Private equity, investment and financial constraints: firm-level evidence for France and the United Kingdom

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Abstract This paper analyses the effects of private equity firms on the investments and financial constraints of their portfolio firms. We use dynamic panel data techniques to account for unobserved firm heterogeneity and endogeneity of private equity backed buyouts and expansion financing, and apply our framework to a large panel data set of firms in the UK and France. In both countries, we find that portfolio firms are characterized by higher investment levels and fewer financial constraints after expansion financing. In the UK, private equity backed buyouts outperform non-private equity backed firms in terms of both indicators.

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1 Introduction

The growing number of leveraged buyouts (LBOs) and the accompanying growth of private equity markets before the turmoil in the debt markets in 2008 (e.g. Wright et al. 2006) raised a controversial debate about the effects of private equity firms (PEFs) and other institutional investors on portfolio firms. Contributions to that debate have included the US Dodd–Frank Act from June 2010, a White Paper by the European Commission (2006), a paper from the UK Financial Services Authority (2006) and a famous speech by Germany's former vice chancellor Franz Müntefering, who equated private equity investors with locusts and stated that those investors would hollow out companies for their own benefit (see e.g. Ferran 2007).

A particular concern is that the high amount of debt that is often used to finance private equity based transactions, which is usually secured by portfolio firms' assets or future cash flows, can lead to financial constraints or even distress in portfolio firms. It is also

controversial to what extent private equity investors take a short-term perspective that hampers long-run investments (e.g. Cao and Lerner 2009). In contrast, theoretical and empirical contributions suggest that ownership changes can shift resources to more efficient uses and more active managers (Harris et al. 2005).

This paper aims to answer the following research questions: First, what is the effect on portfolio firms' investment and financial constraints of PEFs' expansion financing and buyouts? Second, are the effects for small and medium-sized enterprises (SMEs) different from those for larger firms? And finally, do the effects of PEFs differ across countries?

So far, the effects of PEFs on portfolio firms' investment have mainly been investigated for early-stage investments (Manigart et al. 2003; Bertoni et al. 2010). A notable exception is Bertoni et al. (2013), who analyse both expansion financing and buyouts by PEFs for companies in Spain.

Our first contribution to the literature is that we analyse separate effects for SMEs and large firms. SMEs are more likely to be financially constrained than larger firms (see, for instance, Carpenter and Petersen 2002), and Wiersema and Liebeskind (1995) argue that there is a higher potential for restructuring in large firms. Our findings indicate that this differentiation does indeed matter, since we find the most pronounced and statistically significant effects for SMEs.

Our paper also contributes to the literature that investigates the role of institutional investors in general. Pawlina and Renneboog (2005), Agca and Mozumdar (2008) and Lin et al. (2011) look at financial institutional investors (such as PEFs, banks, investment funds, pension funds, insurance firms and real-estate firms) altogether and do not differentiate between types of institutional investor. Different types of investor will have different strategic goals and incentive structures, which can result in different monitoring and governance activities (see, for instance, Chen et al. 2007).

A further contribution of our study is that we analyse heterogeneous effects of PEFs on portfolio firms both in the UK, a country characterized by common law legislation, and in France, a country characterized by civil law legislation. As argued by La Porta et al. (1998, 2000), there are considerable differences across countries in governance mechanisms dealing with agency conflicts. These include different legal rules

and different methods of enforcement to protect outside investors against expropriation by insiders. Further, the UK has more developed stock markets than does France, and PEFs have played a more important role there for many years than they have in France. Analysing the effects of PEFs in France and the UK allows us to check the generalizability of our main findings across two countries with important institutional differences.

Another innovation of our paper is that we provide preliminary evidence on other outcome variables, such as growth of sales, employment and labour productivity, which we link to the reduction in financial constraints.[1] In contrast to much of the previous literature on institutional investors and firm performance, we use a large sample with a large proportion of unlisted companies. Listed firms are arguably among the more successful and are thus not representative for all firms with financial intermediaries as shareholders.

The rest of this paper is organized as follows: Section 2 discusses the financing of European SMEs. In Sect. 3, we discuss the effects of PEFs on their portfolio firms and derive our hypotheses. Section 4 describes our econometric model, and Sect. 5 provides a description of the data. Results of the econometric analysis are presented and discussed in Sects. 6 and 7, and robustness checks are reported in Sect. 8. Section 9 concludes.

2 Financing SMEs in Europe

It is a stylized fact that obstacles to growth and access to finance vary with firm size; For instance, Schiffer and Weder (2001) use the worldwide survey of the business environment conducted by the World Bank and find that small firms report the most obstacles to growth. Beck et al. (2005) show additionally that financing constraints matter even more than obstacles related to the legal system or to corruption. These observations also hold for European countries, as evidenced, for instance, by the survey on access to finance of SMEs in the euro area (SAFE). The survey

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[1] Boucly et al. (2011) find that private equity backed buyouts have more pronounced effects on portfolio firms in industries that are more dependent on external finance, but they do not directly analyse effects on financial constraints and investment.

shows that the availability of bank loans decreases with firm size (European Central Bank 2013a, table Q7B). This result also holds after controlling for firm-level and macro-level characteristics (Lucey et al. 2012). The success rate of full applications for bank loans has been between 60 and 65 % in recent years (European Central Bank 2013b, p. 14) and did not vary substantially during the recent financial crisis.

A rich body of literature analyses the sources of financing constraints. Corporate managers are often better informed about the financial soundness and prospects of their companies than outside investors. Berger and Udell (1998) point out that business contacts and audited financial statements are not publicly visible for many SMEs, and thus external investors face high transaction costs in acquiring sufficient information about these firms. Based on informational opacity, the financing literature suggests that the cost premium for external sources of financing is higher for SMEs than for larger firms. Since new securities (whether in the form of debt or equity) issued on financial markets can be undervalued due to information asymmetries, SMEs' investments are more dependent on internally generated cash flow than are the investment projects of large firms. Empirical studies clearly confirm this (e.g. Harhoff 1998; Audretsch and Elston 2002; Carpenter and Petersen 2002), based on the estimation of investment–cash flow (ICF) sensitivities. These sensitivities have been found to be particularly pronounced for European technology-based small firms (Revest and Sapio 2012).

Based on the insight that financial constraints matter significantly for European SMEs, policy-makers argue for continuous support of SMEs in the form of subsidies and guaranteed bank loans, as well as better access to external finance in general. Financing conditions for European SMEs have changed substantially over the past two decades. Among the most important changes have been the increasing importance of private equity finance (Wright et al. 2006), public equity finance (Moshirian et al. 2013) and improvements of lending technologies such as scoring models (Berger et al. 2005). With respect to public equity finance, many secondary public markets were founded in the 1990s, including the London Stock Exchange's Alternative Investment Market (AIM) in 1995 and the Neuer Markt in Germany in 1997 (see Vismara et al. 2012 for a description of the evolution of secondary markets). Although many alternative

capital markets were closed between 2003 and 2005, market capitalization at the AIM increased to £61,748 million in June 2013. Secondary markets are usually characterized by lower listing standards, which can be more easily fulfilled by SMEs. Vismara et al. (2012) point out that two-thirds of initial public offerings (IPOs) on the AIM did not meet the listing requirements of the primary market, the London Stock Exchange.

However, capital market imperfections still matter for many firms, and private equity investors such as venture capital companies are able to handle these imperfections better than single investors (e.g. Carpenter and Petersen 2002). Further, private equity and public equity are complements rather than substitutes. This view is supported by the fact that, at the time of IPO, 48.2 % of European firms were financed by venture capital companies (Vismara et al. 2012). Analysing the choice between rights offerings and private equity placements in detail, Cronqvist and Nilsson (2005) show that firms which are affected by higher levels of information asymmetries choose private placements more often. Besides the role of PEFs in funding growing SMEs, private equity is a natural means to realize buyout transactions; for instance, Amess and Wright (2012) report that 38 % of leveraged buyouts were financed by PEFs in 2004. The buyout market in the UK is the largest in Europe: the aggregated deal volume is 1.5 times larger than in the whole of Continental Europe, and four out of five European buyout deals in 2005 took place in the UK (Wright et al. 2006).

3 The impact of PEFs on portfolio firms

3.1 Financial occasions, firm size and the role of PEFs

The effects of PEFs on portfolio firms are likely to depend on the occasion of investment. Firms with growth opportunities aim to penetrate existing markets, to enter new markets or to promote product diversification. The exploitation of growth opportunities generally requires significant financial resources, which can be provided either by internal finance or by external investors. The involvement of PEFs in the expansion stage aims to overcome limitations on firms' growth. In contrast, the targets of buyouts are usually mature firms with well-developed products

and significant free cash flow (Jensen 1986). The corporate governance literature postulates that managers of firms that are targeted for buyout tend to waste free cash flow on unprofitable projects (over-investment) in order to keep more resources under their control, instead of increasing pay-outs to shareholders (e.g. Jensen 1986). Debt bonding, managements' equity stakes and the presence of active investors often contribute to overcome this problem (Jensen 1986, 1989). This is confirmed by empirical studies showing that, after buyout, firms' performance increases (Kaplan 1989; Harris et al. 2005) and firms refocus on their core business and reduce diversification (Seth and Easterwood 1993). Since this divestment increases with the degree of diversification and firm size (Haynes et al. 2003), large firms are more likely to undergo restructuring after a buyout. The involvement of PEFs may reduce the problem of over-investment (Jensen 1986, 1989). Wright et al. (2001) argue that buyout transactions are also likely to accelerate entrepreneurial activity in the form of the identification and exploitation of growth opportunities.

PEFs are able to reduce information asymmetries and agency problems, as they have significant board representation (Kaplan and Strömberg 2009) and are able to obtain regular reports[2] to monitor portfolio firms continuously (Gorman and Sahlman 1989). Many portfolio firms perform poorly at the time of acquisition, and in such cases PEFs often use their board rights to replace the management team. PEFs often acquire large proportions of a firm's equity shares, and as Shleifer and Vishny (1997) point out, shareholders with sufficiently large equity positions can gain more from information about the firm. The entry of a PEF as a new shareholder may therefore signal to less well-informed third parties (e.g. banks, suppliers and customers) that efforts will be made to increase a firm's value, which may lead to better access to external financial resources (Stuart et al. 1999).

Against the view that PEFs create value, it is argued that they increase the leverage of their portfolio firms (Amess and Wright 2012) and exit their acquisition targets quickly to realize financial arbitrage (Ferran 2007; Cao and Lerner 2009). PEFs aim to maximize

the return on investment, and thus profitable exit options may shorten the period of equity holding. If portfolio firms' leverage becomes too high, the debt repayments might cause financial distress, and the firms will become more vulnerable to economic shocks. However, Cao and Lerner (2009) do not detect that reverse LBOs with relatively high leverage ratios perform worse with respect to buy-and-hold returns. They do, however, provide some evidence (weakly significant) that firms that go public within a year after a LBO underperform compared with LBOs with longer holding periods by PEFs.

3.2 Research hypotheses

The above discussion shows that the involvement of PEFs in a portfolio firm can affect its investment in various ways, depending on the financial constraints the firm faces and its free cash flow before the acquisition. Since firms' level of investment spending and their dependence on internal finance are expected to vary with firm size and financial occasions, we estimate heterogeneous effects for SMEs and larger firms, as well as for buyouts and expansion financing. As argued in Sect. 3.1, firms in the expansion stage are likely to face growth opportunities and financial constraints at the same time. We therefore hypothesize that the involvement of a PEF in the expansion stage has a positive effect on the investment activity of the portfolio firm and lowers its dependence on internal finance (hypothesis 1).

In contrast, the effect of PEF involvement on investment activity and ICF sensitivities of buyout firms is theoretically ambiguous. On the one hand, buyouts might facilitate the exploitation of newly identified entrepreneurial opportunities, which could boost the investment activity of the portfolio firm. The involvement of a PEF may also increase investment and alleviate financing constraints by easing access to external finance. On the other hand, investment levels may decline, due to a reduction in over-investment, and the high debt ratio which often results from buyouts might imply that some investments are reduced due to the availability of internal and external funds. Therefore, ICF sensitivities may increase after a buyout as well. We expect that the latter effect does not apply to expansion financing, since the amount of debt involved in the expansion stage is usually low and firms at this stage are usually not characterized by

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[2] Biddle et al. (2009) show that higher reporting quality is associated with lower levels of investment in firms that are more likely to waste cash flow and higher levels of investment in firms which are confronted with financing constraints.

over-investment. We therefore hypothesize that the effect of buyouts on investment and ICF sensitivities is less than that for expansion financing (hypothesis 2). Whether the overall effect of buyouts on portfolio firms is positive or negative is not clear from a theoretical point of view.

SMEs are arguably more likely to be financially constrained than larger firms, and signalling effects matter more in situations with high informational opacity. Therefore, we expect that the effect of PEF involvement on portfolio firms' investment and financial constraints is more pronounced for SMEs (hypothesis 3).

4 Econometric approach

Empirical analyses of financing constraints are usually based on estimation of ICF sensitivities (see Bond and van Reenen 2008 for an overview). In our study, we apply a dynamic version of a sales accelerator model (Harhoff 1998; Mairesse et al. 1999) to investigate the impact of private equity on investment and financial constraints.[3] Alternatively, Bertoni et al. (2013) use the Euler model, which is based on the assumption of convex adjustment costs. Many empirical studies find, however, large adjustments in firm-level data, and thus this assumption might be violated (Bond and van Reenen 2008). A potential pitfall with all ICF models is that cash flow might be correlated with unobserved expected future profitability if the adjustment process is not described adequately (see Cummins et al. 2006 and the reply from Agca and Mozumdar 2010). Bond et al. (2003) show that the ability of cash flow to forecast future cash flow or sales does not differ much across groups of firms that are expected to be differently affected by liquidity constraints. Therefore, we believe that, even if cash flow conveys some information about investment opportunities, *differences* in ICF sensitivities between several groups of firms—such as private equity backed and non-private equity backed firms—are a valid indicator of *differences* in financial constraints.

Because ICF sensitivities have been declining over time, their validity in testing for financing constraints

in more recent periods has been questioned. In this light, Chen and Chen (2012) as well as Moshirian et al. (2013) have suggested that cash–cash flow sensitivities, first used by Almeida et al. (2004), might be a better measure of financing constraints. However, empirical investigations have found that ICF sensitivities seem to predict differences in financing constraints across groups of firms better than cash–cash flow sensitivities (D'Espallier et al. 2008). Further, Brown and Petersen (2009) and Moshirian et al. (2013) show that the rising importance of public equity finance to some extent explains the decrease in ICF sensitivities at the firm level.

The dynamic sales accelerator model typically includes current and lagged sales growth as a proxy for investment opportunities, the lagged investment to capital ratio to account for adjustment costs and state dependence in investment decisions and cash flow or an alternative measure for internal finance. Since private equity investors might choose portfolio firms with high growth potential based on innovations, we control for lagged levels of intangible assets in our specification. We also include bank debt, because firms selected by private equity investors might be confronted with credit rationing to a different extent than other firms, even before the acquisition.

Our basic empirical model is given by

$$
\frac{I_{it}}{K_{i,t-1}} = \beta_1 \frac{I_{i,t-1}}{K_{i,t-2}} + \beta_2 \Delta y_{it} + \beta_3 \Delta y_{i,t-1} + \beta_4 \frac{\text{ITA}_{i,t-1}}{K_{i,t-1}} + \beta_5 \frac{B_{i,t-1}}{K_{i,t-1}} + \beta_6 \frac{C_{it}}{K_{i,t-1}} + D_i + Z_t + \varepsilon_{it},
$$

(1)

where I_{it} denotes gross investments in tangible fixed assets of firm i in year t, and $K_{i,t-1}$ is the value of tangible fixed assets at the end of the previous year, $t-1$. Δy_{it} ($\Delta y_{i,t-1}$) is the contemporary (lagged) 1-year change in the logarithm of sales, $\text{ITA}_{i,t-1}$ denotes the lagged value of intangible assets, $B_{i,t-1}$ denotes the lagged value of long-term debt (which is predominantly bank debt), C_{it} is the current cash flow, D_i is a firm fixed effect, Z_t contains time fixed effects and ε_{it} is an error term. Investment is computed as

$$
I_{it} = K_{it} - K_{i,t-1} + \delta_{it},
$$

(2)

where δ_{it} denotes the firm-specific amount of depreciation. Hence, our measure of investment explicitly allows for disinvestment and thus negative values of I_{it}.

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[3] The Q-model of investment, first implemented by Fazzari et al. (1988), cannot be applied to our data set since there is no stock market data to calculate Tobin's Q for the majority of firms in our sample, which are unlisted.

To discriminate between private equity and non-private equity backed firms, we follow recent studies (e.g. Bertoni et al. [2010]) and add to the model a dummy variable for private equity backed firms and an interaction term with the cash flow to capital ratio as follows:

$$\frac{I_{it}}{K_{i,t-1}} = \beta_1 \frac{I_{i,t-1}}{K_{i,t-2}} + \beta_2 \Delta y_{it} + \beta_3 \Delta y_{i,t-1} + \beta_4 \frac{\text{ITA}_{i,t-1}}{K_{i,t-1}}$$
$$+ \beta_5 \frac{B_{i,t-1}}{K_{i,t-1}} + \beta_6 \frac{C_{it}}{K_{i,t-1}} + \beta_7 \text{PE}_{it}$$
$$+ \beta_8 \text{PE}_{it} \cdot \frac{C_{it}}{K_{i,t-1}} + D_i + Z_t + \varepsilon_{it}. \qquad (3)$$

PE_{it} is a time-varying dummy variable which takes the value of 1 in all years we detected involvement of a PEF in portfolio firm i. $\text{PE}_{it} \cdot C_{it}/K_{i,t-1}$ measures the interaction of PEF involvement with the cash flow to capital ratio.[4]

The main parameters of interest are β_7 and β_8. If ICF sensitivities are equal for all firms before private equity financing starts (which we test explicitly), a negative sign for β_8 implies a reduction in ICF sensitivity through PEF involvement, while a positive sign implies an increase. Equation (3) is estimated for British and French firms separately. In alternative specifications, we differentiate between expansion financing (EF_{it}) and buyouts (BO_{it}) by PEFs.

The individual effects in the investment equation are necessarily correlated with the lagged dependent variable, which causes ordinary least-squares (OLS) estimators, random-effects estimators and fixed-effects estimators to be inconsistent (e.g. Baltagi [2001]). To avoid this bias, we use a difference generalized method of moments (GMM) estimator which eliminates firm-specific effects by differencing Eq. (3) and then use lagged values of the regressors as instruments, as proposed by Arellano and Bond (1991).[5] For estimation, we use the more efficient two-step variant of the difference GMM estimator. The finite sample correction proposed by Windmeijer (2005) is used to compute standard errors that are robust to heteroscedasticity and autocorrelation.

The estimation procedure allows the explanatory variables to be treated as strictly exogenous, predetermined or endogenous. This implies that the regressors are assumed to be uncorrelated with all realizations of the error term, correlated only with past realizations, or correlated with present shocks, respectively. If the error term is serially uncorrelated and the model is correctly specified, one-period lagged levels of predetermined variables and two-period lagged levels of endogenous variables are valid instruments. Similarly to the cash flow and sales growth variables, private equity financing might be endogenous if there is feedback from past investment to future acquisitions by PEFs, or if these investors select portfolio firms with higher unobserved future profitability. We will address this issue carefully. We treat cash flow and current sales growth as endogenous and lagged intangible assets and bank debt as predetermined.

In those specifications where we treat PE_{it} as endogenous, we use lagged values of all regressors as instruments. In an alternative specification, we use two-year lagged values of ownership dispersion of non-control relevant shares as an exclusion restriction. This variable is calculated as the Herfindahl index of equity shares across all owners, excluding majority shares. The higher the free float of a company's shares or generally the more dispersed the shares of a company are across owners, the easier it becomes for an external investor to acquire a firm. Although one might argue that ownership concentration could be correlated with corporate governance mechanisms that affect investment, this should be true only of control relevant stakes. We will test the validity of this additional instrument by over-identification tests. In a further amplification of the model, we use the predicted probability of acquisition—estimated by a Probit

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[4] We also experimented using contemporaneous instead of lagged values of bank debt and intangible assets and interacting the private equity dummy with banking debt, but this did not affect our results notably.

[5] An alternative estimator for dynamic panel data models is the system GMM estimator, which has been found to be more efficient and less affected by weak instruments, especially in series that display high persistence, i.e. are close to a unit root. Unfortunately, our specification tests indicated that the additional assumptions

Footnote 5 continued

regarding stationary and initial conditions of the variables were not met in our data. Further, we could reject unit roots for all variables in AR(1) models. We also found that the estimates of the AR(1) processes with the difference GMM estimators were, in all cases, above those with the fixed-effects estimator (which is biased downwards) and below those with the OLS estimator (which is biased upwards). Hence, we conclude that our results are not much affected by weak instruments.

model with our exclusion restriction and the other exogenous regressors—as an alternative instrument.

5 Data and descriptives

The data set used in this paper is compiled from two sources. The first is the ZEPHYR database of mergers and acquisitions (M&As), published by Bureau van Dijk. It includes data on M&As, IPOs, joint ventures and private equity transactions and provides information about the date and value of a deal, the source of financing, as well as a description of the type of transaction and the firms involved. Compared with other M&A data sources, such as Thompson Financial Securities data, it has the advantage that there is no minimum deal value.

The second source is a database named AMADEUS, which is also provided by Bureau van Dijk. It is compiled from company accounts that are reported to national statistical offices in European countries. It provides information on firms' balance sheets and profit and loss accounts for up to 10 years, as well as ownership and subsidiary information. This financial data is supplemented by specialized regional information providers. In addition to financial items, AMADEUS includes information about employment, industry, legal form and date of incorporation. The database has been used in numerous empirical firm-level studies. We merged six updates of the database (nos. 64, 88, 113, 136, 146, 168) to be able to consider entry and exit and thus a broader sample of firms. We selected all firms from the database for which unconsolidated accounts and information on our key variables were available. Observations from the AMADEUS database were merged with the transaction data from ZEPYHR by a common firm identifier. Since data availability varies considerably across countries, we restrict our analysis to firms in the UK and France.

From the merged data set, we identified targets of private equity transactions and deleted all firms that were involved in M&As. To be classified as a private equity backed transaction, either the business description of the acquirer or the financing of the deal had to indicate the involvement of private equity (see Appendix A, available on the web, for a detailed description).

The available time period spans the years 1998–2007. Since our preferred estimation method is not applicable to panels with gaps and requires the availability of lagged values of regressors, we kept only those firms with at least three consecutive firm-year observations. Table 1 provides summary statistics for our key variables (see Table A-1 in Appendix B, available on the web, for detailed definitions of these variables).

Small firms make up a large part of our sample. In line with this observation, the investment to capital ratio and the cash flow to capital ratio are higher than has been reported in other studies (e.g. Bond et al. 2003). Within both France and the UK, private equity backed firms are on average larger and have higher levels of bank debt than non-private equity backed firms. Among the private equity backed firms, the separate statistics for buyout firms and firms with expansion financing differ considerably, in that the former are substantially larger than the targets of expansion financing (and also larger than non-private equity financed firms), they have lower investment rates than the average firm and are older, and they display growth rates of employment and sales that are similar to those of non-private equity backed firms. The cash flow to capital ratios of buyout firms are remarkably high, given that this ratio usually declines with firm size. The degree of leverage in private equity financed buyout firms in France and the UK is similar to that of the remaining private equity financed firms.

The structure of the unbalanced panel used for estimation is depicted in Table 2. A breakdown of the number of observations by year is given in Table 3.

6 Results

In Tables 4 and 5 the results from the difference GMM estimations are reported for British and French firms, respectively.

Column (1) in Tables 4 and 5 shows results of regressions where the private equity dummy is treated as exogenous, while in column (2) the dummy variable is solely instrumented by lagged values of the regressors. In column (3) we use in addition ownership dispersion ("own") lagged two periods and more, and in column (4) we use the predicted probability of acquisition, $\hat{\mathrm{Pr}}(\varDelta\mathrm{PE}_{it} = 1)$. Additional moment restrictions are constructed by lags of interaction terms of these additional instruments with the cash flow to capital ratio. The test statistics show that the validity of our instruments cannot be rejected at conventional significance levels since the Arellano–Bond test does not

Table 1 Summary statistics

	PE = 0		PE = 1		EF = 1		BO = 1	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median
UK								
I_t/K_{t-1}	0.190	0.095	0.239	0.147	0.360	0.212	0.192	0.128
C_t/K_{t-1}	0.463	0.261	0.785	0.561	0.315	0.276	0.966	0.656
Δy_t	0.026	0.031	0.053	0.057	0.079	0.082	0.043	0.043
ITA_{t-1}/K_{t-1}	0.032	0.000	0.087	0.000	0.105	0.000	0.081	0.000
B_{t-1}/K_{t-1}	0.437	0.161	1.071	0.141	1.281	0.393	0.992	0.089
Sales	27,803	11,997	46,504	24,718	36,003	14,773	50,557	29,308
Employees	185	84	341	169	237	105	381	184
Emp growth	0.012	0.008	0.036	0.026	0.073	0.062	0.022	0.021
K	5,779	1,972	6,460	2,685	6,864	1,859	6,304	2,958
Total assets	15,991	6,976	27,313	15,843	23,534	10,333	28,771	18,656
Age	28	21	21	14	15	10	23	16
France								
I_t/K_{t-1}	0.278	0.129	0.248	0.114	0.322	0.149	0.167	0.095
C_t/K_{t-1}	0.834	0.593	0.718	0.652	0.338	0.456	1.130	0.818
Δy_t	0.054	0.047	0.108	0.070	0.161	0.111	0.049	0.043
ITA_{t-1}/K_{t-1}	0.108	0.030	0.160	0.078	0.183	0.103	0.133	0.057
B_{t-1}/K_{t-1}	0.155	0.000	0.329	0.000	0.353	0.000	0.303	0.000
Sales	31,906	8,197	47,025	13,625	29,018	6,068	67,389	27,476
Employees	137	46	273	78	153	45	401	149
Emp growth	0.023	0.000	0.041	0.011	0.072	0.041	0.010	0.000
K	6,686	511	12,206	1,040	11,436	523	13,081	2,074
Total assets	15,132	4,608	39,982	15,230	27,467	9,102	54,031	23,275
Age	25	20	24	15	16	9	32	24

All monetary variables are measured in €1,000 in prices of the year 2000

indicate autocorrelation of second order, and the Hansen test does not reject the orthogonality of instruments to the error term. For both countries, the results of the difference-in-Hansen test in column (1) indicate that private equity transactions are exogenous to the investment equation. Private equity transactions are associated with higher investment spending and a lower dependency of investment on internal funds of a similar magnitude in France and the UK. Interestingly, we cannot reject the null hypothesis that the ICF sensitivity of private equity financed firms [$(\beta_6 + \beta_8)$ in Eq. (3) in Sect. 4] is zero.[6] This indicates that private equity financing is associated with significant reductions in financial constraints.

The estimation results suggest that, within both countries, a change in private equity involvement leads to a change in investment spending of approximately 25 % for firms with a zero change in the cash flow to capital ratio. The overall effect of PEFs declines with increasing change in the cash flow to capital ratio, approaching zero for a value of $\Delta(C_{it}/K_{i,t-1})$ close to 1.[7] Treating PE_{it} as endogenous does not alter our conclusion substantially. The estimates for the coefficient of PE_{it} are a little higher, but the

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[6] We found that the GMM estimate lies above the fixed-effects estimator (which is biased downwards) and below the OLS estimator (which is biased upwards). Hence, we conclude that our results are not greatly affected by weak instruments. The

Footnote 6 continued
results are documented in Table A-4 in Appendix B, available on the web.

[7] This value is beyond the 95 % quantile of $\Delta(C_{it}/K_{i,t-1})$ within both countries.

Table 2 Number of firms and observations

	Firms	Observations	PE = 1	EF = 1	BO = 1
France					
3	2,096	6,288	384	207	183
4	3,694	14,776	500	296	228
5	2,043	10,215	435	255	200
6	1,504	9,024	384	192	204
7	4,337	30,359	518	252	287
8	4,411	35,288	576	232	352
All	18,085	105,950	2,797	1,434	1,454
UK					
3	1,502	4,506	252	65	190
4	1,753	7,012	338	132	206
5	1,176	5,880	339	100	244
6	828	4,968	324	54	270
7	1,609	11,263	658	133	532
8	675	5,400	328	80	248
All	7,543	39,029	2,239	564	1,690

Table 3 Observations by time period in per cent

	UK		France	
	PE = 0	PE = 1	PE = 0	PE = 1
2000	11.6	3.6	13.3	2.5
2001	14.7	8.0	14.3	4.9
2002	15.9	10.9	14.8	7.6
2003	15.7	13.3	14.7	11.0
2004	13.4	16.7	12.8	16.6
2005	12.1	17.8	12.2	20.5
2006	10.8	18.5	11.6	21.7
2007	5.9	11.3	6.3	15.3

confidence intervals are clearly overlapping. The estimates for the coefficients of the interaction terms with cash flow are quite similar. We cannot reject exogeneity either of PE_{it} in column (1) or of our additional instruments in columns (2)–(4). Further, the Hansen tests for the joint validity of lagged levels of the regressors as instruments and the autocorrelation test do not reject the validity of the instruments. This indicates that our results are not primarily driven by the endogeneity of private equity backed acquisitions.

Irrespective of this positive effect of PEFs on average, the debate about regulation of private equity financed deals focusses on buyouts rather than on expansion financing. Therefore, in Tables 6 and 7, we present findings for expansion financing and buyouts separately.

In France, we see that only expansion financing affects investment and ICF sensitivities significantly, while in the UK both buyouts and expansion financing have a significant impact. Thus it seems that expansion financing clearly spurs investment and reduces ICF sensitivities. As over-investment is probably a minor problem for firms in the expansion stage, we interpret these findings as evidence that expansion financing by PEFs increases investment opportunities and leads to a reduction in financing constraints. This is line with hypothesis 1, which states that expansion financing has a positive effect on portfolio firms' investment and reduces financing constraints.

The evidence for buyouts is mixed. For UK firms, Table 6 shows that buyout activity is associated with increases in investment spending and a decrease in ICF sensitivities. No significant effects on ICF sensitivities for buyout firms are detected in France (Table 7).[8] A likely explanation for this result is that buyout firms are less confronted with financing constraints and may have lesser growth opportunities than firms in the expansion stage. Although there are differences between the two countries, our results are in line with hypothesis 2, which states that the effects of expansion financing are larger than the effects of buyout transactions.

The degree of financial constraint as well as the level of under- or over-investment are usually found to vary across different groups of firms, and it is often argued that financial constraints are more severe for small firms. To check whether the impact of private equity investors differs with firm size, we estimated separate regressions for firms with a median value of total assets below and above €30 million.[9] The results are depicted in columns (2) and (3) of Tables 6 and 7. We see that the ICF sensitivity of large private equity funded firms does not differ significantly from large non-private equity backed firms. For the subgroup of smaller firms, expansion financing is associated

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[8] As the previous results did not indicate that endogeneity of private equity backed transactions is a severe problem in the difference GMM estimations, we present only results that assume exogeneity of private equity for the heterogeneous effects.

[9] This threshold was chosen in order to ensure a sufficient number of firms with buyout financing and firms with expansion financing for each size class in both countries.

Table 4 GMM first differences—British firms

	(1)	(2)	(3)	(4)
I_t/K_{t-1}	0.0348***	0.0357***	0.0364***	0.0341***
	(0.009)	(0.009)	(0.009)	(0.009)
C_t/K_{t-1}	0.2462***	0.2466***	0.2340***	0.2253***
	(0.026)	(0.026)	(0.025)	(0.024)
Δy_t	0.1315***	0.1343***	0.1458***	0.1415***
	(0.020)	(0.020)	(0.019)	(0.018)
Δy_{t-1}	0.0210*	0.0224*	0.0267**	0.0266**
	(0.012)	(0.012)	(0.012)	(0.012)
PE_t	0.2506***	0.3777**	0.3819**	0.3173**
	(0.058)	(0.148)	(0.173)	(0.156)
$PE_t \cdot C_t/K_{t-1}$	−0.1898***	−0.1866***	−0.1877***	−0.2488***
	(0.049)	(0.049)	(0.066)	(0.062)
ITA_{t-1}/K_{t-1}	0.0505	0.0552	0.1696	0.0385
	(0.289)	(0.289)	(0.275)	(0.269)
B_{t-1}/K_{t-1}	0.0168*	0.0171**	0.0170**	0.0158*
	(0.009)	(0.009)	(0.008)	(0.008)
N	39,029	39,029	39,029	39,029
m1	0.000	0.000	0.000	0.000
m2	0.562	0.498	0.485	0.588
Hansen	0.224	0.236	0.276	0.169
Diff-Hansen	0.298	0.236	0.514	0.660
IV for ΔPE_t	ΔPE_t	$PE_t(2,5)$	Own_{t-2}	$Pr(\Delta PE_t = 1)$

***, **, * Significance at the 1, 5, 10 % level. Robust standard errors are shown in parentheses. m1 (m2) is a test of the null hypothesis of no first (second)-order serial correlation. Hansen is a test on the over-identifying restrictions based on the two-step GMM estimator. Diff-Hansen is a test of the validity of the moment restrictions based on the instruments used in addition to the lagged levels of the regressors. For all test statistics, p values are reported

with higher investment and lower ICF sensitivities in both countries, while the effect of buyouts is significant only in the UK. These results are in line with hypothesis 3, which states that SMEs are expected to benefit more from private equity financing.

7 Discussion

Our results indicate that private equity investors enhance investment and reduce financial constraints. From a theoretical point of view, a reduction of ICF sensitivities could also arise from a reduction in over-investment. However, we found that the effects of private equity are much more pronounced for smaller firms in our sample—which are arguably more likely to face financial constraints and less likely to be characterized by over-investment—which indicates

that this is an unlikely explanation for our results. Further, we found that private equity financed transactions are associated with an increase in the level of investment for a given level of cash flow, which is clearly not in line with reduced over-investment. Over-investment is probably of minor importance in our sample, which has a large proportion of small and unquoted companies. We find that buyout financing has a qualitatively similar effect to expansion financing. However, this effect is smaller and shows up only for firms in the UK. Since the investment rates of buyout firms are never significantly negatively affected and ICF sensitivities do not increase after a buyout in either country, we conclude that PEFs do not hamper the investment activity of buyout firms. The results for both countries have in common that expansion financing alleviates ICF sensitivities and induces investment, and that buyouts do not seem to

Table 5 GMM first differences—French firms

	(1)	(2)	(3)	(4)
I_t/K_{t-1}	0.0480*	0.0519*	0.0592**	0.0530*
	(0.029)	(0.029)	(0.028)	(0.027)
C_t/K_{t-1}	0.1831***	0.1792***	0.1754***	0.1793***
	(0.015)	(0.015)	(0.015)	(0.015)
Δy_t	0.3886***	0.3593***	0.3393***	0.3673***
	(0.109)	(0.109)	(0.116)	(0.114)
Δy_{t-1}	0.0453**	0.0444**	0.0399**	0.0463**
	(0.019)	(0.019)	(0.020)	(0.019)
PE_t	0.2533***	0.3163**	0.2803**	0.2740**
	(0.055)	(0.158)	(0.132)	(0.127)
$PE_t \cdot C_t/K_{t-1}$	−0.1904***	−0.1868***	−0.1850***	−0.1860***
	(0.027)	(0.029)	(0.049)	(0.051)
ITA_{t-1}/K_{t-1}	0.0011***	0.0011***	0.0011***	0.0011***
	(0.000)	(0.000)	(0.000)	(0.000)
B_{t-1}/K_{t-1}	−0.0079	−0.0084	−0.0080	−0.0073
	(0.008)	(0.009)	(0.008)	(0.008)
N	105,950	105,950	105,950	105,950
m1	0.000	0.000	0.000	0.000
m2	0.979	0.880	0.678	0.841
Hansen	0.241	0.250	0.151	0.143
Diff-Hansen	0.193	0.728	0.564	0.358
IV for ΔPE_t	ΔPE_t	$PE_t(2,5)$	Own_{t-2}	$Pr(\Delta PE_t = 1)$

***, **, * Significance at the 1, 5, 10 % level. Robust standard errors are shown in parentheses. m1 (m2) is a test of the null hypothesis of no first (second)-order serial correlation. Hansen is a test on the over-identifying restrictions based on the two-step GMM estimator. Diff-Hansen is a test of the validity of the moment restrictions based on the instruments used in addition to the lagged levels of the regressors. For all test statistics, p values are reported

increase financial constraints. The latter finding contradicts results reported by Bertoni et al. (2013), who find that investment levels are not changed substantially after an acquisition by a PEF, whereas the ICF sensitivity of buyout firms increases significantly. The authors interpret their evidence as an indication that buyout firms do have significant growth opportunities but their ability to exploit these is limited by internal finance.

Our estimated effects seem to be more pronounced for firms in the UK. There are several, not mutually exclusive, potential explanations for this. First, the overall level of ICF sensitivities—and thus the potential for alleviating financial constraints—is larger in the UK than in France. Further, as mentioned above, there are large differences in the institutional environment across European countries. In our application, the higher degree of investor protection in the UK compared with France might be especially

important (La Porta et al. 2000). Bottazzi et al. (2009) argue that better investor protection induces more activism by venture capitalists. This activism can translate into a higher chance of 'successful exit' via an IPO or an acquisition (Bottazzi et al. 2008).[10] The cross-country differences in our results are more pronounced for buyout financing than for expansion financing, in which the main channel affecting portfolio firm performance might be capital infusion. However, there might be other differences between the UK and France, such as the degree of experience of the private equity investors, the composition of management buyins and buyouts and the flexibility of labour markets. A more detailed analysis—which is beyond

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[10] See also Bruton et al. (2010), who find that IPOs financed by venture capital are more successful in the UK than in France, which they trace back to cross-country differences between institutions.

Table 6 GMM first differences (buyouts and expansion financing), British firms

	All firms (1)	Small firms (2)	Large firms (3)
I_t/K_{t-1}	0.0311***	0.0282***	0.0456*
	(0.011)	(0.010)	(0.024)
C_t/K_{t-1}	0.2479***	0.2503***	0.1526***
	(0.027)	(0.027)	(0.047)
Δy_t	0.1310***	0.1231***	0.1936***
	(0.022)	(0.020)	(0.041)
Δy_{t-1}	0.0243*	0.0285**	0.0180
	(0.013)	(0.014)	(0.024)
EF_t	0.3043**	0.3444**	0.2518
	(0.146)	(0.170)	(0.155)
$EF_t \cdot C_t/K_{t-1}$	−0.2300***	−0.2670***	−0.0617
	(0.071)	(0.048)	(0.124)
BO_t	0.1487**	0.2636***	−0.1384
	(0.068)	(0.082)	(0.118)
$BO_t \cdot C_t/K_{t-1}$	−0.1581***	−0.2084***	0.1529
	(0.045)	(0.045)	(0.094)
ITA_{t-1}/K_{t-1}	−0.1572	−0.3403	0.0421
	(0.342)	(0.346)	(0.568)
B_{t-1}/K_{t-1}	0.0215	0.0241***	0.0082
	(0.017)	(0.009)	(0.016)
N	39,029	33,818	5,211
m1	0.000	0.000	0.000
m2	0.666	0.429	0.175
Hansen	0.512	0.668	0.878
Diff-Hansen	0.233	0.393	0.934

***, **, * Significance at the 1, 5, 10 % level. Robust standard errors are shown in parentheses. m1 (m2) is a test of the null hypothesis of no first (second)-order serial correlation. Hansen is a test on the over-identifying restrictions based on the two-step GMM estimator. Diff-Hansen is a test of the validity of the moment restrictions generated by the assumption of exogeneity of BO and EF. For all test statistics, p values are reported

the scope of this paper—would be necessary to examine such differences.

We also investigated whether private equity backed transactions are correlated with other outcome variables. While an in-depth analysis is beyond the scope of this paper, some simple OLS regressions were run in which sales growth, employment growth, labour productivity growth (measured as first differenced logarithmic values) and changes in intangible assets (as a proxy for investment in research and development)—scaled by sales—were regressed on contemporaneous and lagged values of dummy variables for expansion financing and buyouts by PEFs. The results are documented in Tables A-2 and A-3 in Appendix B (Available on web). We find that there are positive correlations of sales and employment growth with expansion financing in both countries, and positive correlations with buyouts in the UK only. Interestingly, this is in line

with our cross-country differences in the effects on financing constraints. This indicates that the reduction in financing constraints induced by PEF involvement translates into positive growth effects for portfolio firms. There are only small and mostly insignificant correlations with labour productivity and intangible assets. However, it is possible that the results would be different if more sophisticated indicators of productivity and innovation were used—such as total factor productivity, expenditure on research and development, and patenting—which we leave for future research.

8 Robustness checks

We performed several robustness checks to investigate the sensitivity of our results. First, instead of using GMM estimates with lagged variables as instruments,

Table 7 GMM first differences (buyouts and expansion financing), French firms

	All firms (1)	Small firms (2)	Large firms (3)
I_t/K_{t-1}	0.0395	0.0359	0.0366
	(0.030)	(0.031)	(0.028)
C_t/K_{t-1}	0.1721***	0.1760***	0.0499
	(0.016)	(0.016)	(0.031)
Δy_t	0.4820***	0.5082***	0.2775***
	(0.121)	(0.122)	(0.080)
Δy_{t-1}	0.0632***	0.0629***	0.0629
	(0.021)	(0.023)	(0.052)
EF_t	0.2358***	0.2390***	−0.0180
	(0.074)	(0.087)	(0.115)
$EF_t \cdot C_t/K_{t-1}$	−0.1834***	−0.1952***	−0.0677
	(0.033)	(0.036)	(0.047)
BO_t	−0.0818	−0.2304	−0.1265
	(0.128)	(0.227)	(0.082)
$BO_t \cdot C_t/K_{t-1}$	−0.0239	0.0462	−0.0134
	(0.067)	(0.092)	(0.042)
ITA_{t-1}/K_{t-1}	0.0012***	0.0012***	0.0061
	(0.000)	(0.000)	(0.005)
B_{t-1}/K_{t-1}	−0.0095	−0.0059	−0.0007
	(0.009)	(0.009)	(0.026)
N	105,950	101,657	4,293
m1	0.000	0.000	0.000
m2	0.805	0.748	0.112
Hansen	0.259	0.364	0.856
Diff-Hansen	0.912	0.542	0.728

***, **, * Significance at the 1, 5, 10 % level. Robust standard errors are shown in parentheses. m1 (m2) is a test of the null hypothesis of no first (second)-order serial correlation. Hansen is a test on the over-identifying restrictions based on the two-step GMM estimator. Diff-Hansen is a test of the validity of the moment restrictions generated by the assumption of exogeneity of BO and EF. For all test statistics, p values are reported

we estimated OLS and fixed effects versions of our specifications from Tables 4 and 5. The results, documented in Table A-4 in Appendix B (Available on web), confirm our findings that PEFs increase investments and reduce ICF sensitivities. Second, we checked the sensitivity of the results towards using alternative control variables. The results of these alternative specifications are reported in Tables A-5 and A-6 in Appendix B (Available on web). We controlled for financial (non-PEF) investor ownership by adding a dummy variable (F_{it}) and an interaction

with the cash flow to capital ratio. In further estimates, we controlled for firm size (measured as total assets) and firm age (years since incorporation). We also replaced the measure of long-term debt with a measure of total debt (scaled by capital stock), and we estimated models that account for possible sample selection due to missing values.[11] These alternative specifications do not affect our main conclusions.

A further set of checks investigates the validity of ICF sensitivities as a measure of financing constraints. We compared ICF sensitivities of firms that receive private equity in the future with those of other firms by creating a dummy variable, $PREPE_{it}$, that equals 1 for firms without private equity involvement at time t that received private equity later in our sample period and interacted this variable with cash flow. The results are depicted in Table A-7 in Appendix B (Available on web). Within both France and the UK, ICF sensitivities of firms that will receive private equity in the future are not significantly different from other firms, although the coefficient is negative. Thus it seems that differences in ICF sensitivities between private equity backed firms and non-private equity backed firms arise after an acquisition takes place.

As argued by Cummins et al. (2006), cash flow might be correlated with unobservables that affect future profitability and investment opportunities. Therefore, we follow Bond et al. (2003) and estimate simple forecasting models for future cash flow. The results, reported in Table A-8 in Appendix B (Available on web), show that the ability of cash flow to forecast future cash flow is not significantly different for private equity backed firms in the UK compared with other firms, and the difference is very small and only weakly significant for firms in France. Thus, a different role of cash flow in forecasting future profitability for private equity backed firms and other firms is unlikely to be the predominant explanation for our results.

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[11] For this purpose, a Probit selection equation with time dummies, lagged values of total assets and firm age was estimated, and the inverse Mills ratio was entered in the investment equation in the second step. Estimation results for the Probit selection equation are available upon request. Although we found that the Mills ratio seems to be correlated with investment, accounting for sample selection does not affect our main results.

9 Conclusions

This paper analyses how PEFs affect investment and financial constraints in their portfolio firms from the UK and France. Based on the estimation of dynamic investment models and differences in ICF sensitivities across groups, we find that private equity backed transactions are associated with increases in investments and reductions in financing constraints in portfolio firms. Consistent with the view that SMEs are affected by financial constraints to a larger extent, we find that expansion financing provided by PEFs is associated with higher investment and an alleviation of financial constraints only for SMEs. Buyouts seem to have a positive impact on investment and lead to a reduction of financial constraints in the UK, but they seem to have no significant impact for French portfolio firms on average. Using dynamic panel data and instrumental variable techniques, we find that neither unobserved heterogeneity nor endogeneity of private equity transactions are likely to be the predominant explanation for these findings. Our results are robust to the use of alternative estimation techniques and specifications of our investment equation. We also provide some evidence that transactions that are associated with increased investment and an alleviation of financial constraints—buyouts in the UK and expansion financing in both countries—are also positively correlated with sales and employment growth of portfolio firms.

From an economic policy point of view, our results contrast with the notion of several policy-makers, as we do not find any evidence that private equity financed buyouts increase the financial constraints on portfolio firms.

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