



Private Equity and the firm-level impact: the case for investments

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Brief Biographical Note

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Abstract

One of the most common anecdotal criticisms to private equity (“PE”) activity is that they cut myopically capital expenditures. Notwithstanding the fact that it is relatively clear that investments do fall after the buyout, it is far from answered the question on whether this results from *underinvestment* or, alternatively, *overinvestment* - a correction of an agency problem. Until recently, this has remained an understudied subject in the literature, with an *overinvestment* correction hypothesis being implicitly adopted, conditioned by the focus of research on US public-to-private deals and the lack of private firms financial data in US keeping the debate on *overinvestment* of public over private firms, opposing Jensen (1989) to Stein (1988), mainly on a theoretical ground. Only more recently, this hypothesis started to be questioned with Sousa and Jenkinson (2013), Bharath *et al.* (2014) and Ughetto (2014) concluding that evidence is, at least, not supportive of an *overinvestment* explanation. At the same time, a recent US study (Asker *et al.*, 2015) also disputes the idea that public firms overinvest their private counterparts. We analyse a sample of 92 PE entry deals that took place in Europe between 2006 and 2010. We also compare a sample of 29 thousand European public and private companies, during the last decade. We find some evidence, even though limited, that PE impact negatively firms investment policies due to a mix of increased financial constraints and probably to lower sensitivity to investment opportunities. In any case, we found stronger evidence that the *overinvestment* correction is hardly a valid explanation, as public firms, at least before the crisis, clearly invested less than their private counterparts, under all matching criteria, and controlling for investment opportunities and cash-flow. Under some specific matching criterion, they still did after the crisis.

Key-words: private equity, investments, capital expenditures.

JEL-Codes: G11, G24, G34

Resumo

Uma crítica frequente ao capital de risco (“CR”) é a de cortarem o investimento de forma cega. Embora seja relativamente consensual que o investimento cai após a aquisição, encontra-se por responder se isso resulta de *subinvestimento* ou antes de *sobreinvestimento* (custos de agência). Até recentemente, a questão permaneceu negligenciada na Literatura, com a hipótese *sobreinvestimento* a ser implicitamente aceite, em parte pelo facto de a investigação ser centrada em transações de aquisição de empresas cotadas nos EUA e devido à falta de dados financeiros de empresas não cotadas nesse país, determinando que o debate sobre se as empresas cotadas investem mais ou menos, opondo Jensen (1989) a Stein (1988), se mantivesse teórico. Apenas recentemente, a hipótese de *sobreinvestimento* começou a ser questionada, com Sousa and Jenkinson (2013), Bharath *et al.* (2014) e Ughetto (2014) a concluírem que a evidência, não é favorável àquela explicação. Asker *et al.* (2015) apresentou também nova evidência que contesta a ideia de que as empresas cotadas investem mais que as não cotadas nos EUA. Analisámos uma amostra de 92 transações de aquisição de empresas por CR, entre 2006 e 2010, e uma amostra de 29 mil empresas cotadas e não cotadas Europeias, nos últimos 10 anos. Encontramos alguma evidência, embora limitada, de que entrada de CR impacta negativamente a política de investimento das empresas, devido a uma combinação de aumento de restrições financeiras e menor sensibilidade às oportunidades de investimento. Em todo o caso, encontramos evidência significativa de que a hipótese de correção de *sobreinvestimento* dificilmente será uma explicação válida, tendo em conta que as empresas cotadas, pelo menos antes da crise, investiam menos que os pares não cotados, em todos os critérios de formação de pares e controlando as oportunidades de investimento e a rentabilidade. Sob determinado critério, essa situação continuou mesmo depois da crise.

Palavras-chave: capital de risco, investimento, despesas de capital.

Códigos-JEL: G11, G24, G34

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1. Introduction

In the late 80's, as the first private equity ("PE") wave neared its end, Jensen (1989), in a seminal article, argued that leveraged buyouts ("LBO") would emerge as a permanent and superior form of organization, "eclipsing" public corporations.

Rappaport (1990) presented an opposite view, by considering LBOs a "*cul-de sac*", due to its self-limited nature, whose benefits, in terms of governance and agency costs mitigation, could be matched by a permanent organization, the public corporation, through other means.

The first significant empirical research on the subject was provided by Kaplan (1989), who concluded that PE create value through LBOs, following significant improvements in operating performance.

Other studies backed this overall conclusion. In one of the most recent and comprehensive studies Guo *et al.* (2011) concluded that albeit that there are still some improvements in operating performance of PE backed firms, they had, somehow, reduced significantly during the second wave (late 90's onwards).

In addition to the operating performance improvement, the studies also reported that capital expenditures ("CAPEX") typically fell after the buyout. This fact can be consistent with two contradicting hypothesis (Wright *et al.*, 2009): (1) post-buyout firms are cash constrained and underinvest; and (2) the buyout governance structure induces managers to reduce capital expenditures that are non value maximising.

While the latter would be a confirmation of Jensen's free cash flow hypothesis, the former could have some significant implications on the long term value of PE activity, as an "artificially" lower CAPEX, to boost the buyout deleveraging and, thus, ensure to the PE investor a higher return, could hamper the long term performance of the firm.

The question is, however, far from being straightforward. First, it is difficult to assess whether a firm is postponing, or not, positive net present value ("NPV") investments, as the investment level data is hardly available. Second, the interpretation of the effect of

financial constraints on investment is not completely free from discussion in the literature.

The more or less consensual evidence that CAPEX falls after the PE entry, was early interpreted explicitly by Kaplan (1989), and implicitly since then, as a sign of a correction of *overinvestment* due to free cash-flow / agency problems (Jensen, 1986).

This tacit assumption was somehow conditioned by the fact that a significant proportion of the empirical research was focused on public-to-private deals and, as research is prone to be US centric, the lack of private firms financial data has kept debate on the *overinvestment* of public over private firms, opposing Jensen (1989) to Stein (1988) - who claimed that public firms cut myopically investments due to short terms pressures - mainly on a theoretical ground.

Hence, until recently, the impact of PE activities in firms' investment policies has been somehow a neglected topic, despite the fact that this is one of the most common anecdotal criticisms to PE activity - the fact that they allegedly cut myopically CAPEX.

Only more recently, the *overinvestment* correction hypothesis started to be questioned, as for the typical study (US/UK, large companies) evidence started to mount up that there may be some flaws to the free cash flow hypothesis in explaining CAPEX behaviour. Sousa and Jenkinson (2013), Bharath *et al.* (2014) and Ughetto (2014) have concluded that there is some evidence that supports the *underinvestment* of PE firms or, at least, that evidence is not supportive of an *overinvestment* explanation.

More recently, focusing on the public vs. private firm debate, Asker *et al.* (2015), building on an exclusive and new US private firm database, showed that, in the US, public firms invest less and are less sensitive to changes in investment opportunities than private firms, even during the recent financial crisis, when private firms most probably became more financially constrained than their public counterparts.

This dissertation seeks to explore this thematic, incorporating and combining some of the early approaches (Kaplan, 1989) with the most recent contributions from the literature, namely by adapting Asker *et al.* (2015) methodology to the PE context.

Using data collected from *Zephyr* and *Amadeus* databases, we analysed a sample of 92 European PE entry deals, that took place from 2006 to 2010, and c. 29 thousand European public and private firms, during the last decade, with a twofold research goal.

First, we tried to assess the impact of PE entry in European companies during the last decade, answering the question on whether PE backed firms cut myopically investments, by comparing to its matched peers and controlling for variables commonly used in the empirical investment literature to explain investment intensity.

Second, we also try to compare public to private firms investment policies, in order to compare to Asker *et al.* (2015) results for US with Europe, and verify empirically the question of public firm *overinvestment* (Jensen, 1986) vs. *underinvestment* (Stein, 1988) hypothesis.

Both goals are related, as the common explanation for the investment intensity reduction after the buyout is exactly the correction of *overinvestment*.

In a sample deeply marked by the financial crisis, which severely penalizes the statistical significance of our results, we found limited evidence that investment of PE backed firms falls below its peers, even after controlling for the variables that explain it.

This is only visible in a specific investment intensity metric and in relation to a certain matching criterion, sector and return on assets (“ROA”), under which it is also possible to conclude that, after the PE entry, firms become less sensitive to investment opportunities.

For example, by year 3 after the PE buyout the PE firms’ investment intensity is lower than its matched peers by sector and ROA in -2.2 pp and -10.6 pp, for CAPEX/Lag total assets, CAPEX/sales, respectively. For the same matching criterion, the PE firm has CAPEX/Lag total assets lower in 1.28 pp (sig. 10%) than its peers, holding investment opportunities and profitability constant.

However, the fact that after PE entry firms become more financially constrained is quite more robust to several specifications and samples. The critiques to investment cash flow (“ICF”) sensitivities interpretation relates to the fact if they should, or not, be considered a measure of the *degree* of financial constraints but do not apply to the

interpretation of a *sign* of its existence: financially constrained firms would have positive and significant ICF sensitivities (Bertoni *et al.*, 2013). In our sample only PE firms show positive statistically significant ICF sensitivities in the post buyout period.

In any case, we found stronger evidence that European public firms invest less, controlling investment opportunities and profitability, than private counterparts, under a specific matching criterion (sector and ROA) or, at least they did before the crisis, under all criteria. Although there are some differences, our results are broadly in line with in Asker *et al.* (2015) findings.

Interestingly, the disappearance of the public firm underinvestment with the crisis, under some matching criteria, seems consistent with a higher ICF sensitivity from private firms, which as of common knowledge, have less access to capital markets and, thus, probably became much more dependent on their internal financing sources, as with the crisis the banking system financing availability shrunk.

This, of course, lacks further investigation, but seems also consistent with the fact that the only period where unconstrained investment intensities become higher in public firms than in (matched) private ones is during the start of the crisis period (2007/08), and happens not because public firms increase their investment but because private firms dramatically shrunk their CAPEX.

We also find possible that the different financing structure on the US and European firms, with the former much less dependent on the banking system, can be a clue to explain the differences from our results to ones found in Asker *et al.* (2015).

Besides this section, this report is structured as follows: in section 2 we review the literature on the topic; in section 3 we discuss the methodological aspects of our study; in section 4 we present our empirical findings regarding our sample of 92 European PE large (>€50m) deals (entries) in the 2006/10 period; in section 5 we present a comparison between public and private firms and; finally in section 6 we present our summarized conclusions and suggestions for further research.

2. Literature Review

2.1. The role of Private Equity – early theoretical discussion

Jensen (1989), in a seminal article, argued that LBOs would emerge as a permanent and superior form of organization, “eclipsing” public corporations.

Building on his earlier concept of the disciplining role of debt as a mitigator of agency costs raised by free cash flow (Jensen, 1986), the author argued that together with the leveraged (more efficient) capital structure, LBOs enjoyed a concentrated ownership, resulting in closer monitoring of the managers and stronger managerial incentives.

These unique features, he argued, enabled LBO managers to add value more effectively, otherwise wasted by public corporations, which could be glimpsed by the 50% average premium paid (at the time) in LBOs.

On the opposite side, Rappaport (1990) argued LBOs were an economic “*cul-de sac*”, due to the self-limited nature: by design, LBOs are a transitory organization, as the limited-partnership agreements provide ten-year duration for the partnership. Thus, in order to maximize returns, the sponsor needs to generate cash from operations and divestitures to reduce debt toward pre-buyout levels, in order to cash-out, either by returning the company to public markets by selling it to a strategic buyer.

At most, he argues, the LBO is a short term “shock therapy”, but whose benefits in terms of governance and agency costs mitigation could be matched by a permanent organization, the public corporation, by other means.

2.2. Empirical Analysis to PE firm-level operating impact

In the same year that Jensen (1989) made his proposition, Kaplan (1989) produced the first comprehensive insight on the firm-level impact of PE activity¹. By analysing 76 large management buyouts (“MBOs”), between 1980 and 1986, and comparing operating income and cash flow variables evolution 1 year pre-buyout with up to 3

¹ The author refers the study as the first to use pre buy-out as well as post buyout data.

years after buyout, controlling for divestitures, differences in growth, and industry, he found that buyout firms significantly outperform non-buyout firms².

The author analysed the causes of this outperformance and tested three hypotheses: (i) employee-wealth-transfer hypothesis; (ii) information-advantage or underpricing hypothesis; (iii) reduced agency cost or new incentive hypothesis. The author concludes that evidence points to the fact that the operating improvements are generated by incentives rather than wealth transfers from employees or superior managerial information.

Since then, while mainly focused in US and UK, several studies analysed the operating impact of PE in the buyout firms, and found consistently overall results. Strömberg (2009) provides a useful summary of related studies and findings.

We believe it's worth highlighting Guo *et al.* (2011), due to both its breadth and comparability³ with Kaplan (1989). The authors analysed the operating performance and value creation on the second PE wave, by studying a sample of 192 LBOs, spanning from 1990 to 2006.

They found that, unlike what was documented in relation to the first wave, gains in operating performance are comparable, or, at best, slightly higher than those observed on industry (and matched pre-buyout characteristics), depending on the measure⁴.

Besides the studies on operating performance impact, several other studies have been focusing on several specific issues⁵.

² For example, operating income (EBITDA) in buyout firms increased a median 15.3%, 30.7% and 42%, in years +1, +2 and +3 after the buyout, when comparing to pre-buyout year, significant at 1% level. The difference to median industry change was -2.7%, +0.7% and 24.1%, also significant, meaning that the buyout firm performance is more or less the same as the industry in the first two years after the buyout, but in the third year clearly outperforms its non buyout peers. Similar results were found in net cash flow (EBITDA-CAPEX), and in these two variables as a percentage of sales and assets.

³ Both in terms of certain methodologies used as well as the direct comparison the authors make several times along the text.

⁴ For example, the industry-adjusted changes - comparable to prior research – both for EBITDA to sales and net cash flow to sales do not show any major gains. Using the industry performance and market-to-book-adjusted change, there they found a significant increase from year -1 to year +1 or +2 for both EBITDA to sales and net cash flow to sales. Still, even in these cases, the magnitudes are substantially smaller than reported by Kaplan (1989).

⁵ Gilligan and Wright (2012) provide useful Tables with main research articles on several PE related subjects. Wood and Wright (2009) also provide an extensive compilation of the studies on the effect on employment and wages.

2.3. The Case for Investments

One of the least studied aspects of PE impact regards investments. However, if we split investments in to two strands, the research and development (“R&D”) expenditures, usually referred to as a proxy to long-term investments, and capital expenditures, the results and challenges posed by the existing research are quite different.

We’ll forgo R&D expenditures, on the back of, among other considerations, the different accounting treatments under different GAAP, which can make an analysis based on several countries complex. Nonetheless, we believe it’s worth briefly mentioning the main conclusions regarding R&D.

2.3.1. R&D Expenditures

R&D expenditures are more studied than capital expenditures. However there seems to be fewer consensuses on the outcome.

Studying 131 LBOs between 1981 and 1986, Lichtenberg and Siegel (1990) found data inconclusive regarding the impact on R&D. First, firms involved in LBOs were much less R&D intensive (mean R&D to sales 1%) than other firms (3.5%) before the LBO. Second, the difference is larger in the three years after than in the three years before the buyout. However, the change in these differences was not statistically significant. Third, the relative R&D intensity of LBO firms appears to have been declining in the years before the buyout, despite not statistically significant.

Long and Ravenscraft (1993) confirm that LBOs target significantly below normal R&D intensive firms. Pre-LBO R&D to sales is less than half the overall manufacturing average. Nevertheless some LBOs did occur in high tech industry, as the large variance in R&D intensity among LBO firms denoted.

Unlike Lichtenberg and Siegel (1990), however, they found a significant and dramatic decline in R&D intensity as a result of the buyout: 40%. Still, they also find that the declines in R&D intensity do not appear to hurt the ability of LBOs to generate performance gains. On average, LBOs improve operating performance by 15 percent or more. Cutbacks in R&D have no statistically significant effect on performance. According to one of the estimated equations, for a typical R&D intensity cut of 0.63,

performance would decline by 0.19, which is only about 10% of the 2.06 increase in cash flow/sales.

The theoretical foundations the authors present to indicate the reduction in R&D was expectable after the LBO are more or less in line with Hall *et al.* (1990), who established a clear relationship between leverage and reduced R&D spending. The authors argue that R&D could be an unintended victim of the trend to shift financing towards debt.

Nevertheless, they considered they were unable to demonstrate that the projects that were eliminated in LBO restructurings were worthwhile (high social or private returns).

In a more recent work, Lerner *et al.* (2011) criticised R&D expenditures as a measure for long term investment in innovation. According to the authors, not all research expenditures are well spent, and some critics suggest that many corporate research activities are wasteful and yield a low return, making changes in R&D expenditures difficult to interpret. The authors used an alternative measure, patenting data, and found no evidence that PE backed firms changed their patenting origination pattern. Furthermore, they concluded that those firms become more cited.

Against this idea, Chauvin and Hirschey (1993) identify a clear and significant relationship between R&D spending intensity and corporate value, although varying with size, for several sectors.

Ughetto (2010) cites several other studies that support of the hypothesis that PE intervention is not detrimental to long-term investments in R&D and innovation. This author considered that the use of R&D expenditures or more direct measures of innovative output such as productivity growth might prove more useful, than patents, for a more complete assessment of the difficult task of measuring innovative effort.

Nevertheless, the key takeaway from the author's findings is the suggestion that evaluating all buyouts on the same performance metrics without taking into account the characteristics of the investors/deal may not be appropriate, as they seem to have some impact on the innovation performance of firms.

2.3.2. Capital Expenditures

The question with capital expenditures is not whether the CAPEX falls after the buyout, or not, as there seems to be a relative consensus in this conclusion⁶.

Albeit only few studies refer to CAPEX directly, this assessment can be drawn indirectly in most of the studies on the impact on operating performance, by comparing the conclusions on EBITDA versus net cash flow evolution, two variables commonly analysed. As it is usually observed net cash flow increasing more than EBITDA, and taking into account the difference between the variables is CAPEX, the assertion seems to be self explanatory.

A summary of the main studies addressing the PE/CAPEX topic is provided in Appendix I.

2.3.2.1. *Overinvestment versus Underinvestment*

The real question is the fact that the CAPEX reduction can be consistent with two contradicting hypothesis, a *underinvestment* hypothesis and a *overinvesting* hypothesis, or, as Wright *et al.* (2009) describe it: (1) post-buyout firms are cash constrained and underinvest; and (2) the buyout governance structure induces managers to reduce capital expenditures that are non-value-maximising.

While the latter would be a confirmation of Jensen's free cash flow hypothesis, the former could have some significant implications on the long term value of PE activity, as an "artificially" lower CAPEX, to boost the buyout deleveraging and, thus, ensure to the PE investor a higher return, could hamper the long term performance of the firm.

The question is, however, far from being easy to answer. One of the reasons is that it is difficult to assess whether a firm is postponing, or not, positive NPV investments, as the investment-level data is hardly available.

Kaplan (1989), analysing the evolution of market adjusted return to shareholders, concludes that as the MBO firms provide their shareholders with a higher return than

⁶ Exceptions made to Boucly *et al.* (2011) that found that in a sample of 839 French deals firms increase CAPEX and Engel and Stiebale (2014) which found that in a sample of UK and French PE backed SMEs, investment increased.

the market, there is indirect evidence that the reduced CAPEX was referring to value decreasing projects and, thus, the reduction increased the firm value.

On the opposite direction, Sousa and Jenkinson (2013) show that PE backed firms exited through IPO increase much more the CAPEX than firms that exited through secondary buyouts (“SBO”). If the *overinvestment* hypothesis was right, and IPO firms started to invest in value decreasing projects, they shouldn’t be able to significantly and substantially outperform the market.

As IPO firms invest more than firms that remain under PE hands, and the abnormal return suggests they invest in value increasing projects, this evidence, albeit indirect, seems to imply that PE backed firms do postpone value increasing investments.

Interestingly, although not addressing the *overinvestment/underinvestment* discussion directly, some years before Holthausen and Larcker (1996) had already casted some doubts on the *overinvestment* correction, as a justification for the lower CAPEX in PE backed firms.

They found that, for at least four years after the IPO, reverse LBO (“RLBO”) firms outperform their industries on an accounting basis performance but experience a performance decline. The authors also found that they spend significantly less than the “industry norm” on CAPEX in the year prior to the IPO, but this difference disappears afterwards.

Furthermore, they found no relationship between the changes in CAPEX and leverage and managerial ownership. However, non-managerial insider ownership was found to be significantly and negatively related with changes in CAPEX. The results are not changed by including a variable to control for the IPO proceeds used to retire debt, as many firms explicitly indicate that they are going public in order to raise funds for increasing CAPEX.

It is argued that if the RLBOs are constrained in their ability to make investments, their sample is unlikely to exhibit the positive incentive effects associated with debt as described by Jensen (1989), as those apply to firms with free cash flow generating ability and no profitable investment opportunities.

The authors considered the finding of an increased CAPEX after the RLBO as consistent with the firms being cash constrained before, in the case of the absence of an exogenous shock (for example a change in investment opportunities) to justify the behaviour.

Chung (2011), analysing a UK buyout sample, suggests that the *overinvestment* correction only happens when the target is a public firm and when it's a private firm the PE acts to increase value by reducing financial constraints.

More recently, Bharath *et al.* (2014) analysed a considerable sample of going private (PE buyout, MBOs and operating firm) plant-level detail transactions, spanning from 1981 to 2005.

The authors found that, relative to control groups (industry-age-initial size groups), companies decrease CAPEX after going private, which suggests that public firms invest more than comparable private firms, and would traditionally be considered as a sign of *overinvestment* due to agency problems leading to “empire building”.

However, they argue that if firms had been overinvesting, when they were public, they would have expected to see an improvement in productivity afterwards, but they found no such evidence, relative to control groups.

In fact, they argue that going-private firms achieve the productivity improvements not by improving the productivity in individual plants but by selling the low productivity ones. They conclude the data does not support the *overinvestment* thesis.

2.3.2.2. Investment Cash Flow Sensitivities

The logic behind an *underinvestment* hypothesis is the fact that PE backed firms may face cash flow constraints, on the back of heavy debt repayments and associated restrictions⁷.

⁷ In fact it is common for LBO structures to have considerable and direct restrictions on CAPEX and acquisitions as well as maintenance covenants. See for instance the Loan Market Association (<http://www.lma.eu.com/default.aspx>) or S&P Loan market guide (<https://www.lcdcomps.com/>).

In fact, Achleitner and Figge (2014), found that financial buyouts (SBO) use 28–30% more leverage, measured in terms of Debt/EBITDA, than other buyouts, even after controlling for debt market conditions at the time of the transaction⁸.

However, the relationship between financial constraints, cash flow and investment is not completely free from discussion in literature.

In a seminal study on the subject, Fazzari *et al.* (1988) show there is a link between financial factors and investment decisions. The theoretical foundation for the research was the notion that unlike in Modigliani-Miller world, factors such as transaction costs, tax advantages, agency problems, costs of financial distress, and asymmetric information, make internal finance less costly than new shares or debt.

The authors then argue that, under this reasoning, firms that pay higher dividends are less sensitive to variations in cash flow than firms that exhaust nearly all of their internal cash flows.

This conclusion was challenged by Kaplan and Zingales (1997) who found firms with low dividends and that could invest if needed and were far from being cash constrained. Fazzari *et al.* (2000) and Kaplan and Zingales (2000) continued the debate and Moyen (2004), in a tentative reconciliation approach, showed that the classification of a firm as under financial constraints is hard and results vary under different criteria.

Nevertheless, investment-cash flow (ICF) sensitivities, in the logic of Fazzari *et al.* (1988), continue to be widely used by scholars as a theoretical framework.

ICF sensitivity can be defined as the impact that variations in a measure of cash flow have in the investment intensity, and in the investment literature are usually the coefficient of a regression of an investment intensity measure (e.g. CAPEX/Total assets) against a measure of cash flow (commonly EBITDA/Total assets).

Bertoni *et al.* (2013) suggest that ICF sensitivity should not be used as a direct signal of the *severity* of financial constraints but as an indicator of the *existence* of financial constraints: the ICF sensitivity will not be significantly different from zero for non-

⁸ However, unlike Sousa and Jenkinson (2013) they found no robust evidence that financial buyouts have lower equity returns than other buyouts or offer less potential for operational performance improvements. These authors do not address the CAPEX issue.

financially constrained firms, but a positive and significant ICF sensitivity would indicate the existence of financial constraints. According to the authors, the Kaplan and Zingales (1997) critique refers to the monotonicity of the relationship not about its sign.

Using an ICF sensitivity approach, Engel and Stiebale (2014) analysed a sample of UK and French SME's and concluded that PE enhance investment and reduce financial constraints.

Interestingly, smaller deals, typically the ones that would capture SMEs, are usually excluded from the sample in most studies we reviewed, on the back of less disclosure and information availability. The authors refer to the fact that they believe SMEs are in general more cash constrained, which today is under a generalized public debate in Europe. This can determine a whole different logic behind the PE intervention and, hence, make the results less comparable to the other studies.

The same reasoning can be applied to Chung (2011), as despite a broader sample, has a median deal value of £10m, for the private-to-private subsample, signalling that he captured a significant proportion of small companies, hence probably influencing his overall conclusion that in private-to-private deals the PE intervention alleviates financial constraints.

Ughetto (2014) showed that the characteristics of the deal, namely jurisdiction, applicable law and of the lead PE investor can impact target firm's investments and ICF sensitivities.

Interestingly, this conclusion is highly coherent with the fact that the only studies, found in our review, that conclude for a positive impact in investment in PE backed firms, Boucly *et al.* (2011) and Engel and Stiebale (2014), relate to a particular market, France, and to a usually out of scope type of firms, SMEs.

Regarding the French market, Ughetto (2014) also addresses its peculiarities in term of Legal System. This relates with a strand of the literature usually referred as "Law and Finance", in which is shown the impact of the legal system in valuations – see for instance La Porta *et al.* (2002).

An additional difficulty, relating the ICF sensitivity approach, is the fact that a positive ICF sensitivity can be viewed both as a *underinvestment* or a *overinvestment* symptom, depending on whether you accept Myers and Majluf (1984) *asymmetrical information hypothesis* or Jensen (1986) *agency / free cash flow theory*.

In fact, if we believe that the asymmetrical information will lead to an inflated external funds cost, the positive ICF sensitivity will lead the firm to pass on positive NPV projects and, thus, underinvest. On the other hand, if we believe that in managers' mind internal funds are too inexpensive, the agency / free cash flow hypothesis, they will tend to overinvest.

However, if ICF sensitivity typically leads to *overinvestment*, then as managerial ownership increases, this sensitivity should decrease, as agency related issues started to disappear. Nevertheless, an initial finding of Morck *et al.* (1988) showed that managerial ownership has an "entrenchment effect" from a certain level and, thus, does not vary monotonically.

Hadlock (1998) built a non linear model between management ownership and ICF sensitivities which deals with the "entrenchment"⁹ effect. The author concludes that his findings are consistent with asymmetric-information problems (hence, the *underinvestment* interpretation) becoming more severe as managers care more about shareholder value, which is backed by the fact that the relationship between ownership and ICF sensitivities is strongest for the highest Tobin's Q firms, the commonly used proxy for growth/investment opportunities¹⁰.

Despite the debate on ICF sensitivities as a measure, or not, of financing constraints, the investment intensity regressions can still be used while being agnostic on the financing constraints interpretation (Asker *et al.*, 2015).

Furthermore, regardless of our position in relation this question, it is of common knowledge that LBO structures face restrictions on investments, acquisitions, either

⁹ Weisbach (1988) defines entrenchment as "*Managerial entrenchment occurs when managers gain so much power that they are able to use the firm to further their own interests rather than the interests of shareholders*".

¹⁰ Usually Tobin's Q is defined as the market value of the firm divided by the replacement value of its capital stock

directly or through restrictive covenants¹¹. Hence it is hardly debatable that they face some degree of constraints.

2.3.2.3. Endogeneity

Another important issue, which requires attention when addressing the CAPEX issue, is the endogeneity question. It is possible that PE could know beforehand those companies that require less CAPEX or have lower positive NPV investment opportunities and that fact determines by itself the posterior evolution.

The lower CAPEX can be a symptom of less investment opportunities. In fact, as Muscarella and Vetsuypens (1990) conclude *“high debt usage typically found in LBOs may not be an appropriate financing structure for companies with large capital expenditures needs.”*.

Indeed, Bharath and Dittmar (2010) built 2 models, Cox hazard and a logit, to predict if a firm will go private¹² and the coefficient for the variable CAPEX / Sales is negative both for MBOs and PE buyouts, albeit only statistically significant in MBOs.

The use of matched samples and firm fixed effects, which absorb all not visible differences, mitigate this issue.

Some authors enhance the approach to endogeneity with an Instrumental Variable approach (Asker *et al.*, 2015) or a Treatment-Effect model (Sousa and Jenkinson, 2013), either as a complement or robustness verification for the matching procedure, using an exogenous control for a variable that affects the company status, without directly affecting investment.

Others use a propensity score, as in Bharath *et al.* (2014), where following previous work from two of the authors (Bharath and Dittmar, 2010) they include an additional match criteria based on the probability (in the case) of going private. By matching on the propensity score, they compare the results for the establishments that went private with the ones exhibited by firms that had a similar probability of being selected into going-private event.

¹¹ Common examples are Debt/EBITDA or even Debt/(EBITDA-CAPEX) and EBIT/Interest.

¹² They attain accuracy rates higher than 80%.

2.4. Discussion and Opened Questions

Despite the fact that in the last two years the theme started to receive some attention, we can still consider there is a limited the scope of literature regarding to the impact of PE in investments. This seems to contrast with the importance of the topic.

A report produced by Frontier Economics (2013) for the European Private Equity & Venture Capital Association (EVCA) stated “*We do not yet know enough about the incremental impact of private equity on fixed capital formation (...)*”

There are two main reasons for the importance of the subject. First, if it was verified that PE backed firms cut necessary, positive NPV investments, this could, to some extent, undermine the previous operating performance gains conclusions. In the words of Smith (1990) “*(...) cutbacks in capital expenditures, are alleged to compromise the long-run competitive position of the firm in order to increase short-run cash flows.*”¹³.

To illustrate this point, imagine a company engaged in manufacturing one good, by using just one machine, with very expensive parts and components. If the firm cuts the maintenance CAPEX it could be able to attain a significant cash flow for some time, higher than its peers, who keep replacing defective or worn out parts, or upgrading some of its components with more technologically advanced solution. At some point, the temporary gain on cash flow will start to dent the firm’s profitability and productivity, as stoppage times and expensive repairs start to happen.

Given the length of years usually covered by empirical studies (up to 3 years post-buyout), this seems, at least theoretically, an admissible scenario.

This argument could be the explanation for Holthausen and Larcker (1996) lagged performance reversal after the IPO/RLBO. Bruton *et al.* (2002), who confirm these results¹⁴, refer they would expect a firm to converge to a typical industry firm after the IPO, suffering again from the agency issue. However, they expected it to happen more quickly and not to be such a lagged effect. They conclude that “*efficacy of agency*

¹³ Albeit he concludes that the cuts in CAPEX are not responsible for the short-term increase in operating cash flows, as CAPEX is a non-operating use of cash, the point still remains open for the long run.

¹⁴ On the operating side; they don’t address the CAPEX issue.

theory for explaining a complex topic such as firm performance during the buyout cycle may be limited”.

Second, this is, in fact, one of the most common anecdotal criticisms made to PE activity: *“The most common criticism of private equity activities claims that such funds apply a short-term calculus (...) which in turn strongly implies that capital spending should decline or at a minimum underperform other peer companies”* (Shapiro and Pham, 2009) .

To some extent one can interpret the, until recently, apparent lack of interest in the literature for the theme as an implicit acceptance of the evidence that the PE firms cut CAPEX after the buyout as a confirmation of the correction of the agency problem (Jensen, 1986).

However, this tacit acceptance seems somehow disconnected from the broader debate on whether public firms really overinvest on the back of agency /free cash flow problems.

Stein (1988) presented a complete opposite view, by describing what he called as a “managerial myopia” that lead managers in public corporations, to sacrifice long term goals and investments, to be able to present steadily growing quarter earnings and thus prevent takeovers. Hence, under this view, public firms should underinvest.

Given the fact that research is prone to be US centric and the absence of private firms’ data in the US¹⁵, the question remained mostly as a theoretical debate. Nevertheless, some surveys seemed to back Stein (1988) assertion, by pointing to the fact that public firm managers prefer short term horizon investments, believing that investors fail to properly value long term investments (Poterba and Summers, 1995) and that managers would avoid engaging positive NPV projects if that implied an impact in current quarter’s earnings (Graham *et al.*, 2005).

Recently, building on a exclusive and new private firm database, Asker *et al.* (2015) show that, in US, public firms invest less and are less sensitive to changes in investment

¹⁵ Unlike in Europe, in US it is not mandatory for private firms to deposit/publish their financial statements.

opportunities than private firms, even during the recent financial crisis, when private firms most probably became more financially constrained than their public counterparts.

On a different approach, Kerstein and Kim (1995) had already shown that, after controlling for parallel earnings information and size-related pre disclosure information differences, CAPEX changes are strongly and positively associated with excess returns¹⁶.

These findings support Stein (1988) idea of *underinvestment* in public firms due to “myopia” rather than Jensen (1986) notion that public firm are prone to *overinvestment* as a result of free cash flow / agency related problems.

This can bring some additional light to the investment impact debate on PE backed firms. If in fact, the majority of studies show that PE impact negatively investment, and if public firms tend to invest less than private counterparts, it seems reasonable to, at least, suspect that this reduction in investment is not related to a agency problem correction but to a strategic approach from the financial sponsor to release as much cash as possible to meet debt repayments and de-lever¹⁷.

Albeit some studies have recently debated the investment issue directly, there seems to be still significant space to research. Engel and Stiebale (2014), for example, focus on SME’s, hardly were the main discussion is centred. Bharath *et al.* (2014) use plant level data (US only), which can be at the same time information rich but also somehow lead to the firm broader picture loss and its hardly replicated and comparable to previous studies.

Finally, Ughetto (2014) narrows the analysis in private to private transactions, low and medium tech firms and in 4 countries. Furthermore, this author uses an Euler equation to deal with the investment opportunities issue (Q theory), instead of the more widely used proxies such as sales growth or industry Q (Asker *et al.*, 2015).

¹⁶ These results are in line with previous works such as McConnell and Muscarella (1985) who found empirical evidence, from market reaction to unexpected decreases and increases in CAPEX, more consistent with market value maximization rather than size maximization.

¹⁷ Please bear in mind that we are referring only to CAPEX and are not questioning the managerial incentives and ownership control impacts on performance, which are a separate discussion to which we are agnostic as far as this study goes.

3. Sample and Methodology

3.1 Sample

3.1.1 Retrieving process and source

Bearing in mind that our goal is to analyse the PE first time entry impact¹, our sample, retrieved from *Zephyr* database, encompasses all PE entry deals (“Take Private” and “Vendor Sale”), majority stakes, that were not secondary but-outs, in all sector with exception of banking and insurance or holding companies/head offices, in the 2006 to 2010 period, with a minimum €50m (50 million Euros) deal value and in European Union (“Euro-28”).

The end date is justified by the fact that we need 3 years of post deal financials for our analysis and, at the time of retrieval, the last year with financials was 2013. The start date is conditioned by the fact that *Amadeus* only provides 10 years of financials and we need 2 years of pre-del data, in order to have beginning of year values for the lagged variables in the pre-deal year.

As for the deals size, the choice is justified, as usual, in order to exclude smaller companies and deals harder to analyse, or at least be less comparable with larger ones.

Bank and insurance are not comparable to other non-financial firms, and fall out of this study scope, and regarding “Head Offices” or “Holding” activities it is commonly accepted that these companies are difficult to analyse on a non case study basis.

Our query resulted in 585 deals, which we reduced to 443, mainly due to the lack of a BvD ID number which precludes us from retrieving financials in *Amadeus*.

As shown in Table 1, for 164 companies there was no data (no retrieval or retrieved fields with “n.a.”).

Finally, for the 279 companies for which we had data, we eliminated all the companies (187) where we didn’t have all our key metrics, for all the years. This envisaged having a

¹ Secondary or posterior Buy-Outs impact and motives can be very different from the first entry and should be analysed separately. See, for example, Sousa and Jenkinson (2013) or Achleitner and Figge (2014) for this topic.

sample highly comparable through the years (balanced panel). We ended up accepting some *lacunae* in data for secondary metrics, namely debt, EBIT and interests.

Table 1 - PE Entries sample “cleaning”

<i>Zephir Sample</i>	585
<i>Take out</i>	
Insolvency	1
Administration	2
Public takeover - Unsuccessful	18
Acquisition Increase	10
Unknown BvD ID	111
<i>Sample for financials retrieving</i>	443
No Data	164
Incomplete Financials	187
<i>Final Sample</i>	92

The size of our sample is far from being uncommon, as it can be seen in Appendix I. Studies with large samples usually relax the deal size threshold or are specifically targeting to analyse SME’s, which as we already addressed, can vary from larger corporates both in the deal drivers as well as in posterior impact.

Furthermore, as we show further below, the elimination of incomplete financial firms does not seem to have any statistically significant impact in our pre-deal year metrics.

3.1.2 Sample Description

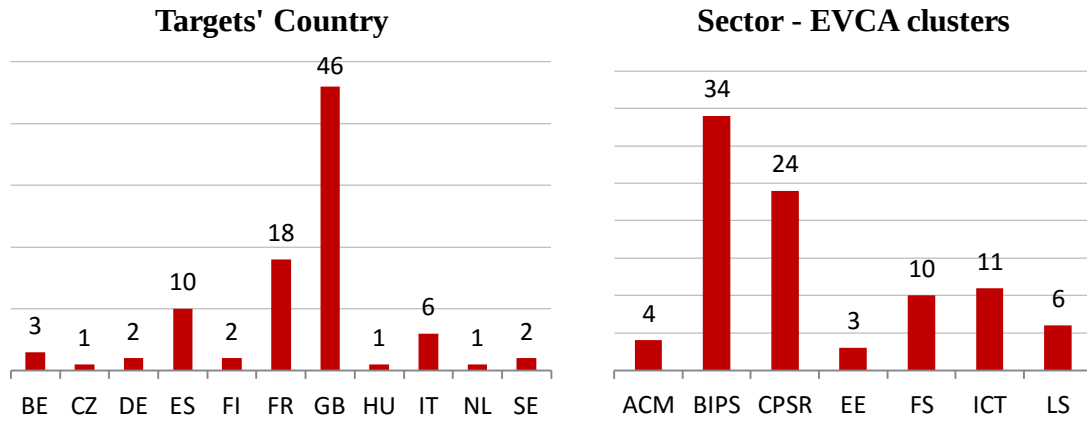
Our 92 target companies are from 11 of Euro-28 countries, notwithstanding the fact that, as one would expect, the majority (50%) is from the UK.

In terms of sectors, our sample encompasses 76 different 4-digit Nace codes, but to give a broader view of the different activities we grouped them in EVCA’s sector clusters², which show that 63% of our sample comes from the Business and Industrial Products and Services (“BIPS”) and Consumer Products, Services and Retail (“CPSR”), leaving a residual importance for tech related companies, utilities and other sectors. Our sample seems to be dominated by “old economy” or traditional sectors.

² Please refer to EVCA website for details of correspondence between clusters and Nace codes: http://www.evca.eu/media/12926/sectoral_classification.pdf.

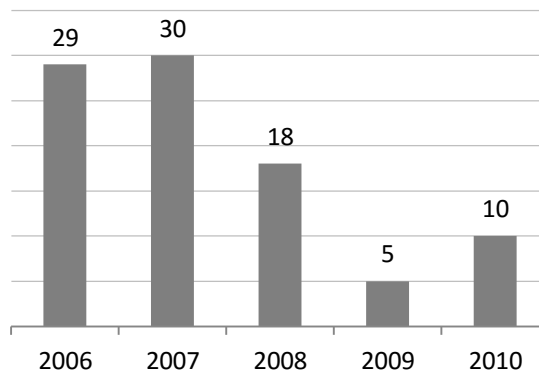
Figure 1 depicts countries and sectors breakdown in detail.

Figure 1 - Target's Country³ of Origin and Sector⁴



Concerning deal years, as depicted in Figure 2, our sample is dominated by pre and early start of the crisis deals as 64% of the transactions occurred in 2006/7.

Figure 2 - Deals per year



Finally, Table 2 shows that the majority of the deals in our sample were institutional buy-outs, and our sample includes both private to private and public to private deals.

³ Countries ISO Codes: Belgium (BE), Czech Republic (CZ), Germany (DE), Spain (ES), Finland (FI), France (FR), United Kingdom (GB), Hungary (HU), Italy (IT), Netherlands (NL), Sweden (SE).

⁴ EVCA Clusters: Agriculture, Chemicals and Materials (ACM), Business and Industrial Products and Services (BIPS), Consumer Products Services and Retail (CPSR), Energy and Environment (EE), Financial Services (FS), Communications Computer and Consumer Electronics (ICT) and Life Sciences (LS).

Table 2 - Deal type breakdown

Institutional buy-out 100%	57
Institutional buy-out 50%-99.9%	20
Acquisition 100%	5
Acquisition 75% minus one vote	1
Management buy-out 100%	9

As shown in Table 3 our final sample had an average (median) total assets of €319m (€94m), sales of €196m (€95m) and an EBITDA of €23m (€8m).

Despite the fact that we do lack several companies' financials, for the ones we have data, the final sample is not statistically different than the initial sample, in any of the shown metrics, which seems to indicate that we do have a representative sample.

Table 3 - Descriptive Statistics

This table reports some key financials for the pre transaction year (n-1) for the initial sample and the final sample. *Panel A* has the EBITDA, total assets and sales in €m. *Panel B* shows three key ratios for our research, investment and EBITDA deflated by beginning of year total assets, and sales growth. *Panel C* has some additional characterization ratios. Significance tests for the difference between samples given by two-tailed Wilcoxon rank sum. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided), respectively. Values are winsorised between 0.05 and 0.95 percentiles for Panels B and C.

PANEL A

	EBITDA		Total Assets		Sales	
	Initial	Final	Initial	Final	Initial	Final
Mean	30.0	22.5	366.7	318.8	267.0	196.4
Median	6.9	8.2	91.8	94.0	76.8	94.8
Std. Dev.	87.9	51.2	858.3	805.1	946.9	388.9
N	132	92	167	92	150	92

Dif Initial vs Final (signif.):

PANEL B

	CAPEX / Total Assets		EBITDA / Total Assets		Sales Growth	
	Initial	Final	Initial	Final	Initial	Final
Mean	0.1027	0.0956	0.1167	0.1199	0.1297	0.1314
Median	0.0455	0.0469	0.1013	0.1087	0.0909	0.0987
Std. Dev.	0.1689	0.1449	0.1281	0.1138	0.3275	0.2191
N	123	92	132	92	129	92

Dif Initial vs Final (signif.):

PANEL C

	Fixed Assets / Total Assets		D/(D+E)		Cash / Total Assets	
	Initial	Final	Initial	Final	Initial	Final
Mean	0.4751	0.4504	0.6227	0.5883	0.1071	0.1232
Median	0.4362	0.4027	0.8419	0.7709	0.0380	0.0545
Std. Dev.	0.3195	0.2862	0.3947	0.3974	0.1469	0.1549
N	166	92	134	81	151	90

Dif Initial vs Final (signif.):

3.2 Methodological Considerations

3.2.1 Descriptive evolution

As usual, we compare the evolution of several key metrics from the year before the transaction ($n-1$) to the year 1 ($n+1$), 2 ($n+2$) and 3 ($n+3$) after the transaction. The transaction year is left out as it is difficult to separate what is PE influence.

We analysed 5 different investment or CAPEX intensity measures.

The first two are the year's CAPEX deflated by the year-end as well as by the year-start total assets ("Lag total assets" or "Lag TA").

Some studies do not make a distinction, while others categorically deflate either by year-start or by year-end total assets. We agree with the view that it makes more sense to deflate by the year-beginning quantum, as it reflects better the investment decisions within the year, as the year-end measure is already influenced by the year's investment policy. Nevertheless for consistency check purposes we decided to present both.

We also present the CAPEX deflated by the year's sales as it is customary. By sales we are actually referring to turnover or operating revenues. Comparability across sector is enhanced by the use of the latter, as it includes services rendered, which, in some sectors, can be the only source of income (no actual sales are recorded as per accounting definitions).

Furthermore, we present 2 additional measures. The measure of "expansionary CAPEX" deflated also by year-start and year-end total assets.

"Expansionary CAPEX" (sometimes referred to as "growth CAPEX") envisages being a measure of how much the company is investing beyond the simple maintenance of its current production capacity, i.e, in expanding its potential growth. Whilst it is hard to categorize in each company what is exactly "expansionary" and what is "maintenance" CAPEX, at least from an outside observer's perspective, typically one expects the annual depreciations to be a measure, or at least a proxy, of what a company needs to invest order to keep its production capacity, as the depreciation itself is calculated, at least in principle, on the basis of the expected useful life of the equipment.

This metric sometimes is just called Net CAPEX and is used as the key metric, but we believe that it could be useful as support but not as a core measure. The difference between gross and net CAPEX is D&A, and, as such, can be somehow arbitrary, impacted by the countries' fiscal policies, and to some extent manipulated by the company. Hence, whilst the potential distortions can be acceptable in our expansionary proxy, a secondary measure, it is our understanding that gross CAPEX captures better the company's investment policy.

We define then expansionary CAPEX ("g CAPEX") as the year's CAPEX – D&A. One alternative measure of the expansionary CAPEX is to present CAPEX/D&A. However this measure is not very stable in companies in early stages as the D&A is still low (e.g. if the equipments are still in assembly or construction phase are not depreciated) and inflates the measure when compared to the chosen.

Our definition of CAPEX is then year-end fixed assets minus year-start fixed assets plus D&A. Three methodological choices arise from this definition.

First, we include the acquisitions effect, following Sousa and Jenkinson (2013) or Asker *et al.* (2015) and by opposition of others as Kaplan (1989). While the former consider acquisitions the latter does not.

The distinction between CAPEX and acquisitions can be important when comparing public with private firms (hence, in pre-post analysis in public to private transactions) due to the fact both are alternatives to acquire physical assets (instead of acquiring a new equipment, the company can acquire another company that has that same equipment). Nevertheless, private firms are less likely to engage in acquisitions as they are unable to pay them with stock and, as such, their overall investment is likely to involve relatively more CAPEX (without acquisitions) than public firms (Asker *et al.*, 2015).

Second, as it is implicit we also consider investment in intangible assets as CAPEX. The same basic reasoning as before applies to this choice: the relative importance of tangible versus intangible assets and CAPEX can be quite different across sectors. Hence, if we only consider tangible CAPEX, we may fail to acknowledge those differences.

We also analyse the evolution of 5 profitability/cash flow metrics. Earning before interests depreciation and amortization (“EBITDA”) deflated by year-start and year-end total assets (commonly referred to as ROA) and by the year’s sales. It is also presented 2 measures of cash flow, defined as EBITDA less CAPEX, deflated both by year-end and year-start total assets.

We also aimed to analyse the evolution of leverage. For this, instead of using debt to assets, we opted to use the measures more commonly used on the PE deals financing structures as covenants, Debt/EBITDA and EBIT/Interest, the latter more accurately a serviceability measure.

However, when comparing Debt/EBITDA in big samples, where negative values can occur (and, in fact, we have several), a contradiction arises: a negative value is bad, as it indicates negative cash flow (proxy) and, hence, no repayment capacity, but the negative values reduce the overall measure, either mean or median, thus underestimating it.

A solution could be to consider only positive values, which would, however, still somehow underestimate the measure of the group’s leverage.

Hence, we decide to present these measures as the difference to the sector median: when the value is negative it is added (positive sign) to the sector median, when positive is subtracted to it. Thus, a negative value means a value lower than the sector median and, albeit somehow still underestimating it, the negative individual values contribute to increase the group’s overall measure.

3.2.2 Sector Medians

For the 76 4-digit Nace codes in our sample, we extracted all the private companies in *Amadeus* database (for the Euro-28 area), which encompassed more than 150 thousand companies, which, after cleaned of all the missing incomplete data for the whole period, came down to 17,804 companies. We only kept companies with values for all of our metrics, during the entire 10 year period, in order to have a fully comparable set of companies during the decade.

3.2.3 Investment Opportunities

A company investment decisions should be influenced by its investment opportunities. It is not expectable that two similar companies, with different investment opportunities, have the same investment policy.

Hence, in order to be fully comparable, the investment decisions need to account for the different investment opportunities. In the empirical investment literature, investment opportunities are usually represented by Tobin's Q, which is typically defined as the firm's market value to the book value of its assets (as a proxy to its replacement cost).

The problem with this ratio is that is not available for private firms. Asker *et al.* (2015) suggests the alternative usage of Sales growth⁵, referred to as widely used in the literature, and an "Industry Q", constructed as a size-weighted average Q of all public firms in that industry.

A third alternative comes from Campello and Graham (2013) who suggest regressing public firms' Q against variables that theoretically explain it⁶, and then use the regression coefficients to generate "Fundamental" Q for each firm, both public and private⁷.

We used 4 alternative measures of investment opportunities: industry average Q⁸, the industry median Q, the theoretical estimated Q and sales growth.

For industry Q means and medians, we extracted all the public firms for our 76 4-digit Nace codes in *Amadeus*, for which we were able to have a balanced panel with market capitalization, net debt and total assets for the entire period, of 1,836 companies. A considerable number of public companies missed market capitalization data.

We then calculated sector mean and median Q's. As we missed or otherwise had a small sample for some sectors, we considered the values for the 2-digit Nace code, encompassing 35 sectors.

⁵ Henceforward, sales growth means sales n / sales $n-1$, where n is the year where we are estimating CAPEX or investment intensity (e.g., CAPEX/Total assets).

⁶ The authors use sales growth, return on assets (EBITDA divided by beginning-of-year total assets), net income before extraordinary items, book leverage, and year and industry fixed effects.

⁷ Interestingly, according to the authors, when used in the regression to explain investment, this Fundamental Q has higher explanatory power than the "real" market Q.

⁸ We used simple average instead of size weighted average.

As detailed in Table 4, for the calculation of predicted Q's we estimated 5 equations, by making a regression of the listed companies' Q with combinations of variables that theoretically can explain it, as mentioned.

Table 4 - Predicting Tobin's Q

This table reports 5 potentially explaining regressions for Tobin's Q. Data in Panel with unbalance data (some missing values mainly leverage). We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided), respectively. Year and industry (EVCA clusters) fixed effects (manual dummies, ACM omitted, as automatic cross-section fixed effects would be firm fixed effects). Year fixed effects test given by redundant fixed effects – Likelihood Ratio. Heteroskedasticity-consistent standard errors (White diagonal) are shown in italics under the coefficient estimates. Median sector Q is at the 35 2-digit Nace code level (value per year). Values were not winsorised.

	(1)	(2)	(3)	(4)	(5)
ROA	0.2611 * <i>0.1434</i>		0.2624 * <i>0.1445</i>	0.3094 *** <i>0.0481</i>	0.2670 * <i>0.1446</i>
Lag ROA		0.0074 <i>0.0147</i>			
Sales g				0.0000 <i>0.0000</i>	
Leverage (D/TA)			0.0289 <i>0.0569</i>	0.0589 <i>0.0447</i>	
Median Sector Q					1.2191 *** <i>0.063</i>
Constant	0.7061 *** <i>0.0485</i>	0.7380 *** <i>0.0471</i>	0.7000 *** <i>0.0503</i>	0.6930 *** <i>0.0942</i>	0.01774 <i>0.0476</i>
Obs.	8960	8632	8960	8506	8959
Adjusted R-squared	6.4%	6.1%	6.4%	6.5%	10.2%
F-statistic	41.5 ***	38.2 ***	39.0 ***	36.0 ***	511.7 ***
Industry Fixed Effects	Yes ***	Yes ***	Yes ***	Yes ***	No
Period Fixed Effects	Yes ***	Yes ***	Yes ***	Yes ***	No

Model (5) seems to fit better data and it's built under the premise that individual Q's converge to sector norm and that differences are explained by ROA. Hence, we chose model (5) to apply to our PE backed companies to estimate a predicted Q for each year.

3.2.4 Investment Regressions

Following the traditional investment literature⁹ and Asker *et al.* (2015), we used two base equations (3.1) which envisages analysing the private equity firms and the peers

⁹ In the traditional investment literature, or “Q-theory”, investment intensity is usually regressed against Tobin's Q or proxy, and other investment determinants, such as ROA. Asker *et al.* (2015) explains that that empirical work shows that standard proxies for investment opportunities are not, as neoclassical theory predicts, a sufficient statistic for investment and that ROA correlates positively with investment.

(see below) separately, or together, by adding a PE dummy variable, isolating its effect; and (3.2) which aims to interact and compare directly the PE firms with its peers, isolating its impact in each of the explainable variables.

$$\frac{I_{it}}{A_{it-1}} = \alpha + \beta_1 Q_{it} + \beta_2 ROA_{it} + \mu_i + \eta_t + \varepsilon_{it} \quad (3.1)$$

$$\frac{I_{it}}{A_{it-1}} = \alpha + \beta_1 Q_{it} + \beta_2 [PE_i \times Q_{it}] + \beta_3 ROA_{it} + \beta_4 [PE_i \times ROA_{it}] + \varphi_i + \delta_t + v_{it} \quad (3.2)$$

Where I is the investment, or CAPEX, A the beginning of year (or end of year) total assets, Q the proxy for Tobin's Q , as discussed above, PE the dummy for private equity status¹⁰ and ROA , meaning the EBITDA divided by total assets (again either beginning or end of year). The equations include firm (μ_i and φ_i) and year (η_t and δ_t) fixed effects and allow estimating within-firm variation in investment in response to within-firm variation in investment opportunities. The PE interaction allows comparing the investment sensitivities of PE firms with its peers (or public and private firms in the posterior analysis).

3.2.5 Matching

Not visible, or not controlled, characteristics can determine variations in firms' investment levels. In order to control or, at least, minimize the effects of any potential bias, a matching procedure should be implemented. The goal is to compare firms that are, in fact, similar.

We followed Asker *et al.* (2015) approach, a calliper-based nearest-neighbour match adapted to a panel setting, which consists in finding for each public firm, the private firm, or for each PE backed firm the private non PE backed firm, closest in size in the same industry code, by requiring the ratio of total assets between the two firms to be less than 2. In the case there is no match, the observation is discarded. The matches are held constant in subsequent years to ensure the panel structure remains intact.

Hence, one can include it in the regression, conditioning investment with ROA, a measure of Cash Flow (as ROA is defined as EBITDA/beginning of year Assets), regardless of its interpretation discussion (as mentioned in 2.3.2.2. regarding the ICF sensitivity debate).

¹⁰ Asker *et al.* (2015) use a public/private firm dummy.

Asker *et al.* (2015) unlike Bharath *et al.* (2014) do not match firms based on age and present an interesting argument against “overmatching”¹¹. Furthermore, they show that matched samples result, as one would expect from previous research, in younger, higher ROA, less cash and more indebted private firms, which nonetheless does not impact the overall conclusions.

In our matching procedure for the public-private pairs we followed closely Asker *et al.* (2015), using 4-digit NACE code instead of 4-digit NAICS. We used VBA coding in Excel to make the matching computations (please see Appendix II).

As for the PE firms and peer private firms matching we adopted the same methodology, matching firms on $n-1$ and keeping them as peers afterwards, relaxing however the $<2x$ relationship between the firms TA¹², as in some industries we ended up with few companies.

Furthermore, in order to minimize the impact of outliers (as our PE firm sample is relatively small) we selected not one but two peers (the two closest) and compare to the mean of the pair.

The percentage of times the ratio between the two firms was $>2x$ was 20% (please bear in mind that we have 2 sets of pairs which is likely to increase the incidence of threshold breaches). The median ratio was 1.15, which seems to indicate we have close peers in size.

We also considered ROA as alternative matching criteria, replacing the total assets with ROA level¹³.

¹¹ “The purpose of matching is not to eliminate all observable differences between public and private firms but to make firms comparable along the dimensions thought to affect the outcome variable of interest (here: investment). Overmatching on dimensions unrelated to the outcome variable of interest results in samples that are unrepresentative of their respective populations. In other words, we can make matched firms arbitrarily similar to each other on arbitrarily many dimensions, but as we do so, the firms that end up in the matched sample become ever less representative of their respective groups. See Heckman, LaLonde, and Smith (1999) for an exhaustive discussion of this point.”

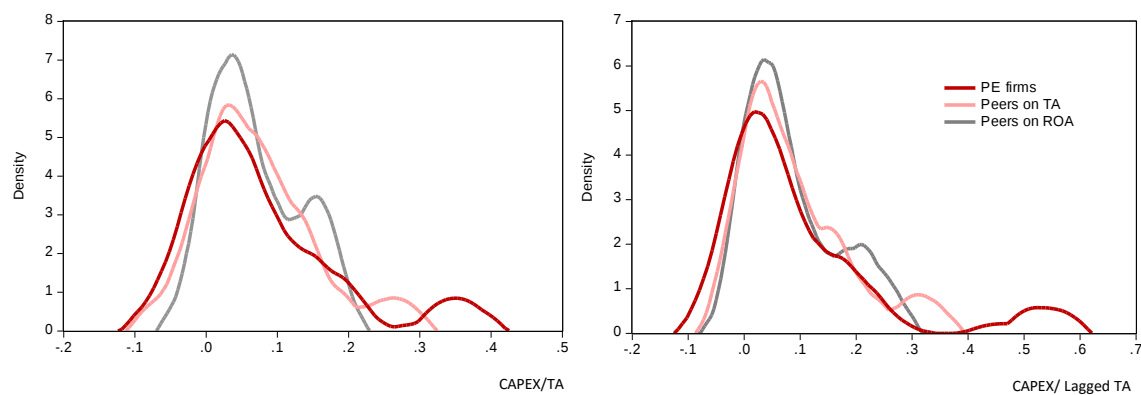
¹² The relationship is between the $\max(\text{company A; company B})/\min(\text{company A; company B})$ to force the results to be always >1 ; otherwise we would have to work with $0.5 < \text{company A/ company B} < 2$, which would introduce unnecessary complexity.

¹³ It seems arguable that it is the dimension, at least isolated, that determines the investment behaviour. Regardless of the overmatching discussion, we envisaged introducing the profitability (ROA) dimension, statistically highly correlated with investment intensity. However, in some sectors the 2 dimensions together determined that we would end up with very different companies in one of the sides or, if we imposed a maximum relationship (e.g. the two times cap), we would end up without peers. One solution

In this case, the incidence of cases where the 2x cap was breached was just 3% (1.01x median), which seems to indicate that we have closer peers under this criteria. The mean absolute difference between ROA is 0.23 percentage points, which confirms that we get really close peers in ROA terms¹⁴.

As depicted in Figure 3, we seem to capture relatively similar companies, in terms of investment policy, by both matching methods, albeit peers matched on ROA seem to be much more centred and with less outliers/fat tails.

Figure 3 - Kernel Density for CAPEX to TA (left) and Lag TA (right) on year n-1



3.2.6 Endogeneity

One common method to deal with endogeneity is to control for effects that originate the predisposition. The matched sample procedure tends to minimize this bias. Also the firm level fixed effects absorbs other non visible within firm differences.

We use both a matching as well as firm fixed effects. As our sample encompasses both public and private firms pre-deal, we believe this procedure suffices.

could be to relax the sector matching from the 4 digit code to a 1 digit code or to EVCA clusters. However, we consider that the sector has a considerable influence in investment intensities, playing a more incisive role than introducing a third, dimension. To illustrate this point, consider glass packaging companies, a highly CAPEX intensive industry, in which the major investment relates to furnaces overhauls and that somehow behaves in “waves”, meaning one or two years of sizeable CAPEX followed by several years of reduced CAPEX, even below what one could consider maintenance CAPEX. Both the intensity and investment pattern have nothing to do with paper packaging which, under a less demanding/precise industry classification, would end up both being classified as just “packaging” or even worse.

¹⁴ To be precise as explained in Appendix II, in ROA matching algorithm we did not use a 2x ratio but a 2x the difference between ROAs in order to better deal with negative values.

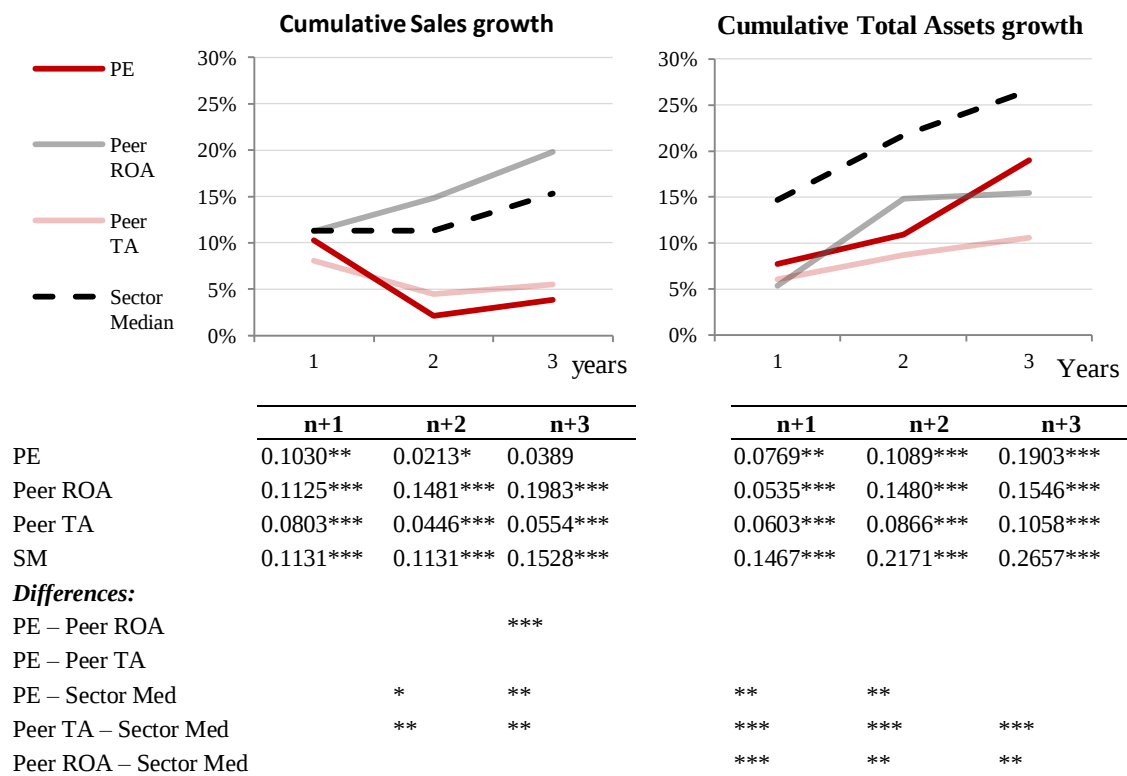
4. PE impact on Investments on Entry – Empirical findings

4.1 Descriptive Evolution

Three years after entry, the median PE backed firm in our sample grew less its sales than both its sector median (“SM”) and its matched peers in ROA (“PROA”) and in total assets (“PTA”). As depicted in Figure 4, in sales terms, our PE sample behaved closely to its PTA and the PROA group was aligned with sector median.

Figure 4 – Median Cumulative Sales (left) and Total Assets (right) Growth

This Figure depicts the sales and total assets median cumulative evolution for the 3 years after the buyout when compared to the year before the buyout. Below the charts we show the numbers. Significance tests given by the two-tailed Wilcoxon signed rank test for the cumulative change from year $n-1$ to $n+i$ and the two-tailed Wilcoxon rank sum for the difference between group. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided), respectively. Values are winsorised between 0.05 and 0.95 percentiles.



At year 3, the difference was statistically significant (two-sample Wilcoxon rank-sum - Mann-Whitney – test) at 5% and 1% for the sector median and PROA. Furthermore, PTA’s cumulative sales growth at year 3 was also statistically different (5%) from sector median while PROA was not.

However, in terms of total assets the evolution was quite different, with our PE firms differing from sector median during the first 2 years, but not in the third, and never differing statistically from its matched peers.

The peers, however, had a statistically different evolution from the SM (1% significance for PTA and 5% for PROA).

Regarding investment intensity, Table 5 shows in *Panel A* the mean and median percentage points change in the 5 alternative metrics, from year $n-1$ to the first three years after the entry, and for the 4 groups (PE, SM, PTA and PROA). The value of change is given by $(Metric_{n+i} - Metric_{n-1}) \times 100$, where *Metric* is one of the 5 alternative investment intensity ratios, for each group, i is the year after entry, from 1 to 3.

Data shows that by year 3 there is a statistically significant reduction, under all of our selected metrics. Despite the fact that the averages are considerably higher than medians, as a result of considerable amount of extreme higher values, the same conclusion is derived from both statistics.

For example, the average (median) PE backed firm by $n+3$ had reduced by 4.048 (1.020) percentage points (“pp”) its CAPEX deflated by its beginning of year total assets (Lag TA). This implies that the mean in year 3 (not shown) is shy from half of the one in $n-1$.

Furthermore, the expansionary CAPEX intensity proxy ($g \text{ CAPEX} / \text{Lag TA}$) reduction implies that the median PE backed firm cut its expansionary CAPEX to virtually 0 in $n+3$.

Also worth highlighting that some statistically significant evolutions by $n+1$ stop being so by year $n+2$, which seems to be a year a major volatility and where apparently some companies partially correct the CAPEX cuts performed during the previous year.

Putting this evolution into context, the sector medians also present a clear reduction trend in investment intensity. By year $n+3$, only the median change in $\text{CAPEX} / \text{Sales}$ is not statistically significant. The same applies to PTA.

Table 5 - Investment Intensity change after entry

This table reports in *Panel A* the mean and median percentage points change in 5 investment intensity metrics for the first 3 years after entry when compared to the pre-deal year and in *Panel B* the difference between medians and medians for the groups. The values are presented for the PE firms, the sector median (of each PE firm) and the peers matched on total assets and on ROA. Significance tests given by the t-statistic for means and two-tailed Wilcoxon signed rank test for medians in *Panel A* and Anova F-Test and the two-tailed Wilcoxon rank sum for means and medians, respectively, in *Panel B*. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided), respectively. Values are winsorised between 0.05 and 0.95 percentiles.

<i>Panel A</i>		PE Firms			Sector Median			Peers matched on TA			Peers matched on ROA		
		n-1 to n+1	n-1 to n+2	n-1 to n+3	n-1 to n+1	n-1 to n+2	n-1 to n+3	n-1 to n+1	n-1 to n+2	n-1 to n+3	n-1 to n+1	n-1 to n+2	n-1 to n+3
CAPEX / TA	Mean	-2.434 *	-1.494	-2.588 **	-0.918 ***	-0.718 ***	-0.750 ***	-1.285	-1.114	-2.720 ***	-1.805 **	0.253	-0.473
	Median	-1.203	-0.695	-1.482 **	-0.528 ***	-0.598 ***	-0.631 ***	-0.771	-1.132	-1.868 ***	-1.356 **	-0.552	-0.656
	Std. Dev.	11.789	11.069	10.131	2.001	1.582	1.717	9.144	8.746	9.499	8.597	8.840	8.806
CAPEX /Lag TA	Mean	-3.428 **	-2.735 *	-4.048 ***	-1.165 ***	-0.969 ***	-0.982 ***	-1.939 *	-1.859 *	-3.716 ***	-1.780	3.061	-0.662
	Median	-0.384 *	-0.271	-1.020 **	-0.737 ***	-0.821 ***	-0.756 ***	-1.143	-1.932 *	-1.907 ***	-1.651 ***	-0.422	-1.274
	Std. Dev.	14.761	15.037	14.180	2.209	1.910	2.008	10.946	10.356	11.358	11.599	18.340	12.513
G CAPEX / TA	Mean	-2.413 **	-1.665	-2.570 **	-0.576 ***	-0.357 ***	-0.365 ***	-1.129	-1.007	-2.388 **	-1.909 **	0.787	-0.181
	Median	-1.084	-0.433	-0.873 **	-0.220 ***	-0.119 **	-0.189 ***	-0.708	-0.346	-1.239 **	-0.844 *	-0.319	-0.673
	Std. Dev.	11.624	10.660	9.633	1.541	1.244	1.190	8.558	8.421	9.203	9.134	9.367	8.848
G CAPEX / Lag TA	Mean	-2.992 **	-2.343	-3.749 ***	-0.629 ***	-0.432 ***	-0.399 ***	-1.629	-1.568	-2.954 **	-1.855	3.412 *	0.003
	Median	-1.142 *	-0.458	-1.019 **	-0.244 ***	-0.137 ***	-0.269 ***	-0.254	-0.843	-1.312 **	-0.966 *	-0.076	-0.862
	Std. Dev.	13.529	13.857	12.604	1.641	1.351	1.280	10.303	10.215	10.883	11.301	17.462	12.125
CAPEX / Sales	Mean	-2.434 *	-1.494	-2.588 **	-0.665 ***	-0.238	-0.036	-9.153 *	-7.267	-12.892 **	-5.960	4.659	5.180
	Median	-1.203	-0.695	-1.482 **	-0.374 ***	-0.305 ***	-0.179 *	-0.981	-0.825	-1.664 **	-0.966	-0.225	-0.107
	Std. Dev.	11.789	11.069	10.131	1.784	1.853	2.482	46.065	44.418	47.363	36.738	41.594	38.166
<i>Panel B</i>		PE Firms minus Sector Median				PE Firms minus Peers on TA				PE firms minus Peer on ROA			
		n-1	n+1	n+2	n+3	n-1	n+1	n+2	n+3	n-1	n+1	n+2	n+3
CAPEX / TA	Mean	3.101 ***	1.584	2.325	1.262 **	0.454	-0.695	0.073	0.585	0.685	0.056	-1.062	-1.430
	Median	0.920	0.362	0.742	0.581	-1.002	-0.595	-0.462	0.301	-1.003	0.199	-0.027	0.158
CAPEX /Lag TA	Mean	4.753 ***	2.490 **	2.987 **	1.687 **	0.658	-0.832	-0.218	0.326	1.158	-0.490	-4.638 **	-2.227 **
	Median	0.476	0.190	0.439	0.702	-1.502	-0.782	-0.773	0.436	-2.024	-0.524	-0.704	-0.002
G CAPEX / TA	Mean	2.881 ***	1.045	1.573 **	0.676	0.899	-0.385	0.241	0.717	0.948	0.444	-1.504	-1.440 *
	Median	1.132	0.239	0.377	0.162	-0.436	-0.173	0.514	-0.091	0.530	0.789	0.100	-0.653
G CAPEX / Lag TA	Mean	4.314 ***	1.951 *	2.403 ***	0.964 *	0.885	-0.477	0.111	0.090	1.259	0.122	-4.496 **	-2.493 **
	Median	1.326	0.285	0.449	0.180	-0.295	-0.430	0.378	-0.146	0.667	0.813	-0.083	-0.537
CAPEX / Sales	Mean	9.353 ***	8.678 ***	9.868 ***	5.738 ***	-10.066 *	-2.254	-2.522	-0.824	-1.772	2.847	-6.155	-10.603 **
	Median	1.077	-0.192	1.681	1.056	-2.409	-2.616	-1.495	-0.384	-0.557	-0.389	-0.711	-0.229

A generalized reduction in investment is not surprising, as our sample is clearly concentrated in the financial crisis period.

Table 5, *Panel B* shows, for each year, from pre-entry (n-1) to year 3 after buyout (n+3), the percentage points difference between the PE investment intensity metric, and each of the other peer groups, i.e., PE vs. SM, PE vs. PTA and PE vs. PROA. The value is then $(Metric_{PEi} - Metric_{PGi}) \times 100$, where PEi and PGi are the value of the metric for the PE and for the peer group, respectively, in year i , the relative year from the deal, from -1 to 3.

When comparing the values between the groups, the conclusions seem different. In year n-1 PE firms invest statistically significant above the sector median, and, while this higher investment still holds in year n+3, it seems that PE firms somehow converged to sector norm, by reducing much more its investment levels.

Comparison with PTA is not as clear cut, as differences are not consistent and not statistically different. Data does not support a difference in behaviour between PE and PTA firms.

Peers matched on ROA, show a very dissimilar picture. Whilst no statistical significant difference is found in year n-1, by year n+3 all mean investment metrics, with exception of CAPEX/TA, show PE firms investing less than its peers (medians also show the same sign but the difference is not statistically significant). For example, mean CAPEX /Lag TA is 2.5 pp lower in PE than in PROA firms and mean CAPEX/Sales is 10.6 pp lower.

The difference in behaviour is especially significant in our expansionary CAPEX measure. We do not show the absolute (metric/group/year) values, but for illustrative purposes, we can indicate that whilst a PE backed firm pre buyout invested on average (median) 4% (1.7%) of its beginning of year assets, the peers (on ROA) invested 3.6% (0.7%). By the end of the 3rd year, while the behaviour remained virtually unchanged for the peer group, the PE backed firms had cut its expansionary CAPEX to 1.1% on average, and the median firm was only replacing assets (0% expansionary CAPEX).

Regarding profitability/cash-flow evolution, as show Table 6, *Panel A*, similar to what happened with CAPEX, data shows that sector medians statistically (mostly significant at 1%) reduce over the period, and that the decline is progressive. The exception is EBITDA / Sales, which peak reduction occurs in year $n+2$ and then recovers, to the point that in $n+3$ the reduction is not statistically significant.

Contrasting with this trend, PE backed firms improve, as found in most of the literature, their profitability levels by year $n+1$ the improvements are statistically significant (at 5% and 1%) with exception of ROA calculated on beginning of year TA (ROA Lag).

However, unlike the literature, we somehow witness a reversal, to the point that by year $n+2$ and $n+3$ the improvements disappear and even represent a reduction, albeit not statistically significant. The exception is cash flow to lagged TA, that in $n+3$ still represents a significant (at 10%) 3.2 pp improvement, no doubt due to the reduction in CAPEX.

In relation to our control groups, PTA also shows reductions in profitability levels, some of which statistically significant. For example, in year $n+3$, ROA calculated on lagged TA evidences a reduction of -1.5 and -0.7 pp in mean and median, respectively (5% and 10% significance).

As PE firms, PTA firm's cash-flow also increases, although with significance only in mean terms and when deflated by lagged TA.

As for PROA firms, both ROA and ROA Lag show significant reductions of c. -2.5 and -1.8 pp in mean/median terms. Unlike the peer group matched on TA and PE firms, PROA group also reduces its cash-flows, significant against lagged TA.

Comparing the groups, as shown in Table 6, *Panel B*, for each year, we can see that PE firms increase the distance for sector medians in profitability. Cash flow measures were lower than sector norm in $n-1$, albeit not significant, and become higher and statistically different by $n+3$.

Table 6 - Profitability and Cash-Flow change after entry

This table reports in *Panel A* the mean and median percentage points change in 5 profitability / cash flow metrics for the first 3 years after entry when compared to the pre-deal year and in *Panel B* the difference between medians and medians for the groups. The values are presented for the PE firms, the sector median (of each PE firm) and the peers matched on total assets and on ROA. Significance tests given by the t-statistic for means and two-tailed Wilcoxon signed rank test for medians in *Panel A* and Anova F-Test and the two-tailed Wilcoxon rank sum for means and medians, respectively, in *Panel B*. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided), respectively. Values are winsorised between 0.05 and 0.95 percentiles.

<i>Panel A</i>		PE Firms			Sector Median			Peers matched on TA			Peers matched on ROA		
		n-1 to n+1	n-1 to n+2	n-1 to n+3	n-1 to n+1	n-1 to n+2	n-1 to n+3	n-1 to n+1	n-1 to n+2	n-1 to n+3	n-1 to n+1	n-1 to n+2	n-1 to n+3
ROA	Mean	2.743 **	-0.937	-0.853	-0.599 ***	-1.055 ***	-1.331 ***	-0.163	-1.316 **	-0.792	-1.341	-2.132 **	-2.503 ***
	Median	1.571 **	-0.729	-1.050	-0.320 ***	-1.106 ***	-1.335 ***	-0.129	-1.336 ***	-0.929 *	-0.265	-1.290 **	-1.783 ***
	Std. Dev.	10.507	11.207	10.587	1.904	1.935	1.763	5.162	5.704	6.381	8.393	9.291	8.365
ROA Lag	Mean	1.512	-2.341	-1.880	-0.846 ***	-1.503 ***	-1.793 ***	-0.491	-1.712 **	-1.539 **	-1.286	-2.002 *	-2.589 ***
	Median	0.299	-0.716	-1.514	-0.804 ***	-1.354 ***	-1.872 ***	0.090	-1.400 ***	-0.756 *	-1.267	-1.262 **	-1.850 ***
	Std. Dev.	14.763	14.609	14.118	1.927	2.231	2.184	6.465	6.785	7.400	8.696	9.898	9.189
EBITDA / Sales	Mean	2.770 **	-0.824	1.558	-0.189	-0.431 **	-0.187	-4.474	-8.437 ***	-4.167	0.117	1.844	1.723
	Median	0.900 **	-0.313	0.743	-0.083	-0.526 ***	-0.564 **	-0.147	-2.234 **	-1.634 *	-0.270	0.028	-1.685
	Std. Dev.	13.056	15.672	16.109	2.180	1.983	2.336	28.412	30.635	30.963	24.969	15.892	21.845
Cash Flow / TA	Mean	5.745 ***	0.628	1.875	-0.182	-0.666 ***	-1.007 ***	0.792	-0.627	1.281	1.588	-3.058 *	-2.101
	Median	3.507 ***	0.401	0.700	-0.034	-1.091 ***	-1.230 ***	0.222	-0.647	0.803	0.846	-1.105	-0.724
	Std. Dev.	16.135	14.858	14.037	2.453	2.223	2.005	10.084	10.163	10.849	14.483	15.361	12.407
Cash Flow / Lag TA	Mean	6.269 ***	1.083	3.235 *	-0.317	-0.878 ***	-1.214 ***	1.562	0.076	2.320 *	0.409	-5.584 **	-2.476 *
	Median	3.940 ***	-0.110	0.842	-0.187	-1.360 ***	-1.330 ***	1.379	0.212	0.966	-1.068	-1.594 *	-1.048
	Std. Dev.	18.926	18.297	17.613	2.641	2.248	2.020	12.467	11.614	12.484	14.958	21.187	14.147
<i>Panel B</i>		PE Firms minus Sector Median				PE Firms minus Peers on TA				PE firms minus Peer on ROA			
		n-1	n+1	n+2	n+3	n-1	n+1	n+2	n+3	n-1	n+1	n+2	n+3
ROA	Mean	2.073 *	5.415 ***	2.192	2.551 **	1.540	4.446 ***	1.920	1.479	-0.419	3.664 **	0.776	1.230
	Median	1.384	2.768 *	1.840	2.131	1.060	1.827	0.460	0.796	-0.135	1.075	1.001	1.029
ROA Lag	Mean	3.829 **	6.187 ***	2.991 **	3.741 ***	3.187 *	5.190 ***	2.558	2.846 *	1.644	4.443 **	1.304	2.353
	Median	1.087	2.208	2.231	2.131	0.368	1.246	0.367	1.421	-0.679	0.562	1.495	0.162
EBITDA / Sales	Mean	3.859 **	6.818 ***	3.467 *	5.605 ***	-8.632 **	-1.389	-1.019	-2.907	-0.624	2.029	-3.292	-0.789
	Median	2.799 *	5.139 ***	1.949	2.123	-0.549	2.997	-0.863	-0.009	0.872	3.593 *	-0.817	1.098
Cash Flow / TA	Mean	-0.155	5.772 ***	1.139	2.727 **	1.218	6.171 ***	2.472	1.812	-1.015	3.142	2.671	2.962 *
	Median	-0.190	2.775 ***	0.443	0.892	0.410	3.375 ***	0.084	1.341	0.543	0.787	0.710	1.987
Cash Flow / Lag TA	Mean	-0.851	5.736 ***	1.110	3.598 ***	2.196	6.903 ***	3.203	3.110 *	-0.832	5.028 **	5.836 **	4.879 ***
	Median	-0.976	2.703 ***	1.184	1.314	1.297	3.853 ***	1.049	1.286	0.108	0.858	1.470	2.104

In relation to PTA group, PE firms considerably increase the difference in the first year (n+1), although only means are statistically different in ROA terms (e.g. 5.2 pp higher in PE than PTA in mean ROA Lag). In cash flows, both means and medians are statistically different. However, given the aforementioned reversal in PE firms' performance, the differences are no longer significant by year n+3, with exception of mean ROA Lag and mean Cash-Flow/Lag TA.

As it's not surprising there are no statistical differences between means/medians, in n-1, in PE vs PROA, as the latter was matched exactly on ROA. By year n+3 however, cash-flow measures are significantly higher in PE firms, due to the mentioned cutbacks in CAPEX, whilst PROA firms basically kept their investment levels.

Finally, in relation to our leverage and serviceability metrics, the results, as shown in Table 7, *Panel A*, show some evidence of increased leverage in our PE firms, and reduced interest cover (IC) in our peer groups.

Table 7 - Leverage and Interest Cover

This table reports in *Panel A* the mean and median change in the difference of each group's debt to EBITDA and EBIT to interest (IC) to the sector median for the first 3 years after entry when compared to the pre-deal year and in *Panel B* the difference between medians and medians for the groups. The values are presented for the PE firms and the peers matched on total assets and on ROA. Significance tests given by the t-statistic for means and two-tailed Wilcoxon signed rank test for medians in *Panel A* and Anova F-Test and the two-tailed Wilcoxon rank sum for means and medians, respectively, in *Panel B*. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided), respectively. Values are winsorised between 0.05 and 0.95 percentiles.

<i>Panel A</i>		PE minus SM			PTA minus SM			PROA minus SM		
		n-1 to n+1	n-1 to n+2	n-1 to n+3	n-1 to n+1	n-1 to n+2	n-1 to n+3	n-1 to n+1	n-1 to n+2	n-1 to n+3
Debt/ EBITDA	Mean	-0.8	1.3	1.9	-1.3 *	-1.1	0.1	-0.1	0.6	0.3
	Median	-0.2	0.2 *	0.2 *	0.0	-0.1	-0.1	-0.1	0.1	0.0
	Std. Dev.	10.0	9.9	10.5	6.6	6.6	8.8	5.0	6.7	5.8
IC	Mean	3.6	-5.3	29.4	-53.3 *	-82.1 **	-73.7 **	-86.1 **	-83.2 **	-98.6 ***
	Median	0.3	0.1	0.4	-0.5	0.3	0.6	-0.7	-0.4	-1.2
	Std. Dev.	151.2	158.9	232.3	268.8	341.5	322.5	347.0	337.4	341.7
<i>Panel B</i>		PE minus SM vs. PTA minus SM				PE minus SM vs. PROA minus SM				
		n-1	n+1	n+2	n+3	n-1	n+1	n+2	n+3	
Debt/ EBITDA	Mean	0.0	0.6	2.4 *	1.9	1.4	0.7	2.1	3.0 **	
	Median	-0.7 **	-1.1	-0.4	0.2	-0.2	0.2	0.1	-0.3	
IC	Mean	-67.4	-17.9	6.5	32.0	-94.2 *	-11.8	-19.2	30.1 *	
	Median	0.8	0.3	0.2	0.8	-4.1	-2.8	-3.4	-1.6	

Comparing the groups (Table 7, *Panel B*), results show that leverage increases in relation to the PROA group and also to PTA, although the latter without statistical significance. For example, the mean difference in debt to EBITDA towards the sector median is 3.0 higher in $n+3$ in PE firms than in PROA group (5.8x vs. 2.8x – not shown in the tables, which only shows the difference of 3.0). Medians have contradictory signs, but are not statistically significant.

Interestingly, interest cover is also higher in PE backed firms than in PROA peers, in year $n+3$, which could be explained by lower interests, on the back of PE higher negotiating power and broader access to financing sources.

4.2 Measuring Investment Opportunities

Although the empirical research shows that other factors explain differences in investment intensity, namely and remarkably ROA, the according to the neoclassical approach those differences should simply be a result of different investment opportunities (Asker *et al.*, 2015).

We arranged our data in panel¹ and estimated for our PE firms sample the sensitivity of the investment intensity to investment opportunities proxies and profitability/cash flow measure, as specified in equation (3.1).

In Table 8, we show in the columns under “Proxies to Investment Opportunities”, for our main investment intensity metric, CAPEX/Lag TA, the estimation of the equation with 4 alternative proxies to Tobin’s Q: (1) sales growth; (2) estimated or “theoretical Q”; (3) median sector Q and; (4) mean sector Q. For the other investment intensity metrics we show under “Alternative Investment Intensity Measures” (regressions 5 to 8) the estimation, using only the Sales growth proxy to Tobin’s Q.

¹ We include the civil year as the year identifier, which results in an unbalanced panel, as our data is balanced relatively (to deal) year terms. We consider, nonetheless, the advantaged of fixing civil years effect, for example, to isolate crisis years. An alternative “crisis” dummy did not seem to be a good approach (we did estimate several alternative formulations), as our sample encompasses very different European countries, which as commonly known, were affected by the crisis in different years (the impact in Europe was not simultaneous), and thus, identifying the years which could fall under the “crisis” dummy could be tricky.

The results show that as reported in the literature, sales growth seems to hold as a good investment opportunities proxy, given its statistical significance across the several investment intensities measures we defined.

Table 8 - PE firms sensitivity to Investment Opportunities

This table reports the estimation of Equation (3.1) for PE firms, testing the different proxies to investment opportunities as discussed, sales growth (1), Estimated Q (2), median sector Q (3) and mean sector Q (4). Investment opportunities proxies are tested against CAPEX to lagged total assets. We also present alternative measures of investment Intensity, regressed against sales growth as investment opportunities proxy. All regressions include company and year fixed effects. Fixed effects test given by Redundant Fixed Effects – Likelihood Ratio. Heteroskedasticity-consistent standard errors (White diagonal) are shown in italics under the coefficient estimates. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided), respectively. Values are winsorised between 0.05 and 0.95 percentiles, with exception of estimated, median and mean Q's.

	Proxies to Investment Opportunities				Alternative Investment Intensity Measures			
	CAPEX / Lag TA				CAPEX / TA	CAPEX / Sales	G CAPEX / TA	G CAPEX / Lag TA
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ROA					0.0528 <i>0.0558</i>		0.0206 <i>0.0537</i>	
ROA Lag	0.2163 *** <i>0.058</i>	0.2662 *** <i>0.059</i>	0.2704 *** <i>0.059</i>	0.2720 *** <i>0.059</i>		0.2011 <i>0.147</i>		0.1651 *** <i>0.056</i>
Sales growth	0.0580 *** <i>0.021</i>				0.0657 *** <i>0.019</i>	0.1030 * <i>0.055</i>	0.0523 *** <i>0.018</i>	0.0455 ** <i>0.020</i>
Estimated Q		0.0071 <i>0.018</i>						
Median Sector Q			0.0199 <i>0.021</i>					
Mean Sector Q				0.0154 <i>0.011</i>				
Constant	0.0310 *** <i>0.009</i>	0.0195 <i>0.021</i>	0.0096 <i>0.021</i>	0.0090 <i>0.015</i>	0.0461 *** <i>0.008</i>	0.0834 *** <i>0.022</i>	0.0091 <i>0.007</i>	-0.0043 <i>0.008</i>
<i>Company / Year Fixed Effects:</i>	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***
Obs.	460	460	460	460	460	460	460	460
Adjusted R ²	31.5%	29.4%	29.5%	29.8%	27.7%	38.9%	15.5%	18.0%
F-statistic	3.09 ***	2.89 ***	2.90 ***	2.92 ***	2.74 ***	3.89 ***	1.83 ***	2.00 ***

Our alternative measures, such as sector's median or mean Q or even our estimate of the “theoretical” Q don't seem to hold. We recall that our Estimated Q was calculated with model (5) in Table 4.

As reported in the investment literature, our sample of PE firms CAPEX intensity seems to be explained by variations in profitability/cash flow and investment opportunities, given by the Tobin's Q proxy (sales growth in our case).

4.3 Conditional Investment Intensities – PE firms vs. Peers

Our research question, however, is not determining the explainable variables for PE firms *per se*, but to determine how they compare with their peers, after controlling for those same explanatory variables.

Equation (3.1) adapted with a PE dummy variable allows us to isolate the PE impact and equation (3.2) allows us to explore this through the interaction of the firm status (dummy variable) with the explainable variables and thus measure the impact of the specific nature of PE backed firms.

We have estimated the equations for all the alternative investment intensity measures, we've considered previously, and for both set of peers at the same time as well as separately.

We also separate the “pre PE” period (n-1 or n-1 and n if necessary) from the “post PE entry” period (n+1 to n+3) in order to assess the impact of the change in ownership.

Several conclusions can be drawn from the results, which are shown in Table 9.

First, Equation (3.1) as shown in Table 9 *Panel A*, seems to provide little evidence of any impact of the PE intervention in firms' investment intensity, controlling for investment opportunities and cash-flow/profitability. In fact, only regression (4) in Table 9 *Panel A*, referring to the post PE entry and in a sample of PE and peers matched on ROA and regarding CAPEX / Lag TA, shows such an impact. In this model, the PE firm, everything else constant, has a CAPEX/Lag TA of lower in 1.28 pp (sig. 10%) in relation to its matched peers.

Second, with exception CAPEX/Sales in PROA and PTA samples only (regressions (51) and (54) in Table 9 *Panel A*), all our regressions show sales growth, our proxy to investment opportunities, as statistical significant, and the majority of times at 1%.

Third, and more important, Equation (3.2), as estimated and shown in *Panel B*, which allows us to develop and further build the results from equation (3.1) - it enables us to separate the explanatory variables by firm type -, seems to provide some evidence of a negative impact of PE intervention in investment.

Table 9 - Sensitivity to Investment Opportunities across PE and matched peers

This table reports the estimation of, in *Panel A* Equation (3.1) adapted with a PE dummy, and in *Panel B* Equation (3.2) which allows the analysis of within-firm variation to differences in the sensitivity of investment intensity to investment opportunities (sales growth as proxy), and profitability, between PE firms and other private firms considered as the best “comparable” according to our two matching criteria. Each of the 5 Investment intensity measure is regressed in three ways (i) all firms, i.e., PE firms and peers matched by both methods (column “All” under each metric);(ii) PE firms and peers matched by ROA (column “PE + PROA”) and; (iii) PE firms and peers matched on TA (column “PE+PTA”). For each sample two regressions are estimated to separate the impact of the PE entry: n-1 (*Panel B* needs to be n-1 to 0 in pre PE period to allow Company FE) vs. n+1 to n+3 periods. Cross section and year fixed effects (FE) are included. In *Panel A* the specification only allows for sector (4-digit Nace) FE, whilst in *Panel B* we are allowed to include company FE. The majority of equations have significant FE (Redundant Fixed Effects – Likelihood Ratio) - kept in all for consistency. Heteroskedasticity-consistent standard errors (White diagonal) are shown in italics under the coefficient estimates. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided), respectively. Values are winsorised between 0.05 and 0.95 percentiles.

	CAPEX / Lag TA						Expansionary CAPEX / Lag TA					
	All		PE + PROA		PE + PTA		All		PE + PROA		PE + PTA	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
PANEL A												
<i>Period</i>	<i>n = -1</i>	<i>n = 1 to 3</i>	<i>n = -1</i>	<i>n = 1 to 3</i>	<i>n = -1</i>	<i>n = 1 to 3</i>	<i>n = -1</i>	<i>n = 1 to 3</i>	<i>n = -1</i>	<i>n = 1 to 3</i>	<i>n = -1</i>	<i>n = 1 to 3</i>
ROA Lag	0.1560 *	0.1033 **	0.3284 **	0.0545	0.1318	0.1163 **	-0.0007	0.0169	0.2649 *	0.0291	0.0055	0.0201
	<i>0.084</i>	<i>0.044</i>	<i>0.149</i>	<i>0.064</i>	<i>0.082</i>	<i>0.047</i>	<i>0.089</i>	<i>0.041</i>	<i>0.152</i>	<i>0.062</i>	<i>0.083</i>	<i>0.042</i>
Sales g	0.1949 ***	0.0921 ***	0.1117 **	0.0915 ***	0.2715 ***	0.0739 ***	0.1909 ***	0.0829 ***	0.1056 **	0.0792 ***	0.2442 ***	0.0633 ***
	<i>0.041</i>	<i>0.020</i>	<i>0.050</i>	<i>0.025</i>	<i>0.053</i>	<i>0.023</i>	<i>0.040</i>	<i>0.019</i>	<i>0.050</i>	<i>0.024</i>	<i>0.051</i>	<i>0.020</i>
PE dummy	-0.0107	-0.0098	-0.0050	-0.0128 *	-0.0174	-0.0077	-0.0049	-0.0059	0.001	-0.011	-0.0104	-0.0033
	<i>0.010</i>	<i>0.006</i>	<i>0.012</i>	<i>0.008</i>	<i>0.012</i>	<i>0.007</i>	<i>0.010</i>	<i>0.006</i>	<i>0.012</i>	<i>0.008</i>	<i>0.011</i>	<i>0.006</i>
Constant	0.0952 **	0.0168	0.0793	0.0103	0.0203	0.0279 **	0.0987 **	0.0040	0.0776	0.0031	0.0255	0.0120
	<i>0.048</i>	<i>0.011</i>	<i>0.069</i>	<i>0.014</i>	<i>0.059</i>	<i>0.012</i>	<i>0.048</i>	<i>0.010</i>	<i>0.065</i>	<i>0.013</i>	<i>0.061</i>	<i>0.012</i>
Adjusted R ²	18.4%	9.0%	27.9%	10.4%	30.0%	10.2%	8.7%	5.9%	20.1%	5.1%	18.6%	8.0%
F-statistic	1.8 ***	2.0 ***	1.9 ***	1.8 ***	2.0 ***	1.7 ***	1.3 *	1.6 ***	1.6 **	1.4 **	1.5 **	1.6 ***
PANEL B												
<i>Period</i>	<i>n = -1 to 0</i>	<i>n = 1 to 3</i>	<i>n = -1 to 0</i>	<i>n = 1 to 3</i>	<i>n = -1 to 0</i>	<i>n = 1 to 3</i>	<i>n = -1 to 0</i>	<i>n = 1 to 3</i>	<i>n = -1 to 0</i>	<i>n = 1 to 3</i>	<i>n = -1 to 0</i>	<i>n = 1 to 3</i>
ROA Lag	0.0545	-0.0071	0.0224	-0.0760	0.1424	0.0782	0.0633	-0.0217	0.0154	-0.0827	0.2067	0.0514
	<i>0.134</i>	<i>0.129</i>	<i>0.150</i>	<i>0.174</i>	<i>0.195</i>	<i>0.194</i>	<i>0.139</i>	<i>0.123</i>	<i>0.153</i>	<i>0.173</i>	<i>0.196</i>	<i>0.179</i>
x PE	-0.0686	0.3937 **	-0.0376	0.4470 **	-0.1518	0.3003	-0.1437	0.3524 **	-0.0998	0.3954 **	-0.2760	0.2574
	<i>0.181</i>	<i>0.155</i>	<i>0.189</i>	<i>0.193</i>	<i>0.220</i>	<i>0.210</i>	<i>0.178</i>	<i>0.152</i>	<i>0.189</i>	<i>0.194</i>	<i>0.219</i>	<i>0.196</i>
Sales g	0.0518	0.0970 ***	-0.0332	0.1245 ***	0.1379 ***	0.045	0.0468	0.0892 *	-0.0367	0.1176 ***	0.1178 **	0.0397
	<i>0.046</i>	<i>0.029</i>	<i>0.056</i>	<i>0.038</i>	<i>0.057</i>	<i>0.042</i>	<i>0.042</i>	<i>0.028</i>	<i>0.051</i>	<i>0.038</i>	<i>0.053</i>	<i>0.038</i>
x PE	0.0658	-0.0556	0.1527 **	-0.0858 *	-0.0280	-0.008	0.0564	-0.0564	0.1437 **	-0.0852 *	-0.0252	-0.0154
	<i>0.061</i>	<i>0.040</i>	<i>0.070</i>	<i>0.048</i>	<i>0.068</i>	<i>0.049</i>	<i>0.060</i>	<i>0.039</i>	<i>0.068</i>	<i>0.048</i>	<i>0.066</i>	<i>0.045</i>
Constant	0.0648 ***	0.0492 ***	0.0731 ***	0.0466 ***	0.0539 ***	0.0331 ***	0.0220 *	0.0091	0.0339 ***	0.0079	0.0102	-0.0049
	<i>0.012</i>	<i>0.010</i>	<i>0.012</i>	<i>0.012</i>	<i>0.014</i>	<i>0.011</i>	<i>0.013</i>	<i>0.010</i>	<i>0.013</i>	<i>0.012</i>	<i>0.013</i>	<i>0.011</i>
Adjusted R ²	30.4%	23.0%	36.4%	24.9%	28.5%	27.1%	19.7%	13.4%	26.2%	13.7%	15.5%	18.0%
F-statistic	1.8	1.9 ***	2.1 ***	1.9 ***	1.8 ***	2.1 ***	1.5 ***	1.5 ***	1.7 ***	1.5 ***	1.4 **	1.6 ***
Obs.	552	828	368	552	368	552	552	828	368	552	368	552
Sector (Panel A) / Company (Panel B) and Year Fixed Effects Included in all equations												

Table 9 (Continued)

Two alternative Investment intensity measures CAPEX and Expansionary CAPEX deflated with end-of-year rather than beginning-of-year Total Assets.

	CAPEX / TA						Expansionary CAPEX / TA					
	All		PE + PROA		PE + PTA		All		PE + PROA		PE + PTA	
	(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)	(34)	(35)	(36)
PANEL A												
<i>Period</i>	<i>n = -1</i>	<i>n = 1 to 3</i>	<i>n = -1</i>	<i>n = 1 to 3</i>	<i>n = -1</i>	<i>n = 1 to 3</i>	<i>n = -1</i>	<i>n = 1 to 3</i>	<i>n = -1</i>	<i>n = 1 to 3</i>	<i>n = -1</i>	<i>n = 1 to 3</i>
ROA	-0.1134 *	-0.0599 *	-0.0095	-0.0437	-0.0707	-0.0421	0.0605	0.0247	0.0692	-0.0237	0.0827	0.0466
	0.067	0.036	0.176	0.055	0.078	0.042	0.069	0.038	0.183	0.055	0.076	0.045
Sales g	0.1498 ***	0.0781 ***	0.0995 ***	0.0766 ***	0.2068 ***	0.0584 ***	0.1487 ***	0.0830 ***	0.0971 ***	0.0842 ***	0.2188 ***	0.0644 ***
	0.029	0.015	0.035	0.019	0.039	0.018	0.031	0.016	0.035	0.019	0.042	0.019
PE dummy	-0.0004	-0.0001	0.0022	-0.0027	-0.0035	0.0018	-0.0053	-0.0047	-0.0030	-0.0057	-0.0091	-0.0033
	0.008	0.005	0.010	0.006	0.009	0.005	0.008	0.005	0.010	0.006	0.010	0.006
Constant	0.0919 **	0.0018	0.0925	-0.0006	0.0258	0.0083	0.0861 **	0.0152	0.0881	0.0078	0.0158	0.0251 **
	0.040	0.009	0.057	0.011	0.050	0.011	0.040	0.009	0.062	0.012	0.047	0.010
Adjusted R ²	9.9%	7.5%	10.1%	6.0%	20.0%	9.0%	17.0%	9.1%	19.4%	11.6%	28.3%	9.8%
F-statistic	1.4 **	1.8 ***	1.3	1.4 **	1.6 **	1.6 ***	1.7 ***	2.0 ***	1.5 **	1.9 ***	1.9 ***	1.7 ***
PANEL B												
<i>Period</i>	<i>n = -1 to 0</i>	<i>n = 1 to 3</i>	<i>n = -1 to 0</i>	<i>n = 1 to 3</i>	<i>n = -1 to 0</i>	<i>n = 1 to 3</i>	<i>n = -1 to 0</i>	<i>n = 1 to 3</i>	<i>n = -1 to 0</i>	<i>n = 1 to 3</i>	<i>n = -1 to 0</i>	<i>n = 1 to 3</i>
ROA	-0.2277 *	-0.2794 **	-0.2369 **	-0.3874 **	-0.0528	-0.1831	-0.2120 *	-0.2739 **	-0.2149 *	-0.3611 **	-0.0862	-0.1823
	0.125	0.111	0.119	0.159	0.225	0.156	0.114	0.112	0.121	0.121	0.181	0.162
x PE	-0.0565	0.4366 ***	-0.0024	0.5358 ***	-0.2352	0.3471 *	0.0365	0.4460 ***	0.0769	0.5312 ***	-0.0976	0.3624 **
	0.192	0.141	0.175	0.178	0.269	0.178	0.192	0.138	0.182	0.182	0.237	0.181
Sales g	0.0470	0.0955 ***	-0.0002	0.1228 ***	0.1052 **	0.0414	0.0453	0.0965 ***	-0.0020	0.1219 ***	0.1046 **	0.0419
	0.032	0.022	0.037	0.029	0.044	0.030	0.035	0.022	0.041	0.041	0.048	0.032
x PE	0.0490	-0.0479	0.0924 *	-0.0759 *	-0.0091	-0.0004	0.0664	-0.0391	0.1069 **	-0.0665 *	0.0088	0.0106
	0.049	0.032	0.052	0.037	0.057	0.037	0.049	0.032	0.054	0.054	0.058	0.039
Constant	0.0399 ***	0.0237 ***	0.0436 ***	0.0233 **	0.0280 *	0.0094	0.0776 ***	0.0647 ***	0.0786 ***	0.0615 ***	0.0656 ***	0.0501 ***
	0.011	0.009	0.011	0.011	0.014	0.009	0.010	0.009	0.011	0.011	0.013	0.009
Adjusted R ²	19.0%	15.0%	23.1%	16.5%	16.0%	18.2%	28.6%	24.6%	34.2%	28.2%	26.3%	26.5%
F-statistic	1.5 ***	1.5 ***	1.6 ***	1.6 ***	1.4 **	1.6 ***	1.8 ***	1.9 ***	2.0 ***	2.1 ***	1.7 ***	2.0 ***
Obs.	552	828	368	552	368	552	552	828	368	552	368	552
Sector (Panel A) / Company (Panel B) and Year Fixed Effects Included in all equations												

Table 9 (Continued)

Last alternative Investment intensity measure: CAPEX deflated with Sales.

	CAPEX / Sales					
	All		PE + PROA		PE + PTA	
	(49)	(50)	(51)	(52)	(53)	(54)
<u>PANEL A</u>						
<i>Period</i>	<i>n= -1</i>	<i>n= 1 to 3</i>	<i>n= -1</i>	<i>n= 1 to 3</i>	<i>n= -1</i>	<i>n= 1 to 3</i>
ROA Lag	-0.3036 0.236	-0.4498 *** 0.112	0.6517 * 0.364	-0.4733 *** 0.137	-0.4232 *** 0.238	-0.3128 ** 0.123
Sales g	0.4191 *** 0.125	0.2100 *** 0.064	0.1286 0.137	0.2769 *** 0.072	0.6595 *** 0.158	0.0912 0.067
PE dummy	-0.0093 0.028	0.0000 0.017	0.0132 0.033	0.0046 0.019	-0.0301 0.031	-0.0025 0.018
Constant	0.5005 *** 0.143	0.3216 *** 0.110	0.3805 ** 0.188	0.2940 ** 0.145	0.4106 * 0.239	0.4329 *** 0.132
Adjusted R ²	17.3%	16.3%	14.7%	20.3%	25.5%	11.8%
F-statistic	1.7 ***	2.9 ***	1.4 *	2.7 ***	1.8 ***	1.9 ***
<u>PANEL B</u>						
<i>Period</i>	<i>n= -1 to 0</i>	<i>n= 1 to 3</i>	<i>n= -1 to 0</i>	<i>n= 1 to 3</i>	<i>n= -1 to 0</i>	<i>n= 1 to 3</i>
ROA Lag	0.2349 0.568	-0.4559 0.282	-0.2866 0.359	-0.7236 * 0.378	1.1649 0.807	-0.0195 0.425
x PE	-0.2065 0.621	0.8214 ** 0.359	0.3038 0.437	1.0370 ** 0.428	-1.1168 0.831	0.3530 0.474
Sales g	-0.0200 0.120	0.1854 * 0.103	-0.1871 0.168	0.4035 *** 0.122	0.1642 0.130	-0.1597 0.124
x PE	0.1156 0.168	-0.0419 0.126	0.2711 0.201	-0.2521 * 0.142	-0.0628 0.169	0.2767 * 0.142
Constant	0.1053 ** 0.047	0.1437 *** 0.023	0.1431 *** 0.029	0.1387 *** 0.027	0.0508 0.049	0.1045 *** 0.026
Adjusted R ²	42.1%	32.8%	38.5%	38.6%	40.8%	36%
F-statistic	2.4 ***	2.4 ***	2.2 ***	2.8 ***	2.3 ***	2.6 ***
Obs.	552	828	368	552	368	552
<i>Sector (Panel A) / Company (Panel B) and Year Fixed Effects Included in all equations</i>						

This impact can be seen in two ways. The first impact is seen in sensitivity to investment opportunities. When measured against peers matched on ROA, for all of the CAPEX intensity measures, after the PE entry, the firms become less sensitive to investment opportunities, as it can be seen by the negative sign of the coefficient which would add (subtract in this case) to the generic coefficient. Furthermore, in some cases the PE was more sensible than its peers before entry.

For example, the CAPEX/Lag TA of a PE firm before PE entry would typically have a 15.27 pp (0.1527) higher sensitivity to investment opportunities than its peers with similar ROA (regression 15), whilst after the entry, the value was 8.58 pp (-0.0858) lower (regression 16).

Nevertheless, the results are not the same if we match firms based on size (TA) rather than ROA. This brings us to the question on what is the better matching alternative. We tend to consider ROA as the better matching alternative.

First, in the literature, a statistical significant relationship between ROA and investment intensity is systematically reported, and hence its inclusion in investment regressions even for authors agnostic to its interpretation (Asker *et al.*, 2015). Size does not seem to have a similar impact in explaining investment policy.

Second, we could match on ROA and TA. However as discussed under the Methodology section, besides the overmatching argument, our sample of private firms does not include sufficient companies to hold the threefold matching criteria. We'd end up with very different companies under one of the dimensions or would have to relax the level of industry matching.

Furthermore, the first matching would impact the final result, and the second matching would only refine the results, which would eventually be different all the same, meaning that matching on TA and then ROA would probably result in different outcomes than matching on ROA and then TA.

Third, despite the fact that both matching criteria result in non statistical differences in investment intensities with PE firms in selection year (n-1), the distribution in ROA firms seems less subjected to outliers and more centred (Figure 3). Additionally, the average difference in matching (under each criterion) seems smaller in ROA, meaning that we find on average more firms with a very similar ROA than firms with a very similar TA (under each sector).

Finally, the sensitivity to investment opportunities (not the PE effect) is almost always statistically more significant in regressions made in a sample of PE and PROA firms than in samples of PE and PTA firms.

Nonetheless, this is clearly a subject that would require additional research and probably deserves a separate research topic.

The second evidence of a negative impact of PE in investment is given by the sensitivity to ROA.

In this case, the impact is more or less consistent across the metrics and matching criteria, with the difference being that in PTA sample, the value is only significant when

CAPEX or expansionary CAPEX is measured against end-of-year assets (regressions 42 and 48).

The rather consensual result is that sensitivity to ROA, or in other words, the ICF sensitivity, increases and is positive and statistically significant for PE firms after the entry.

Despite divergence on the interpretation towards the ICF, we recall our literature review, namely Bertoni *et al.* (2013), who stated that the Kaplan and Zingales (1997) critique is about the *monotonicity* not about its *sign*, meaning that the ICF sensitivity should not be a measure of the degree of financial constraints but a sign of its existence. Hence, non-financially constrained firms should have an ICF not statistically different from zero but financially constrained firms, would have positive and significant ICF sensitivities.

This is precisely our case. The only statistically significant positive sensitivities to ROA, in our sample/regressions, are the ones regarding PE firms.

In fact, we saw a significant increase in leverage towards PROA firms. By year 3, the average difference in PE firms Debt/EBITDA to the Sector median was 5.8x whilst the same difference in the sample of firms matched on ROA was 2.8x.

All in all, the results seem to indicate the existence of financial constraints in PE backed firms, which appear only after entry, that end up underinvesting its comparable peers. This seems consistent with Ughetto (2014) findings.

5. The Public vs. Private discussion

5.1 The discussion and relevance for our analysis

Is there a difference in investment policies between public and private firms, or, in other words, does the listing status impact a firm investment intensity?

As we saw in our literature review, the theoretical answer to this question is not consensual. Whilst according to the free cash flow hypothesis (Jensen, 1986), on the back of agency related issues one would expect public firms to overinvest in relation to similar private firms; Stein (1988), however, offers a different view, arguing that the public firm focus on short term results, which often leads to myopically cuts in investment, sacrificing long term objectives due to short term pressures.

This, as we saw, is relevant for our analysis as the implicit or explicit explanation for a majority of the observed reduction in investment after a going private, or otherwise PE intervention in general, is that it simply results from a correction in *overinvestment*.

As we mentioned previously, very recently Asker *et al.* (2015) showed empirical evidence in support of Stein (1988) arguments, for the US.

5.2 Empirical Findings

We envisaged presenting a high level comparison for Europe and thus we did a similar, albeit much less extensive, approach to Asker *et al.* (2015)¹.

We present in Table 10 the results for the unconditional investment intensities, as measured by CAPEX / Lagged total assets, for the 9 years from 2005 to 2013.

¹ Please bear in mind that this approach is mainly related to our PE deals sample and, thus, the public-private sample encompasses only the sectors analysed in our main study and not the whole economy. Nevertheless, we seem to have a representative sample of the European economy, given we have 76 different Nace 4-digit sectors, encompassing all the 1 digit codes and the fact that our sample of 29,435 companies, represents €3.3tn in assets and €2.4tn sales (2013), which compares with the Euro-28 €13.9tn GDP in 2014. As discussed in methodology, we envisaged a stable sample, meaning the same set of firms throughout the analysis period. Hence we discarded all the companies lacking any of our main financials during any year of the analysed period. Between lacking some or all the financials, from a starting almost 400 thousand companies, we ended up with a sample of 29 thousand companies, before matching, as represented in Appendix III.

Table 10 - Unconditional Investment Intensities

This table reports unconditional investment intensities for public and private firms per year, in four samples: all, unmatched, and three matched on Nace 4-digit code and total assets, ROA and total assets plus ROA, respectively. Significance tests for the difference between public and private samples given Anova F-Test and the two-tailed Wilcoxon rank sum for means and medians, respectively. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided), respectively. Values are winsorised between 0.005 and 0.995 percentiles to reduce the impact of outliers. We use 0.5% in each tail rather than 5% as previously as the outliers carry less weight given the size of the samples and to compare with Asker *et al.* (2015). For the cases where there is a statistically significant difference, we highlight in bold the higher value.

CAPEX / Lag TA N° Firms	2005	2006	2007	2008	2009	2010	2011	2012	2013	
<u>MEANS</u>										
<u>All Sample</u>										
Private	17,803	0.0829	0.0800	0.0693	0.1225	0.0521	0.0641	0.0515	0.0461	0.0363
Public	11,632	0.0917	0.0854	0.0840	0.1272	0.0564	0.0583	0.0534	0.0483	0.0423
All	29,435	0.0863	0.0821	0.0751	0.1244	0.0564	0.0618	0.0522	0.0470	0.0387
Difference		***	***	***			***	*	**	***
<u>Matched on TA</u>										
Private	9,306	0.1037	0.0892	0.0705	0.1345	0.0623	0.0690	0.0551	0.0502	0.0391
Public	9,306	0.0917	0.0899	0.0873	0.1409	0.0588	0.0619	0.0571	0.0505	0.0443
All	18,612	0.0977	0.0896	0.0789	0.1377	0.0605	0.0654	0.0561	0.0503	0.0417
Difference		***		***		*	***			***
<u>Matched on ROA</u>										
Private	9,596	0.0989	0.0955	0.0829	0.1757	0.0687	0.0719	0.0608	0.0536	0.0423
Public	9,596	0.0905	0.0837	0.0831	0.1345	0.0562	0.0590	0.0536	0.0492	0.0433
All	19,192	0.0947	0.0896	0.0830	0.1551	0.0625	0.0654	0.0572	0.0514	0.0428
Difference		***	***		***	***	***	***	***	
<u>Matched on TA & ROA</u>										
Private	8,393	0.102	0.0903	0.0704	0.1313	0.0626	0.0700	0.0561	0.0498	0.0395
Public	8,393	0.0867	0.0865	0.0850	0.1415	0.0575	0.0615	0.0566	0.0501	0.0432
All	16,786	0.0942	0.0884	0.0777	0.1364	0.0601	0.0658	0.0564	0.0500	0.0413
Difference		***		***	*	**	***			**
<u>MEDIANS</u>										
<u>All Sample</u>										
Private	17,803	0.0343	0.0363	0.0292	0.0317	0.0244	0.0281	0.0221	0.0199	0.0136
Public	11,632	0.0371	0.0341	0.0346	0.0391	0.0224	0.0252	0.0235	0.0213	0.0186
All	29,435	0.0355	0.0355	0.0313	0.0349	0.0235	0.0270	0.0226	0.0206	0.0156
Difference		***	***	***	***	***	***			***
<u>Matched on TA</u>										
Private	9,306	0.0364	0.0376	0.0281	0.0283	0.0257	0.0300	0.0232	0.0222	0.0148
Public	9,306	0.0368	0.0345	0.0348	0.0395	0.0224	0.0254	0.0235	0.0216	0.0187
All	18,612	0.0366	0.0361	0.0313	0.0342	0.0240	0.0276	0.0235	0.0219	0.0169
Difference			***	***	***	***	***			***
<u>Matched on ROA</u>										
Private	9,596	0.0358	0.0387	0.0313	0.0327	0.0263	0.0304	0.0237	0.0221	0.0155
Public	9,596	0.0380	0.0350	0.0354	0.0405	0.0228	0.0255	0.0238	0.0214	0.0189
All	19,192	0.0368	0.0369	0.0334	0.0368	0.0245	0.0278	0.0238	0.0217	0.0171
Difference		**	***	***	***	***	***			***
<u>Matched on TA & ROA</u>										
Private	8,393	0.0368	0.0387	0.0286	0.0290	0.0265	0.0309	0.0242	0.0231	0.0154
Public	8,393	0.0366	0.0347	0.0350	0.0401	0.0223	0.0255	0.0237	0.0216	0.0186
All	16,786	0.0367	0.0367	0.0316	0.0348	0.0243	0.0279	0.0239	0.0223	0.0170
Difference			***	***	***	***	***			***

The whole sample, unmatched, shows that public firms, on average, invest more than private firms. This happens in 6 out of the 9 years of the sample. In 2008/9 there is no (significant) difference and in 2010 private firms invest more.

Samples matched on TA and TA & ROA² show broadly inconclusive results, as there are many years where public firms invest more as the other way around.

Again, like in our PE sample, here matching on ROA also shows a different story, in this case, that in the majority of years private firms invest more than public firms (7 out of 9, always significant at 1%) and there is no year where the public firms invest significantly more than their private counterparts (in mean terms).

Curiously, all the samples show a very similar story in median terms: before the crisis, in 2006 private firms invested more, then in 2007/08 public firms invest more than private firms, and then in the two following years the situation reverts again (at least temporarily).

This evolution is basically conditioned by the quick fall in investment intensity in private firms as public firms seem rather unaffected by the crisis, at least in its early years (public firm's investment also reduces but only 2 years after private peers, in 2009). This is consistent with the view public firms have broader access to capital (equity and debt) markets, whilst private firms are much more dependent on the banking sector for external financing, which, as it is common knowledge, was severely halted in the wake of the financial crisis.

As shown in Table 11, *Panel A* (estimation of equation 3.1), holding investment opportunities (sales growth as proxy) and profitability constant for the whole period, the sample matched on ROA shows that public firms invest less than their private counterparts, which is consistent Asker *et al.* (2015) conclusions. Typically, a public firm investment intensity would be 0.6 pp less (-0.0061) than the private counterpart, with the same profitability and investment opportunities.

² Unlike with our PE sample, here we can perform a matching on TA and ROA (much larger sample). However, given the fact that the matching first occurs on TA and then on ROA, the results are undoubtedly conditioned by the first step and the second step is nothing more than refining the first one. Hence, the first step can lead to the exclusion of peers which could under another criterion be classified as better comparable.

Table 11 - Conditional Investment Intensities

This table reports the estimation of Equation (3.1) in *Panel A* and Equation (3.2) in *Panel B*. Whilst Equation (3.1) isolates the public listing status, Equation (3.2) and allows the analysis of within-firm variation to differences in the sensitivity of investment intensity to investment opportunities, with sales growth as proxy, and profitability, between public and private. We estimate the regression of investment intensity as measured by CAPEX / Lagged total assets in three matched samples and for 4 estimation periods, the whole period, 2005/06 as “pre-crisis” period, 2007/10 as “crisis period” and 2011/13 as the “post crisis”. In *Panel A* the regressions include Sector (Nace 4-digit code) and year fixed effects as the specification does not allow for company fixed effects. In *Panel B* company and year fixed effects are included. Fixed Effects test given by Redundant Fixed Effects – Likelihood Ratio. Heteroskedasticity-consistent standard errors (White diagonal) are shown in italics under the coefficient estimates. We use ***, **, and * to denote significance at the 1%, 5%, and 10% level (two-sided), respectively. Values are winsorised between 0.005 and 0.995 percentiles (as in Asker *et al.* (2015)).

Period	Matched on Sector & ROA				Matched on Sector & Total Assets				Matched on Sector & Total Assets & ROA			
	2005 - 2013	2005-2006	2007-2010	2011-2013	2005 - 2013	2005-2006	2007-2010	2011-2013	2005 - 2013	2005-2006	2007-2010	2011-2013
Obs.	172,695	38,372	76,756	57,567	167,439	37,197	74,423	55,819	151,049	33,565	67,136	50,348
Companies	19,192	19,191	19,192	19,192	18,612	18,612	18,611	18,611	16,786	16,786	16,786	16,786
<u>PANEL A</u>												
Public	-0.0061 *** <i>0.001</i>	-0.0058 *** <i>0.002</i>	-0.0089 *** <i>0.001</i>	-0.0024 ** <i>0.001</i>	0.0001 <i>0.001</i>	-0.0051 *** <i>0.002</i>	0.0017 <i>0.001</i>	0.0014 <i>0.001</i>	-0.0005 <i>0.001</i>	-0.0061 *** <i>0.002</i>	0.0015 <i>0.001</i>	0.0007 <i>0.001</i>
ROA Lag	0.1932 *** <i>0.006</i>	0.2402 *** <i>0.013</i>	0.1821 *** <i>0.009</i>	0.1792 *** <i>0.009</i>	0.1507 *** <i>0.006</i>	0.1476 *** <i>0.013</i>	0.1498 *** <i>0.008</i>	0.1632 *** <i>0.009</i>	0.1809 *** <i>0.006</i>	0.2196 *** <i>0.013</i>	0.1695 *** <i>0.009</i>	0.1737 *** <i>0.009</i>
Sales g	0.0711 *** <i>0.003</i>	0.0773 *** <i>0.005</i>	0.0767 *** <i>0.004</i>	0.0554 *** <i>0.004</i>	0.0685 *** <i>0.003</i>	0.0792 *** <i>0.005</i>	0.0719 *** <i>0.004</i>	0.0490 *** <i>0.004</i>	0.0686 *** <i>0.003</i>	0.0750 *** <i>0.005</i>	0.0748 *** <i>0.004</i>	0.0513 *** <i>0.004</i>
Constant	0.0488 *** <i>0.003</i>	0.0429 *** <i>0.006</i>	0.0597 *** <i>0.005</i>	0.0377 *** <i>0.005</i>	0.0521 *** <i>0.003</i>	0.0556 *** <i>0.006</i>	0.0643 *** <i>0.006</i>	0.0334 *** <i>0.004</i>	0.0767 *** <i>0.013</i>	0.0480 *** <i>0.017</i>	0.0894 *** <i>0.023</i>	0.0773 *** <i>0.019</i>
Sector and Year FE:	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***
Adjusted R ²	7.9%	8.3%	7.6%	6.6%	7.4%	7.7%	7.0%	6.2%	7.8%	8.1%	7.3%	6.6%
F-statistic	174.0 ***	44.8 ***	78.8 ***	51.8 ***	157.6 ***	40.3 ***	70.0 ***	47.2 ***	150.9 ***	39.2 ***	66.8 ***	45.9 ***
<u>PANEL B</u>												
ROA Lag	0.2839 *** <i>0.013</i>	0.4324 *** <i>0.051</i>	0.3908 *** <i>0.024</i>	0.1921 *** <i>0.025</i>	0.1957 *** <i>0.013</i>	0.3242 *** <i>0.047</i>	0.2813 *** <i>0.022</i>	0.1615 *** <i>0.025</i>	0.2411 *** <i>0.013</i>	0.4576 *** <i>0.050</i>	0.3230 *** <i>0.023</i>	0.1554 *** <i>0.025</i>
x Public	-0.0849 *** <i>0.019</i>	-0.0540 <i>0.072</i>	-0.1056 *** <i>0.033</i>	-0.0122 <i>0.043</i>	-0.0501 *** <i>0.018</i>	-0.1007 <i>0.065</i>	-0.0236 <i>0.031</i>	-0.0069 <i>0.039</i>	-0.0652 *** <i>0.018</i>	-0.175 ** <i>0.070</i>	-0.0379 <i>0.033</i>	0.0056 <i>0.041</i>
Sales g	0.0513 *** <i>0.003</i>	0.0287 *** <i>0.008</i>	0.0362 *** <i>0.006</i>	0.0325 *** <i>0.006</i>	0.0504 *** <i>0.003</i>	0.0250 *** <i>0.009</i>	0.0414 *** <i>0.005</i>	0.0238 *** <i>0.005</i>	0.0514 *** <i>0.003</i>	0.0271 *** <i>0.009</i>	0.0429 *** <i>0.005</i>	0.0271 *** <i>0.005</i>
x Public	0.0114 ** <i>0.005</i>	-0.0025 <i>0.012</i>	0.0163 * <i>0.009</i>	0.0022 <i>0.009</i>	0.0121 ** <i>0.005</i>	0.0080 <i>0.012</i>	0.0080 <i>0.008</i>	0.0170 ** <i>0.008</i>	0.0072 <i>0.005</i>	-0.002 <i>0.013</i>	0.0044 <i>0.008</i>	0.0090 <i>0.009</i>
Contant	0.0443 <i>0.001</i>	0.0309 *** <i>0.005</i>	0.0446 *** <i>0.002</i>	0.0336 *** <i>0.002</i>	0.0515 *** <i>0.00</i>	0.0533 *** <i>0.00</i>	0.0503 *** <i>0.00</i>	0.0357 *** <i>0.002</i>	0.0455 *** <i>0.001</i>	0.0356 *** <i>0.001</i>	0.0440 *** <i>0.005</i>	0.0348 *** <i>0.002</i>
Company and Year FE:	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***	Yes ***
Adjusted R ²	10.9%	19.2%	9.8%	15.1%	10.9%	19.8%	9.5%	14.5%	11.3%	20.0%	9.9%	14.6%
F-statistic	2.10 ***	1.48 ***	1.44 ***	1.53 ***	2.09 ***	1.49 ***	1.42 ***	1.51 ***	2.15 ***	1.50 ***	1.44 **	1.51 ***

This holds out through the subsamples we've created for the "pre-crisis" (2005/6), "crisis" (2007/10) and "post-crisis" (2011/13) periods. Curiously, the difference in public firms towards private peers increases in the "crisis" period (-0.89 pp).

However, matching both on TA and TA&ROA shows no statistically significant difference for the public vs. private companies in the whole period, after controlling for investment opportunities and profitability.

Nonetheless, looking to the subsamples, we can see that in the pre-crisis period, there was a difference, which was consistent with the sample matched on ROA, i.e., the public firms invest less than their private peers and the value is quite similar across the three matching criteria.

With the crisis, and after it, the difference disappears. This could signal both that the impact of the crisis was still present in our otherwise classified as "post-crisis" period (in fact if we consider it just as one period the results are the same), or that there was a change in the investment structure across firms.

Albeit this would require further investigation, out of the scope in this study, this can relate to the aforementioned dependency of European private firms to banking financing, unlike their US counterparts, much more relying on capital markets.

This also seems consistent with the results from Equation (3.2) as reported in Table 11, Panel B, which as we referred, splits the "public effect" of equation (3.1), as seen in Panel A, between the profitability/cash-flow and investment opportunities explanatory variables.

Although with some differences in sub periods, for the whole period analysed, all three matching criteria output the a consistent idea, which is that the impact of the public listing status is basically due to the lower ICF sensitivity as, unlike Asker *et al.* (2015), if any, the difference in sensitivity to investment opportunities is higher in public firms.

For instance, in a sample of matched peers on sector and TA, the public firm sensitivity to investment opportunities, for the whole period (2005/13), was 0.0625 (0.0504+0.0121) whilst the private firm was 0.0504. This compares with the 0.028 and 0.118, respectively estimated by Asker *et al.* (2015) for the US in the 2002/11 period.

Looking at sub periods, it seems that the same outcome in the ROA and in the TA matching samples have different origins, as the difference in investment opportunities seems to arise from the “crisis” period in the former and in the “post-crisis” in the latter.

The sample matched by TA&ROA produces no difference in investment opportunities across public or private firms.

Although subjected to discussion, the lower ICF sensitivity in public firms seems consistent with the fact that, at least in the “pre-crisis” period, public firms did invest less than private firms and that with the “crisis”, private firms reduce more their investment.

If private firms are more dependent on the banking sector for financing and have less access to capital markets, then it’s plausible that they can be more dependent on cash-flow to finance its investments. And in fact, with the profitability/cash-flow plunge during the crisis, private firms’ investment is severely affected whilst public firms’ is not, or, at least, is highly lagged (2 years). We do not show these values, but to illustrate, the mean private (public) ROA Lag was 13.3% (12.2%) in 2007 and falls to 10% (9%) in 2009.

European firms have historically been more dependent on banking, which can also explain some of the differences to the US. In fact, a special report from FitchRatings (2013) shows an increase of the bond weight in European corporate funding from a 17% in 2005 to 52% in 2013 (1H). One of the reasons presented is the banking deleveraging trend, on the back of regulatory pressures (e.g. Basel III). Nonetheless, despite the evolution, European firms are still long way until the typical American capital structure where bonds represent [70-80]% of the whole debt.

All-in-all, our results show higher sensitivity to ROA than to investment opportunities, while for US, Asker *et al.* (2015) found opposite results.

6. Conclusions

Only recently the *overinvestment* correction (Jensen, 1986), as an explanation for the evidence that CAPEX falls after the PE entry, started to be questioned, with Sousa and Jenkinson (2013), Bharath *et al.* (2014) and Ughetto (2014) concluding that evidence is, at least, not supportive of that hypothesis, and Asker *et al.* (2015) showing that in US public firms invest less and are less sensitive to changes in investment opportunities than private firms.

Our research goal was twofold: first assess the impact of PE entry in European companies, in recent years, and second, try to compare the investment policies of public and private firms, in order to briefly compare to Asker *et al.* (2015) results for US with European data, and verify empirically the question of public firm *overinvestment* (Jensen, 1986) or *underinvestment* (Stein, 1988) thesis. Both goals are related, as the common explanation for the investment intensity reduction after the buyout is exactly the correction of an *overinvestment*.

Using *Zephyr* and *Amadeus* databases, we have collected a sample of 92 PE entry deals in Europe-28, between 2006 and 2010, and a sample of c. 29 thousand European companies (c. 11 thousand public and 18 thousand private) and tried to answer to the questions: How do investments evolve after the PE entry and what can we conclude from that evolution after controlling matched peers and for the variables that according to the empirical investment literature explain the investment intensity? Do European public firms overinvest their private comparables?

Using the Kaplan (1989) approach we've compared the pre-entry (n-1) with the post entry (n+1 to n+3) investment levels and found some evidence that PE firms invest statistically significant less than their peers, in a period marked by the crisis and where there was a generic trend (sector medians) to reduce investment intensity.

However, this trend is not consistent across different matching criteria and appears only when ROA (after sector) is our matching criteria.

Controlling for the investment intensity standard explainable variables, found in the empirical investment literature, and following Asker *et al.* (2015) methodology, we

found some evidence that only PE firms exhibit positive significant ICF sensitivity. This results, consistent with Ughetto (2014), seem to indicate the existence of financial constraints in PE backed firms.

The literature critiques on the ICF sensitivity interpretation relate to the fact that it should not be considered a measure of the *degree* of financial constraints but a *sign* of its existence: financially constrained firms would have positive and significant ICF sensitivities (Bertoni *et al.*, 2013).

We also found some evidence that after the PE entry, firms become less sensitive to investment opportunities, with sales growth as proxy, which unlike the ICF, is dependent on the matching criteria, in the case, only occurring when peers are matched by ROA. Despite acknowledging that the question can be debatable, and would require further investigation, we present some arguments that support ROA rather than total assets as matching criteria.

Finally we've compared public to private firms in Europe during the last 10 years.

We found some evidence that private firms invested more than their public counterparts before and, under some criteria/matching did it again after the crisis, even if temporarily in some cases. The convergence, during the early crisis years, was caused by significant fall in investment in private firms and not by an increase in public firms (which lag the private counterparts drop by 2 years).

At the same time, we found lower ICF sensitivity in public firms, which seems consistent with the fact that, with the initial stage (2007/08) of the "crisis", private firms reduce their investment whilst public firms did not. If private firms are more dependent on banking financing and have less access to capital markets, then it's plausible that they can be more dependent on cash-flow to finance their investments.

Although with some differences in sub periods, for the whole period analysed, all three matching criteria output the same consistent idea, which is that the impact of the public listing status – it reduces, at least before the crisis, the investment intensity - is basically due to the lower ICF sensitivity as, unlike Asker *et al.* (2015), if any, the difference in sensitivity to investment opportunities is higher in public firms.

In a nutshell, we find some evidence, even though limited, that PE impact negatively firms investment policies due to a mix of increased financial constraints and probably to lower sensitivity to investment opportunities. In any case, we found stronger evidence that the *overinvestment* correction is hardly a valid explanation, as public firms, at least before the crisis, invested less than their private counterparts.

This research has some limitations. The concentration of deals in the “crisis” period seems to considerably “taint” our sample, the ultimate example being the fact that unlike any other research we found no evidence of profitability increase after the entry (by $n+3$). In fact, the period is marked by a significant generalized reduction in investment and profitability, which can to some extent “mask” the PE firm behaviour. Furthermore, our sample of public and private firms, albeit significantly larger than in Asker *et al.* (2015), does not encompass all the sectors nor European countries.

This research leaves several topics for future research, namely: the development of our PE sample, in order to be possible to isolate the “crisis” effect; the analysis of the exit (we were not able to pursue due to the lack of deals with data); a deeper insight on what matching criteria produces better and more consistent results, under more “normalized” economic circumstances; the enlarging of the public/private sample to the whole set of sector codes, the countries influence, as well as a deeper investigation on the differences and its motives to the US.

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Appendix I

Table 12 - Main Studies addressing CAPEX impact on PE backed firms

Author/Year of study	Sample	Findings	Underinvestment vs Overinvestment Hypothesis
Kaplan (1989)	76 US MBOs between 1980-86	CAPEX falls in all 3 years after buyout although not statistically significant. Industry adjusted reductions are larger and significant.	Suggests that indirect evidence given by the fact that market adjusted returns to post-buyout investors is large and significant points to the overinvestment hypothesis .
Smith (1990)	58 US MBOs between 1977-86	CAPEX significantly falls after buyout. CAPEX to Sales also decreases but is not the major cause for the increase in RoA	Not addressed
Muscarella and Vetsuypens (1990)	72 RLBOs from 1983-87 of LBOs occurred 1976-86	RLBO has CAPEX/Sales lower than industry and experienced a decrease in the relative level of CAPEX under private ownership. Decline is most relevant for subsample not engaging in acquisition/divestiture activity.	Not addressed
Holthausen and Larcker (1996)	90 RLBOs from 1983-88 of LBOs occurred 1976-87	Pre IPO LBOs have lower CAPEX than industry but the difference disappears after the IPO, as RLBOs increase CAPEX.	Authors refer to the fact that the increase in CAPEX in RLBOs is consistent with the fact that these firms being cash constrained prior to the RLBO.
Boucly <i>et al.</i> (2011)	839 French LBOs over 1994–2004	CAPEX increased relatively to control groups.	Increase in CAPEX is concentrated in Private to Private deals - evidence of existing financial constraints. In the sub sample of Public to Private, CAPEX reduces, but the difference to control groups is not statistically significant.
(Chung, 2011)	1,009 UK buyouts from 1997 to 2006	Suggests that PE attempts to reorganize target firms in a way which reduces inherent the targets' inefficiencies—agency problems in public targets and investment constraints in private ones	Suggests that public targets suffered from agency whilst private targets from financial constraints - overinvestment hypothesis in case of public firms.
Sousa and Jenkinson (2013)	PE exits: 345 SBOs and 117 IPOs between 2000-07	IPO firms increase CAPEX much more than SBOs	As IPO firms outperform market substantially it is hard to believe that they can do that while overinvesting. Thus the underinvestment hypothesis seems, indirectly, more plausible.
Bertoni <i>et al.</i> (2013)	324 Private Spanish firms that were subject to a VC and PE Investment period 1995–04	VC: reduction in the investment dependency on internal cash flows in SMEs in expansion stage after VC deal PE (buyouts): did not find a significant sensitivity before, whereas a positive value is found after the acquisition.	Mentioned that firms in which leverage increased to finance the acquisition, investments will be constrained to the internally generated funds. Investment rate falls for buyout firms.
Engel and Stiebale (2014)	2239 PE backed SMEs in UK and France spanning from 1998-2007	CAPEX increases and Financial constraints decrease with the PE intervention	Reduction of ICF sensitivities could be reduction in overinvestment. However, effects of PE are much higher for smaller firms - more likely to face financial constraints and less likely to suffer overinvestment.
Bharath <i>et al.</i> (2014)	1981-05 US PE/MBO/Op. plant level data	Investment and Capital decrease after going private.	Overinvestment interpretation is not consistent with productivity not changing in relation to control groups.
Ughetto (2014)	206 low-med tech firms, o/w 108 (private to private) buyouts 1997-04 in FR, UK, IT and SP	ICF Sensitivity rises with buyout. No signif. impact of buyouts on the investment rates in the post-buyout. However, results show a decrease in the Investment of UK firms and an increase in the investment rates French firms.	PE contributes to raising target firms' financing constraints and adversely affect firms' investment rates - more likely to have lower commitments to long-term investments

Appendix II

VBA coding for Matching on Total Assets:

```
Sub macro_sector()
```

```
Sheets("Sector").Select
For i = 2 To 77
    Sheets("Sector").Select
    sector = Range("a" & i)
    Sheets("PrivateTotal").Select
    Range("b1").Select
    Selection.AutoFilter
    Selection.AutoFilter field:=2, Criteria1:=sector
    Range("b2").CurrentRegion.Copy
    Sheets("private").Range("a1").PasteSpecial
    Application.CutCopyMode = False
    Selection.AutoFilter
    Sheets("PublicTotal").Select
    Range("b1").Select
    Selection.AutoFilter
    Selection.AutoFilter field:=2, Criteria1:=sector
    Range("b2").CurrentRegion.Copy
    Sheets("Public").Range("a1").PasteSpecial
    Application.CutCopyMode = False
    Selection.AutoFilter
    Call macro_match
Next
End Sub
```

```
Sub macro_match()
```

```
Sheets("Public").Select
Dim linhaspublic As Integer
linhaspublic = Range("A1048576").End(xlUp).Row
Sheets("Private").Select
Dim linhasprivate As Integer
linhasprivate = Range("A1048576").End(xlUp).Row
If linhaspublic >= linhasprivate Then
    janela1 = "Private"
    janela2 = "Public"
Else
    janela1 = "Public"
    janela2 = "Private"
End If
Sheets(janela1).Select
Do While Range("a2") <> ""
    Sheets(janela1).Select
    If Range("a2") <> "" Then
        Rows("2:2").Select
        Application.CutCopyMode = True
        Selection.Cut
        Sheets("Match").Select
        Range("A1048576").End(xlUp).Offset(1, 0).Select
        ActiveSheet.Paste
        Sheets(janela1).Select
        Rows(2).Delete
        Sheets("Match").Select
```

```

linha = Range("A1048576").End(xlUp).Row
Sheets(janela2).Select
Range("Db1") = "asset ratio"
ultimalinha = Range("A1048576").End(xlUp).Row
For i = 2 To ultimalinha
If Sheets("Match").Range("f" & linha) > Sheets(janela2).Range("f" & i) Then
Range("db" & i) = Sheets("Match").Range("f" & linha) / Sheets(janela2).Range("f" & i)
Else
Range("db" & i) = Sheets(janela2).Range("f" & i) / Sheets("Match").Range("f" & linha)
End If
Next
Range("A2", "db" & ultimalinha).Select
Selection.Sort key1:=Range("db1"), Order1:=xlAscending
If Range("db2") < 2 Then
Rows("2:2").Select
Application.CutCopyMode = True
Selection.Cut
Sheets("Match").Select
Range("A1048576").End(xlUp).Offset(1, 0).Select
ActiveSheet.Paste
Sheets(janela2).Select
Rows(2).Delete
Else
Sheets("match").Select
apagar = Range("A1048576").End(xlUp).Row
Rows(apagar).Delete
End If
End If
Loop
Sheets("Private").Select
Cells.Select
Selection.ClearContents
Sheets("Public").Select
Cells.Select
Selection.ClearContents
End Sub

```

For matching on ROA the approach was the same, with exception of the calliper based criteria, in which we substitute the ratio between the max. (TA) / min. (TA) < 2 (the part in bold) with forcing the difference between ROA's to be less than 2x the min. (ROA):

VBA coding adjustment (replace part in bold) for Matching on ROA:

```

If Sheets("Match").Range("f" & linha) > Sheets(janela2).Range("f" & i) Then
Range("db" & i) = Abs(Sheets("Match").Range("f" & linha) - Sheets(janela2).Range("f" & i))
Else
Range("db" & i) = Abs(Sheets(janela2).Range("f" & i) - Sheets("Match").Range("f" & linha))
End If
Next
Range("A2", "db" & ultimalinha).Select
Selection.Sort key1:=Range("db1"), Order1:=xlAscending
If Range("db2") < 2 * WorksheetFunction.Min(Sheets(janela2).Range("f" & i),
Sheets("Match").Range("f" & linha)) Then

```

Appendix III

Table 13 - Public and Private firms per Country/Legal Form

This Table reports the country and legal form breakdown of our sample of public and private companies, before and after each matching procedure.

Country ISO / Legal Form	All	Matched on NACE 4-digit plus:		
		TA	ROA	TA & ROA
AT	22	20	19	19
Private	22	20	19	19
BE	836	626	657	574
Private	67	59	41	49
Public	769	567	616	525
BG	158	97	108	83
Private	101	46	60	39
Public	57	51	48	44
CZ	449	310	313	277
Private	302	188	192	170
Public	147	122	121	107
DE	461	375	307	336
Private	355	294	219	264
Public	106	81	88	72
ES	1,411	1,015	1,099	947
Private	518	451	377	423
Public	893	564	722	524
FI	415	258	265	240
Private	387	240	242	223
Public	28	18	23	17
FR	8,375	5,861	6,005	5,195
Private	2,906	1,260	1,520	1,118
Public	5,469	4,601	4,485	4,077
GB	1,172	946	760	826
Private	1,029	856	652	748
Public	143	90	108	78
GR	854	730	726	667
Private	20	11	11	10
Public	834	719	715	657
HU	68	49	44	42
Private	67	49	44	42
IE	1			
Public	1			
IT	12,444	6,591	7,186	6,001
Private	9,566	4,326	4,751	3,911
Public	2,878	2,265	2,435	2,090
LV	6	5	4	5
Private	4	4	3	4
Public	2	1	1	1
PL	183	144	137	132
Private	144	114	106	105
Public	39	30	31	27
PT	173	124	127	113
Private	25	23	20	22
Public	148	101	107	91
SE	2,176	1,311	1,266	1,192
Private	2,133	1,277	1,235	1,165
Public	43	34	31	27
SK	233	150	169	137
Private	158	88	104	81
Public	75	62	65	56
Total	29,437	18,612	19,192	16,786