant shortcoming of this parsimonious estimation strategy is that very strong assumptions are made on the structure of the Euler equation, since it compels parameters other than β_3 and δ to be constant across the investment event. The intertemporal first-order condition from which the Euler equation derives suggests, instead, that changes in firm's productivity, cost of capital or financial structure could translate into shifts in other coefficients, and especially in β_4 and β_5. We thus estimate a specification of Eq. 1 in which β_4 and β_5 are also allowed to change across the investment event. According to us, this estimation strategy presents the best compromise between model flexibility, estimation efficiency and control for the endogeneity of the investment event.

Finally, a further note on the instrument set which is used in System-GMM estimations is called for. We include among exogenous variables time dummies, sector dummies and stage dummies. We include in the set of endogenous variables lagged investment, cash flow, sales and debt. This might be considered a somewhat excessively cautious assumption. However, the studies mentioned in Sect. 2 do not propose a unanimous theoretical argument about which variables should be considered endogenous and which ones can be considered as exogenous or predetermined. We therefore opted for the most conservative assumption. To limit the number of instruments and reduce over-identification, we limit the number of lags included in the regressions to 3 (i.e. lagged investments are used as instruments from $t - 2$ to $t - 5$ in differences for the level equations and from $t - 3$ to $t - 6$ in levels for the first differenced equations). We are still left with a sufficiently rich number of instruments without including very weak instruments such as remote lags of the covariates. We maintain the same set of instruments in all our specifications, to enhance comparability. The standard tests used to validate the use of System-GMM (i.e. AR(1), AR(2), and Hansen) are met in all the models and specifications. It is however important to highlight that the application of GMM, especially when moment conditions are numerous, can lead to serious estimation problems, unstable estimates and unreliable diagnostics (see e.g. Bowsher 2002; Windmeijer 2005). To verify the robustness of our results to the choice of System-GMM we also report the results obtained using alternative estimation techniques.

4 Sample and descriptive statistics

4.1 The sampling process

This Spanish VC/PE market mirrors closely the progressive change from VC-type investments to buyouts in more mature firms. Balboa and Martí (2004) broadly describe the main characteristic of the market as well as the causes of the reduction in early stage investments and the shift to investments in more mature firms.[8] By focusing on the Spanish market we can analyse the financial role of VC and PE players on an extremely long time window, thus limiting the effect of short-term financial conditions that could distort the measurement of changes in financial constraints. Since all Spanish firms are required to report their accounts to the Official Trade Register since 1991, we are able to obtain relevant pre-investment data for investments carried out from 1995 onwards. Similarly, since we aim to trace the change in the investment sensitivity to cash flows after the VC/PE investment event and we were able to collect accounting data on investee firms up to 2007, we would only consider unlisted Spanish firms that were subject to expansion (VC) and buyout (PE) investments between 1995 and 2004. In accordance with the data obtained from the Spanish Private Equity and Venture Capital Association (ASCRI), in that period 1,572 first time VC and PE investments were recorded in Spain, including all stages but excluding firms belonging to the financial and real-estate sectors and SBOs (Martí et al. 2010). Some 259 firms in this population never reported to the Official Register (i.e. accounting information is unavailable), or were acquired less than 3 years after the investment event (i.e. the post-investment window is too short to be significant). Regarding the former group some companies deliberately did not report, whereas others were early stage firms that never made it to the first or the second year. Regarding the latter, the acquired firms were mostly firms at the expansion or buyout stages that were subject to a rapid acquisition by a third party and in which the PE firm only played the role of bridge financing. As a result, firms excluded from the sample do not seem to introduce a significant success bias in our analysis. For all remaining (1,313) companies we collect accounting information from the AMADEUS database, which records information on 1,202,363 Spanish firms.

Since the aim of this work was to analyse the effect of VC/PE involvement on the investments of the portfolio firms, we needed to have a sufficient number of pre-investment observations, which would not be the case for early stage companies. After excluding 575 early stage firms from the sample, the remaining 738 firms belonged to the expansion (579 firms) and buyout (159 firms) stages. We also restricted sectoral heterogeneity by focusing on the most typical sectors in which VC and PE firms invest in Europe. This restriction is justified by the sectoral matching between VC and PE, which would be affected by the lack of high technology investments found at the buyout stage and the limited number of primary sector firms that become VC-backed. Accordingly, we excluded 98 VC-backed and 12 PE-backed firms from the sample in the following sectors: research & development (R&D), high-tech manufacturing, and primary.

In order to properly address the requirements of the dynamic models that are required in the empirical work, we only retained those firms for which we could have at least six consecutive years with complete accounting data. A huge effort was spent in tracking these companies over time since most VC and PE investors create new vehicles to pursue their acquisitions. Combining accounting data from the pre and post-investment period was, however, not always possible. In some cases, information was available in consolidated accounts but not in both the pre and the post-investment period. In other cases, investors acquired two (or more) firms which were merged immediately afterwards. As a result, we were able to obtain reliable accounting data on six or more consecutive years, including the investment year, for 246 firms at the expansion stage and 78 firms that were subject to a buyout deal, representing 51.1 and 53.1% of the number of fully identified firms in their respective categories.

Sample firms operate in the following sectors: provision of electricity, gas, water, etc.; construction; wholesale and retail trade; hotels and restaurants; transportation; food products; beverages; textiles; clothing; leather and leather-type products; wood and wood products; paper and paper products; furniture and recycling; chemicals and chemical products;

[8] For a more detailed description of the Spanish VC/PE market, see Martí (2002).

rubber and plastic products; building materials; basic metals and metal products; and motor vehicles and other transportation equipment. Following Dunning (1986) and Cantwell and Barnard (2008), we further distinguished sample companies in general services (NACE rev1 2-digit codes 40, 41, 45, 50, 51, 52, 55, 60, 62, 63, 64 and 71), low research-intensive manufacturing (NACE rev1 2-digit codes 15, 17, 18, 20, 21, 22, 36 and 37), and medium research-intensive manufacturing (NACE rev1 2-digit codes 24 with the exclusion of 24.41 and 24.42, 25, 26, 27, 28, 34 and 35).

The definition used in the construction of variables is the following: investments (I) are measured by the increase in net fixed assets plus depreciation; capital is firm's beginning-of-period net book value of fixed assets; cash flow (CF) is computed as net earnings plus total depreciation and amortisation; sales (S) is measured as net revenues; debt (D) is measured by short- and long-term financial liabilities.

4.2 Descriptive statistics

Panels A and B in Table 1 report the distribution of sample firms across sectors and stages. Sample firms are rather evenly distributed across general services (33.6%), low research-intensive manufacturing (36.1%) and medium research-intensive manufacturing. Most investments in our sample are in the expansion stage (75.9%) and only a minority belongs to the buyout category (24.1%).

It is quite important for our purposes to underline that the sectoral composition of VC and PE investments in our sample is similar. A χ^2 test does not reject the hypothesis that the two samples come from the same underlying sectoral distribution ($\chi^2(2) = 2.65$). This reassures us that our results will not be driven by differences in investment–cash flow sensitivity across sectors. It should be noted, however, that the similarity in sectoral distribution in our sample should not be generalised to the whole VC and PE industry but is mainly the result of our choice to exclude from the analysis high-tech and R&D companies, where VC is far more specialised than PE.

Regarding buyout types, as discussed in Sect. 2, we explicitly exclude SBOs for the purpose of our analyses. The 78 buyouts reported in Table 1 include 2 PTPs in which the original management was replaced, 29 divisional buyouts and 47 buyouts on family and whole private firms. There are no PS_BOs or TURN_BOs in our sample.

Table 2 reports the descriptive statistics about variables included in the estimates, split by stage and period (pre vs. post-investment). To control for the potential influence of outliers (which are extremely relevant when dealing with accounting ratios), all the variables are winsorised at a 2% cut-off value for each tail. In other words, we truncate the distribution of each variable and impute to all observations falling outside the second and 98th percentiles the respective threshold levels.[9] The accounting information on the related firms was expressed in constant 2005 euros using the Harmonised Consumer Price Index as deflator. Accounting information includes data from 1991 up to 2007, whenever possible.[10]

For the objectives of our paper it is particularly interesting to give some preliminary evidence on the level of investments and cash flows before and after the deal for expansion and buyout companies.

As expected, the average investment ratio in the pre-investment period is much higher for firms at the expansion stage than for firms at the buyout stage (0.5044 vs. 0.3732). At the same time, the pre-investment ratio between cash flow and the stock of capital is reversed, being substantially lower for expansion firms (0.3079 vs. 0.3356). This gives a first, rough confirmation to the argument that expansion firms are more financially constrained than firms which are subject to a buyout. This is amplified by the fact that, before the investment, firms at the expansion stage have a higher level of debt (scaled by capital stock) than buyout companies (1.4141 vs. 1.1046).

As regards the post-investment period, the average investment and cash flow ratios are lower for firms at the expansion stage than they are for firms at the buyout stage. The average investment ratio of firms at the expansion stage is 0.3471, with the cash flow ratio being 0.1660. Turning to buyouts, the average investment ratio is 0.3542, whereas the cash flow ratio stands at 0.2392. After receiving VC funds, the growing process seems to be gradually absorbed in firms at the expansion stage, since they are no longer experiencing

[9] This technique is usual in this field of analysis. See Cleary (1999) and Bertoni et al. (2010a), among others. We replicate all the regressions using 1 and 5% winsorising thresholds and obtain fairly similar results.

[10] In a few firms data about 2008 are also included.

Table 1 Distribution of sample firms

Panel A: distribution of sample firms according to industry

Industry	Total sample	
	N	%
General services	109	33.6
Low research–intensive manufacturing	117	36.1
Medium research–intensive manufacturing	98	30.3
Total	324	100.0

Panel B: distribution of sample firms according to industry by stages

Stage	Total sample		General services		Low research-intensive manufacturing		Medium research-intensive manufacturing	
	N	%	*N*	%	*N*	%	*N*	%
Expansion	246	75.9	83	33.7	90	36.6	73	29.7
Buyout	78	24.1	26	33.3	27	34.6	25	32.1
Total	324	100.0	109	33.6	117	36.1	98	30.3

Panel C: distribution of buyout firms according to buyout type

Type	Total buyout sample	
	N	%
Public to private	2	2.6
Divisional buyouts	29	37.2
Family and whole private buyouts	47	60.2
Total	78	100.0

Panel A shows the distribution according to industry of a sample of 324 unquoted Spanish firms that were subject to a VC and PE investment during the period 1995–2004

Panel B shows the sectoral distribution across different stages. Percentages in 'Total sample' column are related to the total number of sample firms. Percentages in the 'General services', 'Low research–intensive manufacturing' and 'Medium research–intensive manufacturing' columns are related to the total number of the firms in, respectively, the expansion or buyout

Panel C shows the distribution of buyouts according to the buyout type

high growth rates. Conversely, after a buyout deal, target firms exhibit a greater investment ratio and smaller cash flow ratio. These results may signal the desire to develop growth strategies despite the increase in leverage and the tighter cash flow available after a buyout deal.

Finally, albeit this is not the core objective of our analysis, we report in Fig. 1 how sales growth (measured as year-on-year change in the logarithm of net revenues) and leverage (measured as the ratio between long-term liabilities and total assets) evolve across the investment event for VC and PE-backed companies. VC-backed companies exhibit a relatively stable growth rate across the investment event: median yearly growth rate is declining slightly (typical as a company matures) from 10.9% 3 years before the investment to 7.5% 3 years after the investment. Interestingly, VC-backed companies also slightly increase their leverage from 11.0% 3 years before the investment to 16.8% 3 years after the investment. The evolution of sales and leverage for PE-backed companies appears to be significantly different. PE-backed companies appear to have declining growth rates before the investment event (from 12.0% 3 years before the investment to 2.2% in the investment year). However, this accelerates after the investment (up to 8.4% 3 years after the investment), consistently with the view of PE as a trigger for company rebirth. The most interesting aspect for our purpose, however, is the tremendous increase in leverage which increases almost threefold between the year before the investment and the year after the investment. This increase is

Table 2 Descriptive statistics

The table reports descriptive statistics on winsorised (2% each tail) values of the variables. The definition used in the construction of variables in equations is the following: investments (I) are measured by the increase in net fixed assets plus depreciation; capital is firm's beginning-of-period net book value of fixed assets; cash flow (CF) is computed as net earnings plus total depreciation and amortisation; sales (S) is measured as net revenues; debt (D) is measured by short and long term financial liabilities

Statistic	$\left(\frac{I}{K}\right)_{it}$	$\left(\frac{CF}{K}\right)_{it}$	$\left(\frac{S}{K}\right)_{it}$	$\left(\frac{D}{K}\right)_{it}$
Panel A: expansion				
Pre-investment				
Observations	1,213	1,213	1,213	916
Mean	0.5044	0.3079	7.8109	1.4141
Std. deviation	0.9279	0.4851	10.5233	1.4813
Post-investment				
Observations	1,951	1,951	1,951	1,437
Mean	0.3471	0.1660	4.3407	1.2398
Std. deviation	0.7329	0.3662	6.8219	1.1762
Panel B: buyout				
Pre-investment				
Observations	410	410	410	371
Mean	0.3732	0.3356	7.3071	1.1046
Std. deviation	0.6366	0.4159	9.4666	1.2777
Post-investment				
Observations	605	605	605	522
Mean	0.3542	0.2392	5.1743	1.1092
Std. deviation	0.8041	0.4284	8.1477	1.0930

from 8.5%, which is lower than in the expansion subsample, to 23.5%, which is much higher than in the expansion subsample.

5 Results

To ascertain whether our hypotheses are correct we estimate Eq. 1 separately on the expansion and buyout samples. Results are reported, respectively, in Tables 3 and 4. We begin by noticing that Hansen, AR(1), and AR(2) respect in all models the expected level of significance. Hansen never rejects the null hypothesis of the validity of over-identifying restrictions, and errors exhibit an AR(1) structure but no higher order autocorrelation.

Table 3 shows that, coherently with hypothesis 1a, and with the results of related works, the investment dependency on internal cash flow of firms at the expansion stage, before receiving VC, is positive and strongly significant in all models, ranging from 0.6692 to 0.9141. The post-investment sensitivity to cash flow is remarkably lower, ranging from 0.2923 to 0.4360. More importantly, it is not statistically different from zero in any of the three models. This is fully in line with our hypothesis 2a.

Interestingly, results reported in Table 4, which focuses on buyouts, depict a markedly different story. Pre-investment–cash flow sensitivity is very low (between 0.0597 and 0.1871) and never statistically significant at conventional confidence levels. This is exactly what we expect from hypothesis 1b: buyout companies do not exhibit any significant sign of being hampered by financial constraints before they are acquired. The estimates of post-investment–cash flow sensitivity are, instead, large and statistically highly significant, ranging from 0.4687 to 0.4936. It is also interesting to observe that the coefficient of company debt is positive and significant after the firm is subject to a PE investment. This finding also provides evidence as to how the strategy implemented by the PE institution dramatically changes the firm's financial structure and, accordingly, the relative coefficient in the Euler equation.

Results shown in Tables 3 and 4 are subject to a number of additional robustness tests. For the sake of conciseness we focus on the last, most flexible, specification reported in the last column of the two tables. First, we compare System-GMM estimates with those obtained using different estimation techniques. Table 5 reports the results obtained using Difference-GMM, OLS, FE and Hausman–Taylor

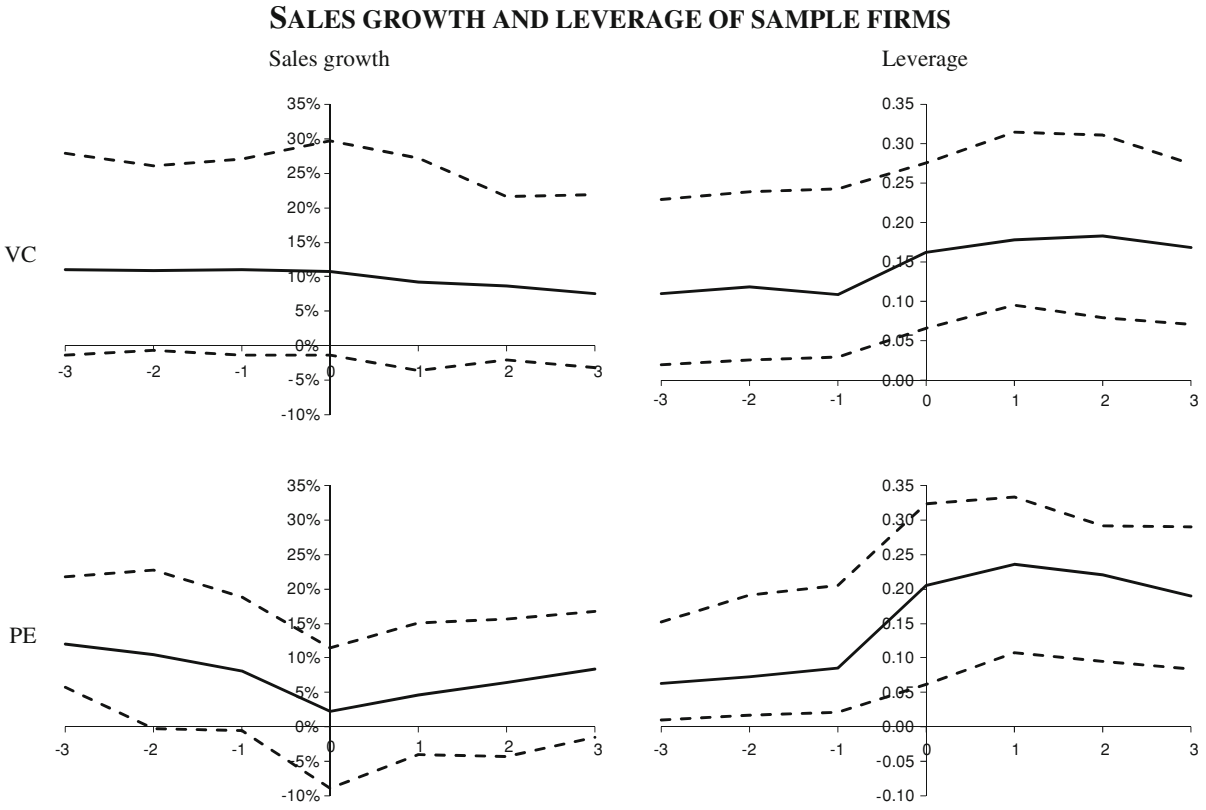

Fig. 1 Sales growth and leverage of sample firms. *Solid lines* represent median, *broken lines* are, respectively, the 1st and 3rd quartiles. The horizontal axis reports years, where 0 is the year of the venture capital/ private equity (VC/PE) investment. Sales growth is computed as the year-on-year increase in log(sales). Leverage is computed as long-term liabilities divided by total assets

(System-GMM estimates are also reported, in the first column, for convenience). Broadly speaking, our results are confirmed throughout the different estimation techniques. Cash flow sensitivity of investments is always positive and significant before a VC investment at expansion stage (confirming hypothesis 1a) and never statistically significant before a PE investment at buyout stage (confirming hypothesis 1b). In the post-investment period, investment–cash flow sensitivity becomes insignificant for VC-backed companies, with the exception of OLS estimates which, however, are known to be upward biased (see Bond et al. 2003), and becomes positive and significant for PE-backed buyouts. Both the significance level and the size of the coefficients are remarkably stable across different estimation techniques, thus giving us further confidence of the robustness of our results.

Second, we re-estimate all our models augmenting the original specification by Bond and Meghir (1994) by adding company's log-age. The dynamics of investments are likely to be affected by company age and, other things being equal, mature companies normally exhibit a lower investment rate. All models in Tables 3 and 4 (and all those in Table 5 except for OLS) already include firm FE, which captures, among other factors, company average age during the estimation window. However, especially for companies in the expansion stage, which are relatively younger, including age among the regressors could allow us to control better for company's aging during the observation window, and thus improve the accuracy of the estimates. Results are reported in Table 6. As expected, firm's age is negative and significant in the expansion sample and non significant in the buyout sample. Our hypotheses on investment–cash flow sensitivity are, however, still confirmed.

Third, we re-estimate the model excluding the 3-year period across the investment event (between

Table 3 Cash flow sensitivity for venture capital (VC)-backed firms at the expansion stage before and after the investment event

Independent variables	(i)		(ii)	(iii)
	Pre-VC	Post-VC		
Investments $(t-1)$				
Pre-VC	0.2459*			
	(0.146)			
Post-VC		0.2171*		
		(0.118)		
Pooled			0.1483*	0.1549*
			(0.086)	(0.086)
Investments $(t-1)^2$				
Pre-VC	−0.0343			
	(0.042)			
Post-VC		−0.0244		
		(0.033)		
Pooled			−0.0040	−0.0062
			(0.025)	(0.025)
Cash flows				
Pre-VC	0.6699***		0.6692***	0.9141***
	(0.193)		(0.234)	(0.175)
Post-VC		0.3702	0.4360	0.2923
		(0.258)	(0.263)	(0.284)
Sales				
Pre-VC	−0.0145			−0.0085
	(0.011)			(0.009)
Post-VC		0.0129		0.0194
		(0.012)		(0.013)
Pooled			0.0053	
			(0.008)	
Debt^2				
Pre-VC	0.0368***			0.0313***
	(0.009)			(0.009)
Post-VC		0.0212***		0.0245***
		(0.007)		(0.007)
Pooled			0.0279***	
			(0.005)	
δ			−0.0151	−0.0635
			(0.084)	(0.088)
Constant	−0.0526	0.0490	−0.1188**	−0.0885*
	(0.055)	(0.053)	(0.046)	(0.051)
Time dummies	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	918	1,417	2,156	2,156
Firms	190	244	246	246
Hansen	178 [214]	225 [248]	229 [319]	227 [317]
AR(1)	−3.80***	−5.19***	−5.90***	−5.84***
AR(2)	−1.32	−0.36	−1.01	−1.10

The table reports two-step System-GMM estimates with finite sample correction on Eq. 1, using different assumptions about the structural break as presented in Sect. 3. The dependent variable is firm *i*'s investment ratio at time *t*. Standard errors are reported in parentheses. ***, ** and * indicate, respectively, significance levels of <1, <5 and <10%. AR(1) and AR(2) are tests of the null hypothesis of, respectively, no first or second order serial correlation. Hansen is a test of the validity of the overidentifying restrictions based on the efficient two-step GMM estimator. Investments, cash flows, and debt are all normalised by beginning of period level of fixed assets and winsorised at the 2% level. Pre and post rows report estimates of coefficients, respectively, before or after the investment event. Pooled rows refer to coefficients which are assumed to remain constant. Column (i) reports separate estimations of the pre and post-investment periods. Columns (ii) and (iii) report estimations on the whole period, allowing some coefficients to change before and after the initial VC investment

Table 4 Cash flow sensitivity for private equity (PE)-backed buyouts before and after the investment event

Independent variables	(i)		(ii)	(iii)
	Pre-PE	Post-PE		
Investments $(t-1)$				
Pre-PE	0.1013			
	(0.152)			
Post-PE		−0.1372		
		(0.140)		
Pooled			−0.0581	0.0034
			(0.090)	(0.104)
Investments $(t-1)^2$				
Pre-PE	−0.0048			
	(0.036)			
Post-PE		0.0339		
		(0.038)		
Pooled			0.0207	0.0013
			(0.025)	(0.027)
Cash flows				
Pre-PE	0.0597		0.1536	0.1871
	(0.136)		(0.173)	(0.223)
Post-PE		0.4687***	0.4811***	0.4936***
		(0.182)	(0.181)	(0.180)
Sales				
Pre-PE	0.0228*			0.0267
	(0.014)			(0.021)
Post-PE		−0.0107		−0.0104
		(0.016)		(0.019)
Pooled			0.0087	
			(0.011)	
Debt^2				
Pre-PE	0.0016			−0.0077
	(0.011)			(0.016)
Post-PE		0.0605***		0.0716***
		(0.013)		(0.016)
Pooled			0.0367***	
			(0.013)	
δ			−0.0107	−0.0181
			(0.154)	(0.175)
Constant	0.2254	−0.0728	0.3460	0.3006
	(0.207)	(0.287)	(0.338)	(0.281)
Time dummies	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
Observations	367	509	815	815
Firms	65	77	78	78
Hansen	42 [192]	55 [219]	62 [308]	60 [306]
AR(1)	−2.37**	−3.96***	−4.41***	−4.25***
AR(2)	−1.02	−1.18	−0.34	−1.00

The table reports two-step System-GMM estimates with finite sample correction on Eq. 1, using different assumptions about the structural break as presented in Sect. 3. The dependent variable is firm i's investment ratio at time t. Standard errors are reported in parentheses. ***, ** and * indicate, respectively, significance levels of <1, <5 and <10%. AR(1) and AR(2) are tests of the null hypothesis of, respectively, no first or second order serial correlation. Hansen is a test of the validity of the overidentifying restrictions based on the efficient two-step GMM estimator. Investments, cash flows, and debt are all normalised by beginning of period level of fixed assets and winsorised at the 2% level. Pre and post rows report estimates of coefficients respectively before or after the investment event. Pooled rows refer to coefficients which are assumed to remain constant. Column (i) reports separate estimations of the pre and post-investment periods. Columns (ii) and (iii) report estimations on the whole period, allowing some coefficients to change before and after the initial PE investment

Table 5 Results obtained using different estimation techniques

Independent variables	Sys-GMM	Dif-GMM	OLS	FE	HT
Panel A: VC-backed firms at the expansion stage					
Investments $(t-1)$	0.1549*	0.0510	0.2160***	0.1897***	0.1743***
	(0.086)	(0.080)	(0.056)	(0.059)	(0.065)
Investments $(t-1)^2$	−0.0062	0.0223	−0.0236	−0.0246	−0.0199
	(0.025)	(0.022)	(0.017)	(0.017)	(0.022)
Cash flows					
Pre-VC	0.9141***	0.7841***	0.6166***	0.5076***	0.5681*
	(0.175)	(0.127)	(0.159)	(0.135)	(0.234)
Post-VC	0.2923	0.0120	0.3600**	0.2040	0.2549
	(0.284)	(0.113)	(0.141)	(0.157)	(0.201)
Sales					
Pre-VC	−0.0085	0.0070	−0.0044	0.0131	0.0048
	(0.009)	(0.007)	(0.007)	(0.009)	(0.010)
Post-VC	0.0194	0.0373***	0.0041	0.0271**	0.0176
	(0.013)	(0.008)	(0.012)	(0.013)	(0.014)
$Debt^2$					
Pre-PE	0.0313***	0.0392***	0.0320***	0.0424***	0.0413***
	(0.009)	(0.006)	(0.009)	(0.007)	(0.011)
Post-PE	0.0245***	0.0421***	0.0340***	0.0443***	0.0422***
	(0.007)	(0.006)	(0.009)	(0.009)	(0.011)
δ	−0.0635	0.1443*	0.0192	0.1109*	0.0900
	(0.088)	(0.081)	(0.066)	(0.058)	(0.086)
Time dummies	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Observations	2,156	1,881	2,156	1,881	2,156
Firms	246	228	246	228	246
Panel B: PE-sponsored buyouts					
Investments $(t-1)$	0.0034	0.0380	0.0935	0.0142	0.0017
	(0.104)	(0.099)	(0.080)	(0.095)	(0.107)
Investments $(t-1)^2$	0.0013	−0.0055	−0.0222	−0.0050	−0.0024
	(0.027)	(0.027)	(0.021)	(0.025)	(0.028)
Cash flows					
Pre-VC	0.1871	−0.0109	0.1961	−0.0032	0.0841
	(0.223)	(0.154)	(0.148)	(0.192)	(0.228)
Post-VC	0.4936***	0.4247**	0.4168***	0.2869*	0.3255*
	(0.180)	(0.187)	(0.129)	(0.149)	(0.197)
Sales					
Pre-VC	0.0267	0.0841***	0.0168	0.0511***	0.0298
	(0.021)	(0.013)	(0.013)	(0.016)	(0.023)
Post-VC	−0.0104	0.0071	−0.0216	0.0056	−0.0114
	(0.019)	(0.012)	(0.018)	(0.020)	(0.029)
$Debt^2$					
Pre-PE	−0.0077	−0.0240**	−0.0025	−0.0055	−0.0019
	(0.016)	(0.010)	(0.009)	(0.011)	(0.022)

Table 5 continued

Independent variables	Sys-GMM	Dif-GMM	OLS	FE	HT
Post-PE	0.0716***	0.0791***	0.0833***	0.0821***	0.0838***
	(0.016)	(0.006)	(0.012)	(0.010)	(0.017)
Δ	−0.0181	0.2450*	0.0350	0.1638	0.1213
	(0.175)	(0.135)	(0.088)	(0.102)	(0.132)
Time dummies	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	No	Yes	Yes
Observations	815	726	815	726	815
Firms	78	78	78	78	78

VC venture capital, *PE* private equity, *OLS* ordinary least square, *HT* Hausman–Taylor regression, *FE* fixed effect panel regression

The table reports different estimates on Eq. 1 using the same specification reported in column (iii) in Tables 3 and 4 (which is reported here as Sys-GMM for convenience). The dependent variable is firm *i*'s investment ratio at time *t*. Standard errors are reported in parentheses. ***, ** and * indicate, respectively, significance levels of <1, <5 and <10%. Investments, cash flows, and debt are all normalised by beginning of period level of fixed assets and winsorised at the 2% threshold. Pre and post rows report estimates of coefficients, respectively, before or after the investment event. Dif-GMM reports estimates obtained using Difference-GMM with the same instrument structure as System-GMM used in Tables 3 and 4 (and reported here in the first column). OLS reports estimates obtained using OLS with robust standard errors clustered by firm. FE reports fixed effect panel regression with robust standard errors. HT reports Hausman–Taylor regression with bootstrapped standard errors, where the same exogenous time-invariant instruments used in System-GMM are used as instruments of firm's FE

$t_{INV} - 1$ and $t_{INV} + 1$). This allows us to control whether our results are driven by a short-time effect across the investment event or, rather, are persistent. Results, reported in Table 7, confirm what we find on the whole sample both in terms of statistical significance and in terms of size of the parameters.

Finally, for the buyout sample, we assess the extent to which our results hold for different subsamples of deals. First, we re-estimate the model on excluding the PTP transactions included in the sample. Unsurprisingly, given that we only have two PTPs, results hold unchanged. Second, we also exclude all 29 divisional buyouts and re-estimate the model on family and wholly independent private firms only. Investment–cash flow sensitivity is again non-significant in the pre-event window and positive and significant after. While neither PTPs nor divisional buyouts are sufficiently numerous to allow us to estimate a separate model for them, we find no evidence that our results are undermined by buyout heterogeneity. Results are reported in Table 8.

6 Conclusions

In this paper we study the differential financial role played by VC and PE firms on the investments of their investee firms. Based on agency theory, we explain why VC firms help in alleviating financial constraints in their investee firms. Regarding PE-sponsored buyouts, we also base on agency theory our hypothesis about the absence of financial constraints before the acquisition. This approach is valid for all buyout types (apart from SBOs, which are not considered in this work). As regards the post-investment increase in financial constraints, following Meuleman et al. (2009), we base our hypothesis on a complementary approach between agency theory and the resource-based view of the firm. We argue that in all buyout types, excluding SBOs and PTPs in which the original managers are not replaced, firm managers will try to put forward a strategic entrepreneurial approach. Since one of the main goals of strategic entrepreneurship is growth, the desire to take advantage of growth opportunities in firms in which leverage increased to finance the acquisition, investments will be somewhat constrained to the internally generated funds.

We tested our hypotheses on a firm-level large panel dataset on a representative sample of Spanish VC and PE-backed firms first invested between 1995 and 2004. Since we aimed to compare the differential role played by VC and PE investors, we limit the scope of the paper in two ways. First, we excluded firms at the seed and start-up stages because little or no data are available on the pre-investment period and, therefore, we cannot analyse the change in financial constraints

Table 6 Estimates including firm's age

Independent variables	Sys-GMM	Dif-GMM	OLS	FE	HT
Panel A: VC-backed firms at the expansion stage					
Investments $(t-1)$	0.1174	0.0007	0.2034***	0.1618***	0.1561**
	(0.087)	(0.081)	(0.056)	(0.058)	(0.063)
Investments $(t-1)^2$	0.0007	0.0333	−0.0245	−0.0216	−0.0190
	(0.025)	(0.022)	(0.017)	(0.017)	(0.021)
Cash flows					
Pre-VC	0.9340***	0.7696***	0.6079***	0.4925***	0.5453**
	(0.172)	(0.126)	(0.158)	(0.133)	(0.228)
Post-VC	0.3503	−0.0080	0.3573**	0.2041	0.2460
	(0.288)	(0.112)	(0.140)	(0.159)	(0.194)
Sales					
Pre-VC	−0.0074	0.0065	−0.0049	0.0119	0.0053
	(0.010)	(0.007)	(0.007)	(0.009)	(0.011)
Post-VC	0.0181	0.0354***	0.0045	0.0262**	0.0184
	(0.013)	(0.008)	(0.011)	(0.013)	(0.014)
$Debt^2$					
Pre-PE	0.0310***	0.0389***	0.0319***	0.0422***	0.0414***
	(0.009)	(0.006)	(0.009)	(0.007)	(0.011)
Post-PE	0.0222***	0.0417***	0.0340***	0.0441***	0.0427***
	(0.007)	(0.006)	(0.009)	(0.009)	(0.011)
Δ	0.0502	0.2618***	0.0298	0.1590***	0.1221
	(0.081)	(0.090)	(0.065)	(0.060)	(0.087)
Log(age)	−0.0766***	−0.3243***	−0.0849***	−0.3402***	−0.1767***
	(0.021)	(0.111)	(0.021)	(0.081)	(0.050)
Time dummies	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	No	Yes	Yes
Observations	2,156	1,881	2,156	1,881	2,156
Firms	246	228	246	228	246
Panel B: PE-sponsored buyouts					
Investments $(t-1)$	0.0301	0.0391	0.0915	0.0129	−0.0004
	(0.074)	(0.099)	(0.081)	(0.096)	(0.108)
Investments $(t-1)^2$	−0.0043	−0.0060	−0.0219	−0.0052	−0.0022
	(0.021)	(0.027)	(0.021)	(0.025)	(0.028)
Cash flows					
Pre-VC	0.1354	−0.0076	0.1958	−0.0066	0.0872
	(0.248)	(0.154)	(0.148)	(0.192)	(0.226)
Post-VC	0.4724**	0.4194**	0.4183***	0.2782*	0.3277*
	(0.192)	(0.187)	(0.130)	(0.149)	(0.195)
Sales					
Pre-VC	0.0280	0.0845***	0.0168	0.0516***	0.0303
	(0.021)	(0.013)	(0.013)	(0.016)	(0.023)
Post-VC	−0.0114	0.0073	−0.0218	0.0061	−0.0111
	(0.019)	(0.012)	(0.018)	(0.020)	(0.029)

Table 6 continued

Independent variables	Sys-GMM	Dif-GMM	OLS	FE	HT
$Debt^2$					
Pre-PE	−0.0098	−0.0241**	−0.0025	−0.0061	−0.0019
	(0.013)	(0.010)	(0.009)	(0.011)	(0.023)
Post-PE	0.0722***	0.0789***	0.0833***	0.0818***	0.0837***
	(0.013)	(0.006)	(0.012)	(0.010)	(0.017)
δ	−0.0405	0.2649*	0.0352	0.1781*	0.1318
	(0.143)	(0.141)	(0.088)	(0.103)	(0.135)
Log(age)	−0.0109	−0.0756	−0.0105	−0.1247	−0.0388
	(0.023)	(0.164)	(0.029)	(0.091)	(0.046)
Time dummies	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	No	Yes	Yes
Observations	815	726	815	726	815
Firms	78	78	78	78	78

VC venture capital, *PE* private equity, *OLS* ordinary least square, *HT* Hausman–Taylor regression, *FE* fixed effect panel regression

The table reports different estimates on Eq. 1 using the same specification reported in column (iii) in Table 5, augmented with the inclusion among regressors of firm log-age. The dependent variable is firm *i*'s investment ratio at time *t*. Standard errors are reported in parentheses. ***, ** and * indicate, respectively, significance levels of <1, <5 and <10%. Investments, cash flows, and debt are all normalised by beginning of period level of fixed assets and winsorised at the 2% threshold. Pre and post rows report estimates of coefficients, respectively, before or after the investment event. Dif-GMM reports estimates obtained using Difference GMM with the same instrument structure as System-GMM used in Table 5. OLS reports estimates obtained using OLS with robust standard errors clustered by firm. FE reports fixed effect panel regression with robust standard errors. HT reports Hausman–Taylor regression with bootstrapped standard errors, where the same exogenous time-invariant instruments used in System-GMM are used as instruments of firm's FE

before and after the investment. Second, we focus on low and medium tech industries, which are surprisingly under-researched but account for most of the amount invested by VC and PE firms. We intend to have a balanced sector presence in our VC and PE subsamples and it is agreed that PE buyouts are rare in high technology firms.

Our results confirm that there is a significant reduction in the investment dependency on internally generated cash flows in SMEs at the expansion stage after the VC deal, thus highlighting the role of VC players in alleviating the financial constraints that would limit their growth prospects. Regarding buyouts, we do not find a significant sensitivity before the investment event, whereas a positive value is found after the acquisition. This finding, which is in accordance with our hypothesis, points to the implementation of management practices (i.e. strategic entrepreneurial approach) to increase the firm's value with tighter corporate governance rules and a significant amount of debt. Results are robust to various specifications of the econometric model.

This work has some limitations which leave room for future research. The size of the sample did not allow us to perform more in-depth analyses, including investor, firm and investment characteristics. Investors differ in their experience, skills, social capital and reputation (see e.g. Hsu 2004; Sørensen 2007). All these elements could influence the impact they have on firm's investment–cash flow sensitivity. Another aspect which is found to be relevant in the literature (e.g. Bertoni et al. 2010a) is the affiliation of the VC/PE investor (e.g. independent, corporate, bank, or governmental VC) involved in the deal, which we could not include in this analysis. Firm-level characteristics, like the availability of financial and human capital of founders, could interact as well with the impact of VC/PE investors on firm's investments (see e.g. Colombo and Grilli 2009). In addition, our work would also benefit from an extension of the sample to an international scale. Engel and Stiebale (2009) show that VC/PE influence firm's investment–cash flow sensitivity differently depending upon the framework conditions in which the firm operates.

Table 7 Estimates excluding the [−1, +1] period

Independent variables	Expansion	Buyout
Investments $(t-1)$	0.1601**	0.0384
	(0.079)	(0.108)
Investments $(t-1)^2$	−0.0113	−0.0052
	(0.024)	(0.027)
Cash flows		
Pre-VC	0.9835***	0.2150
	(0.171)	(0.209)
Post-VC	0.1902	0.6192**
	(0.288)	(0.260)
Sales		
Pre-VC	−0.0040	0.0184
	(0.011)	(0.019)
Post-VC	0.0278	−0.0128
	(0.018)	(0.023)
Debt^2		
Pre-PE	0.0345***	−0.0092
	(0.009)	(0.015)
Post-PE	0.0134	0.0822***
	(0.011)	(0.010)
δ	0.1896	−0.2514*
	(0.122)	(0.150)
Time dummies	Yes	Yes
Firm FE	Yes	Yes
Observations	1,623	634
Firms	239	78

VC venture capital, *PE* private equity

The table reports two-step System-GMM estimates on Eq. 1 using the same specification reported in the column (iii) in Table 5 on a sample where the 3 years across the investment event are excluded (between $t_{INV\_}1$ and $t_{INV}+1$). The dependent variable is firm *i*'s investment ratio at time *t*. Standard errors are reported in parentheses. ***, ** and * indicate, respectively, significance levels of <1, <5 and <10%. Investments, cash flows, and debt are all normalised by beginning of period level of fixed assets and winsorised at the 2% threshold. Pre and post rows report estimates of coefficients before or after the investment event, respectively

Nevertheless, this paper adds to the previous literature in several ways. The first contribution is related to the theoretical explanation, and empirical evidence provided, on the increased dependency of investments to cash flows in PE-sponsored buyouts. As a second contribution, our results provide further evidence on the positive role played by VC investors in alleviating the investment dependency on internally generated cash flows in growing SMEs, a phenomenon which might explain why higher growth rates are observed in VC-backed firms. This work also adds to the limited literature on investment–cash flow sensitivity in unlisted firms (Manigart et al. 2003; Guariglia 2008; Bertoni et al. 2010a; Engel and Stiebale 2009). Regarding VC/PE literature, we analysed a period (17 years) that is long enough to avoid the distortion of the investment–cash flow sensitivity due to short-term economic conditions (as could be the case in Manigart et al. 2003). Furthermore, we explored the sensitivity in the most widely invested sectors in Europe, when the effect of VC involvement was only previously analysed in VC and non-VC-backed high technology firms (Bertoni et al. 2010a). Finally, we differentiated the role played by VC and PE, as in Engel and Stiebale (2009), but using an alternative methodology that allows us to capture explicitly the role of debt, which is important at least in buyouts.

Our results have several important implications. First, they provide evidence that the positive role played by VC investors to bridge the equity gap of SMEs is not limited to technology intensive companies but holds also in low and medium technology industries, which are far less studied. Regarding buyouts, our work confirms that the criticism that is sometimes associated with these investments is groundless. Often the public opinion associates buyouts to a purely financial transaction pursued by vulture investors. This stigma has led to the introduction of a restrictive regulation throughout Europe. However, there are many examples of firms growing substantially after a buyout acquisition. To name just a few of those based in the country in which the work is based, Amadeus, Parques Reunidos, Mivisa, and Dorna Sports, are noticeable examples of Spanish companies which experienced an impressive international expansion after a buyout. On a less anecdotal level, our work shows that, at least on average, buyouts exert a significant and positive effect on the entrepreneurial attitudes of the managers of the acquired firms, albeit curbed by higher financial risk.

In addition, our results highlight that VC and PE have an opposed impact on the investment–cash flow sensitivity of their portfolio companies; while the former alleviates the financial constraints of previously constrained companies, the latter results in increased financial constraints in previously unconstrained firms. In other words, the dependence of

Table 8 Estimates on different buyout subsamples

Independent variables	All buyouts	Excluding PTPs	Excluding PTPs and divisional
Investments $(t-1)$	0.0034	0.0095	0.1817
	(0.104)	(0.086)	(0.128)
Investments $(t-1)^2$	0.0013	−0.0000	−0.0534
	(0.027)	(0.024)	(0.038)
Cash flows			
Pre-investment	0.1871	0.2106	0.4155
	(0.223)	(0.232)	(0.253)
Post-investment	0.4936***	0.4991***	0.6298***
	(0.180)	(0.186)	(0.181)
Sales			
Pre-investment	0.0267	0.0241	0.0105
	(0.021)	(0.019)	(0.014)
Post-investment	−0.0104	−0.0144	−0.0022
	(0.019)	(0.019)	(0.014)
Debt^2			
Pre-investment	−0.0077	−0.0074	−0.0037
	(0.016)	(0.013)	(0.010)
Post-investment	0.0716***	0.0742***	0.0907***
	(0.016)	(0.013)	(0.009)
δ	−0.0181	−0.0230	−0.1995
	(0.175)	(0.152)	(0.181)
Time dummies	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Observations	815	796	512
Firms	78	76	47

PTPs public to private buyouts

The table reports two-step System-GMM estimates on Eq. 1 using the same specification reported in the column (iii) in Panel B of Table 5, which is reported as *All buyouts* here for convenience. The dependent variable is firm *i*'s investment ratio at time *t*. Standard errors are reported in parentheses. ***, ** and * indicate, respectively, significance levels of <1, <5 and <10%. Investments, cash flows, and debt are all normalised by beginning of period level of fixed assets. Pre and post rows report estimates of coefficients, respectively, before or after the investment event. In the column *Excluding PTP*, the estimation is based on a sample where the two PTP transactions are excluded. In the column *Excluding PTP and divisional*, the estimation is based on a sample where the two PTP transactions and the 29 divisional buyouts are excluded (leaving 47 family and whole private buyouts)

investments on internally generated cash-flows is reduced by VC and increased by PE. This is likely to generate macro-level differences; the aggregate impact of VC and PE will depend crucially on the mix of these two types of investments in a region.[11] Interestingly, substantial differences can be found to this extent. On average, between 2003 and 2007 early stage deals in Europe accounted for 6.2% of overall VC and PE investments (EVCA 2004–2008). In the same period, instead, late stage deals, most of which are buyouts, accounted for 75% of investments. These figures are dramatically different from those observed in the United States where, in the same period, early stage deals accounted for 17.6% of total amount invested (i.e. about three times Europe's), and late stage deals for 37.8% (i.e. about half Europe's) (NVCA 2004–2008). The effect of this huge difference in the structure of VC and PE across the two continents is still under-researched. Our study, however, suggests that the aggregate impact of the VC and PE industry on relaxing financial constraints should be much stronger in the United States than in Europe. Similarly, our results indicate that policies aiming at increasing the size of the VC and PE industry as a whole, for instance, reducing taxation on capital gains, will yield very different outcomes in the two continents. Arguably, governments may modify the aggregate impact of the VC and PE industry on investment–cash flow sensitivity by enacting policies which affect asymmetrically VC or PE, favouring one over the other. An interesting scenario is that of a government which wants to reduce aggregate investment–cash flow sensitivity during a recession (when cash flows are limited) but cannot do so through usual expansionary policies (e.g. because of political unwillingness to increase the state budget or due to obstacles in issuing sovereign debt). Our study suggests that the introduction of an asymmetric tax regime, favouring VC over PE, could generate an aggregate reduction in investment–cash flow sensitivity without imposing an additional burden on taxpayers. Even though the size of the VC and PE industry is small compared to the size of the economy, also in the most financially developed countries, this option should well be considered by policymakers as one of the tools to accelerate the rebound of the economy after the

[11] It is interesting to point out that this is consistent with the work by Da Rin et al. (2006), who show that the *innovation ratio* (defined as the ratio of early stage investments to total VC/PE investments) is a crucial element in the ability of the VC and PE industry to boost R&D and innovation.

financial, economic, and fiscal crisis at the end of the 2000s.

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