Economics of Leveraged Buyouts: Theory and Evidence from the UK Private Equity Industry

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Abstract

Empirical analysis of a sample of companies with private equity (PE) ownership in the UK shows that PE firms act as deep-pocket investors for their portfolio companies, rescuing them if they fall in financial distress. In contrast, external financing is expensive for companies without PE-ownership in financial distress. The paper builds a model that shows how companies form rational expectations about the costs of financial distress, and how these expectations affect ex-ante policies. The model explains the empirically-observed differences in how companies with and without PE-ownership invest, pay dividends, and issue debt. In particular, the model quantitatively explains the difference in leverage of companies with and without PE-ownership. The model shows that greater tax-shield benefits and superior growth of PE-backed companies can explain 6.4% of the abnormal return of PE firms. The conclusion that follows from the paper, however, is that abnormal returns PE firms cannot be replicated by other investors.

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1 Introduction

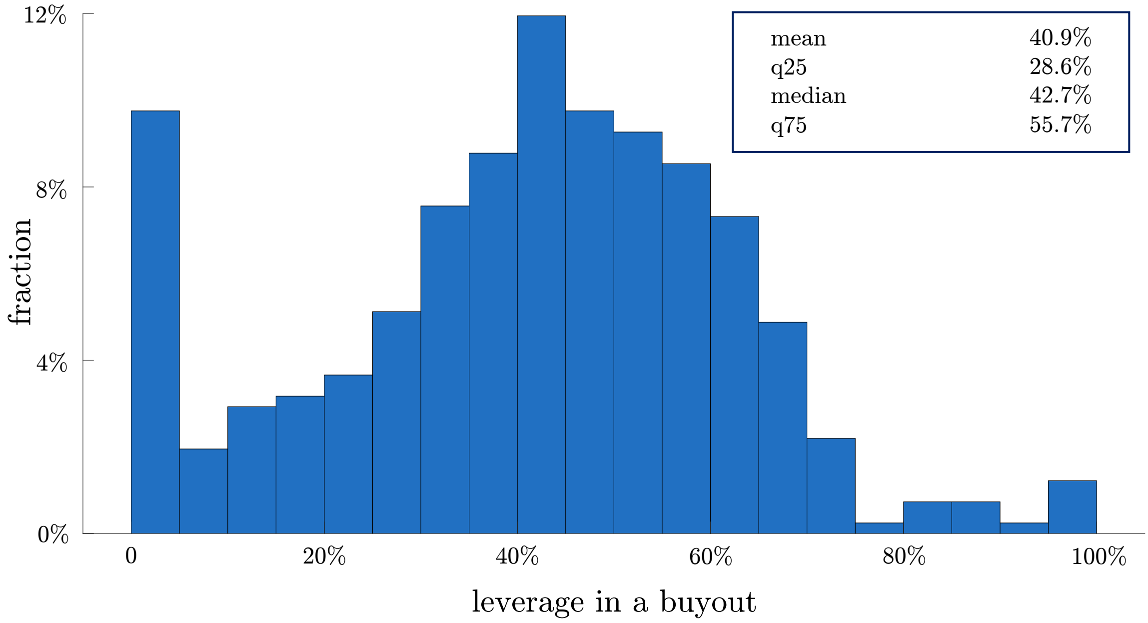
The private equity industry has grown significantly since the early buyouts of the 80s. Nevertheless, our understanding of what happens to companies that are bought by private equity firms is still in its early stages. Due to the scarcity of available data, most academic knowledge is based on small and often biased samples. Similarly, the public understanding of the private equity business model is misguided by several colorful but unrepresentative cases.

To further complicate matters, details of the structure of private equity deals are important. It is well-known that a significant portion of a buyout is financed with debt. What is not known, however, is that the private equity itself is the provider of a large part of the debt. In a typical buyout of £100mln, the private equity pays £60mln, which are split between £10mln equity, and £50mln debt, which is called shareholder loans. Neglecting to account for shareholder loans will overstate the buyout leverage. Neglecting to account for other nuances of the structure of buyouts will similarly bias other conclusions, from investments that companies make, to performance, to dividends, and external financing.

This paper shows results of the analysis of manually-collected information about a representative sample of 407 buyouts in the UK.The analysis is focused on how buyouts are financed and how acquired companies are managed under the PE-ownership. Results show that companies with PE-ownership are significantly less levered than traditionally considered: the average and median leverage for companies in my sample at the time of buyout are 41% and 43%. There are as many companies with leverage below 5% as companies with leverage above 65%. Large companies are more levered than small companies, but average leverage is 52% even among companies that are larger than £200mln. PE-backed companies are still more levered than most other companies, but the difference is not as high as previously thought.

Contrary to some popular opinions, private equity firms are not “over-extracting”, and do not prioritize dividends at the expense of the long-term growth of their portfolio companies. In my sample, 33% of companies receive more money from the private equity owner post-buyout than what they pay in dividends. The number of companies that pay more than what they receive post-buyout is almost the same - 38%. Results show that private equity firms act as deep-pocket investors: when the internal cash flow of their portfolio companies is insufficient to fully finance

Figure 1
Distribution of leverage at the time of buyout

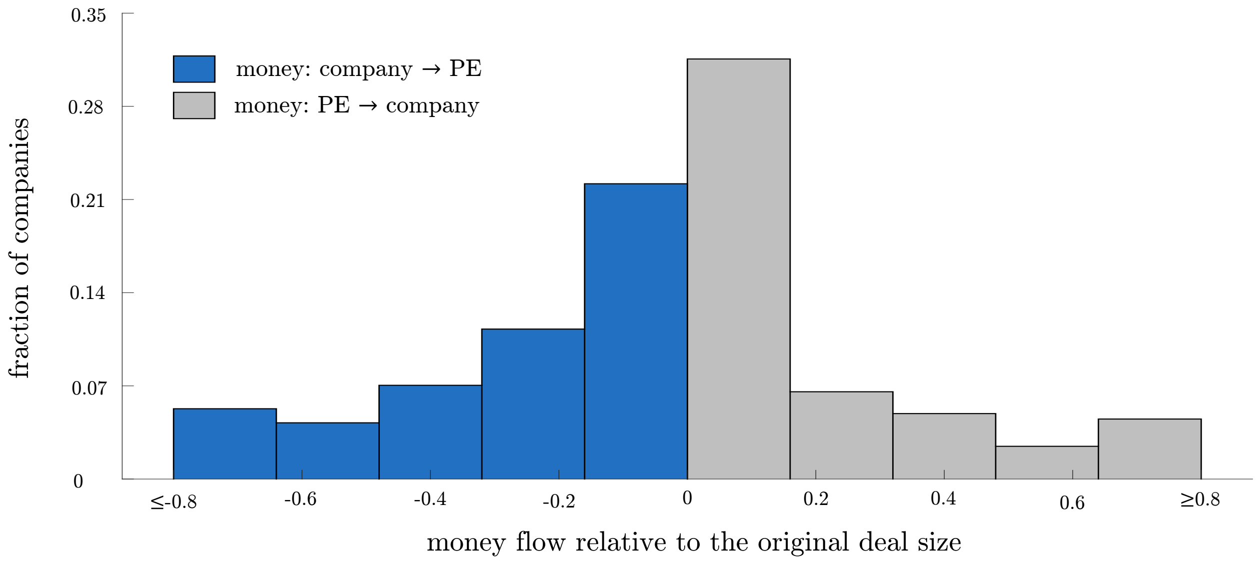


investments and/or make required debt payments, the private equity owner steps in and provides additional capital.

This last observation that private equity firms help their portfolio companies in financial distress by giving them money makes the biggest difference between companies with and without private equity ownership. Most financially distressed companies without private equity ownership rely on expensive debt financing to cover their shortfalls. Those few that manage to issue equity sell their shares at a high discount. Naturally, companies form rational expectations about the severity of financial distress even when they are well-performing. The paper then builds a model that shows how expectations about the costs of financial distress can quantitatively explain the difference in empirically observed policies of companies with and without private equity ownership.

The model assumes that financially distressed companies without private equity ownership can only issue debt if they need external financing. Debt, in turn, is fairly priced in equilibrium and is, therefore, more expensive for companies that have a high default likelihood. Consider what happens to a company without private equity ownership, whose cash flow falls below the level of interest expenses. To avoid bankruptcy, the company has to issue debt to cover the shortfall,

Figure 2
Total money flow between the PE and the company



Total money flow is the difference between the amount of money received by the company from the PE and the amount of money paid by the company to the PE, during the time when the PE controls the company excluding the year when the PE acquires the company, normalized by the buyout size. Negative money flow means the company pays more money to the PE than what it receives from the PE, and positive money flow means the company receives more money from the PE than what it pays to the PE. The figure does not show 29.1% of companies that have zero money flow - those companies that neither pay nor receive money from the PE (therefore, bars on the figure add up to only 0.709).

committing to higher interest expenses in the future. The current cash flow is already insufficient to pay even small interest expenses. It is likely, therefore, that the company will need to issue more debt next period at even higher rates. As a result, financial distress can quickly turn into a debt spiral for a company without private equity ownership. In contrast, companies with private equity ownership do not need to increase their debt if the cash flow is lower than interest expenses. As long as the economic value of the company is positive, the private equity firm will provide money to the company to help it make its interest expenses.

Expectations about the severity of financial distress affect ex-ante leverage choice. Companies without private equity ownership optimally follow a very conservative leverage policy. In the model, the average leverage in a simulated cross-section is only 26%. In contrast, companies with private equity ownership, for whom financial distress is easier to manage, choose a much higher leverage: buyout leverage is 49% in the model. These results align well with empirically observed values of leverage, and resolve one of the long-standing puzzles in the private equity literature.

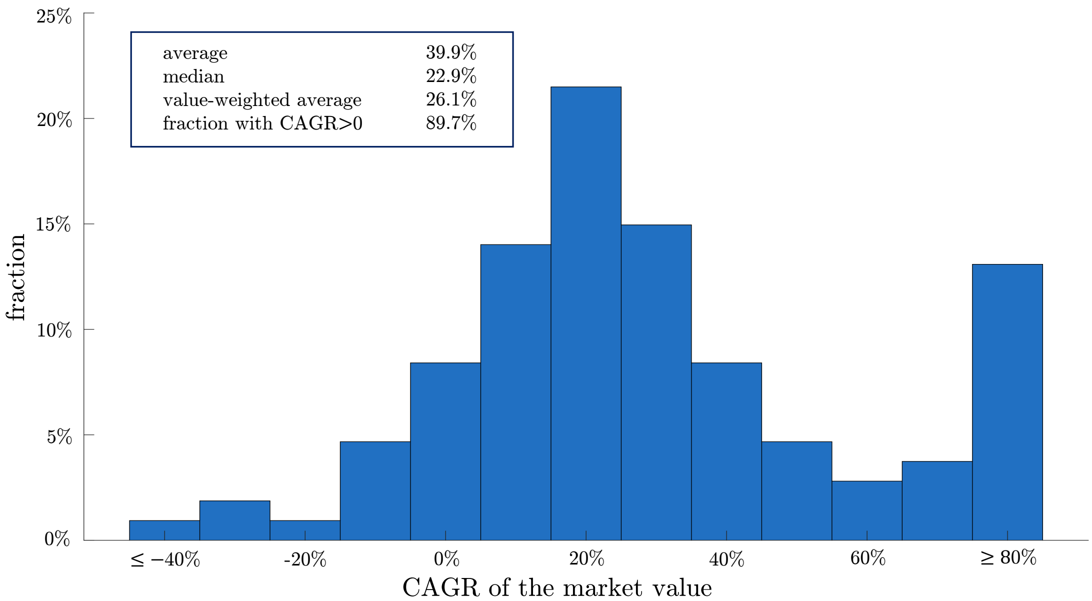
The model says that there should be a difference in investment patters of companies with and without private equity ownership. Specifically, companies without private equity ownership whose leverage exceeds 42% stop investing in large projects that require external financing. Two reasons contribute to this result: 1) debt overhang problem, and 2) expectations of the financial distress, that becomes more likely if the company raises more debt to finance the project. Private equity ownership alleviates both of these problems. As a result, companies with private equity ownership in the model take all investments as long as their leverage is below 79%.

Consistent with the model, empirical results strongly support the fact that companies with private equity ownership make large investments more often. The data shows that, in a sense, buyouts do not stop at the point when a private equity firm acquires a company. Instead, 59.6% of buyouts have a follow-on acquisition, meaning another company is acquired and merged with the first. Among companies that are originally bought for £100mln or more, the frequency of follow-on acquisitions is 76.7%. On average, a company with private equity ownership has one acquisition every 2.5 years. For comparison, the frequency of acquisitions by COMPUSTAT companies in the UK and the US is once every five years.

The model shows that companies with private equity ownership grow faster than companies without private equity ownership. The average growth rates of cash flows of the two groups of companies in the model are 9.6% and 8.9%. The difference is fully explained by the fact that companies with private equity ownership have better access to external financing, and can invest in more large projects. In the data, companies with private equity ownership also grow faster. The median sales growth rate is 10.2% for companies with private equity ownership. In comparison, the median sales growth rate is only 4.5% for a group of companies, which were potential buyout targets, but for which the buyout fell through.

The model partially explains the abnormal returns generated by private equity firms in the following sense. The value of a company is different depending on whether it has private equity ownership or not (because the company will invest more with private equity ownership). Therefore, when a private equity firm buys a company, there is a range of prices at which the buyout can happen. If the private equity industry is small relative to the size of the public market, buyouts should happen at the lowest price that public investors accept. What ends up happening is that the private equity firm pays a relatively small price for a company that produces high dividends after the buyout. Because realized dividends are disproportionately high relative to the purchase

Figure 3
Constant annual growth rate (CAGR) of the market value of PE-backed companies



The figure shows the CAGR of the company value (sum of debt and equity claims, or, equivalently, the value at which the company is bought and sold). CAGR equates to zero the discounted stream of cash flows to all company's investors. Every year, excluding the first and last years, the total cash flow to investors is computed as the sum of debt repaid (positive) and issued (negative), plus all other securities repaid (positive) and issued (negative), plus any dividends or interest expenses (positive). Paper transactions that did not happen (such as certain forms of interest expenses that are not paid but appear on the income statement) are not included. The first-year cash flow is the total acquisition value with a negative sign; the last-year cash flow is the total exit value with a positive sign. CAGR's are only computed for the set of SBO transactions, in which the company is sold from one PE to another.

price, the average realized returns are higher than the discounting rates. The difference between the average realized returns and the appropriate discounting rates is the abnormal return of the private equity investments.

Quantitatively, the model shows that the excess return on a portfolio of companies without private equity ownership (i.e., market) is 5.6%. The excess return on a portfolio of companies with private equity ownership is 13.3%. Companies with private equity ownership, however, are more levered and, therefore, are more exposed to the market risk. Indeed, out of the 13.3% excess return, 6.6% is compensation for market risk, implying beta of 1.2. The remaining 6.7% is alpha, which can further be decomposed into 5.6% part that is due to higher investments, and 1.1% part that is due to higher benefits of tax-shield.

Empirically, numbers unequivocally support the conclusion that companies with private equity ownership outperform companies without private equity ownership. For a subset of companies, for which the exit value is known,[1] the paper measures constant annual growth rate (CAGR) of the company value. CAGR shows the rate at which cash flows to and from investors should be discounted, so that investors are indifferent between investing and not investing in the company. The average return is almost 40%. Smaller companies have a higher CAGR, but value weighted return is still 26%.

Related literature

This paper is related to the line of literature that discusses the capital structure choices of companies, both with and without PE-ownership. The big-picture puzzle is the fact that companies with and without PE-ownership have very different leverage, which is hard to rationalize on the basis of traditional theories. On the side of companies without PE-ownership, Miller (1977) argues that the present value of expected default losses seems disproportionally small relative to the tax-shield benefits of debt, concluding that most companies are, on average, underlevered. Graham (2000) estimates that the value of an average company would go up by 5% if it increased its leverage to the optimal level. This puzzle is known as the underleverage puzzle, and several papers discuss frictions that prevent companies from issuing additional debt (e.g. Faulkender and Peterson (2006)) or propose mechanisms that could rationalize the seemingly-suboptimal behavior (e.g. Chen (2012), Morellec, Nikolov, and Schuroff (2012), or Glover (2016) among others).

The flip side of the underleverage puzzle is the fact that companies with PE-ownership are more levered than most theoretical models predict, and more levered than companies without PE-ownership. For instance, Axelson, Jenkinson, Stromberg, and Weisbach (2013) study a sample of leveraged buyouts and conclude that "there appears to be no discernible relation between leverage in buyout firms and median leverage of public firms in the same industry-region-year, regardless of what leverage measure we use" (see also Gompers, Kaplan, and Mukharlyamov (2015)). Several channels have been discussed in the literature that could explain the high leverage of LBO-transactions. Ivashina and Kovner (2011) emphasize the role of the PE-banking relationship in determining the amount of debt used in a buyout (see also Demiroglu and James (2010)). Berger,

[1]This subsample only includes companies, which were sold by one private equity to another private equity. This exit type is second most frequent in the sample. Therefore, there is certainly some selection bias in returns shown on Figure 3. Some casual evidence suggest that the bias is negative, implying that returns, on average, are higher for other exit types. Degeorge, et. al. (2016) also show that returns for secondary-buyout deals are below average, though they compute equity returns.

Ofek, and Yermack (1997) argue that the optimal capital structure is linked to company's corporate governance, and it has been shown that the corporate governance changes significantly following the buyout (see, for instance, Gertner and Kaplan (1996), Acharya and Kehoe (2008), or Cornelli and Karakas (2008)).

This paper contributes to the discussion of capital structure by proposing a mechanism that quantitatively explains the leverage of companies with and without PE-ownership simultaneously. The paper focuses on the access to external financing in distress. External financing costs increase with company's leverage for companies without PE-ownership, and so they optimally choose to follow conservative leverage policy ex-ante. Companies with PE-ownership, in contrast, can always receive an equity injection from the PE-owner, and so they optimally choose a much higher leverage. Empirically, Hotchkiss, Smith, and Stromberg (2014) show that private equity firms are indeed efficient at resolving the financial distress of their portfolio companies (see also Andrade and Kaplan (1998)).

The mechanism in this paper is most closely related to Elkamhi, Ericsson, and Parsons (2011), who show that if companies experience even modest financial distress costs prior to bankruptcy, they are much more conservative in their ex-ante leverage policy. This paper complements the Elkamhi, Ericsson, and Parsons research by explicitly showing how the financial distress costs can arise if external financing costs increase with company's leverage (through higher default probability), and how private equity firms can mitigate these costs.

This paper is also related to the line of literature that discusses the performance of companies with PE-ownership. The majority of authors agree that PE-ownership positively affects the value of companies, and that companies with PE-ownership have higher operating growth (Harris, Siegel and Wright (2005)), better margins (Kaplan (1989)), greater investments (Chung (2009)), and increased labor productivity (Lichtenberg and Siegel (1990), or Davis, Haltiwanger, Handley, Lipsius, Lerner, and Miranda (2019)). This paper contributes to the literature by showing how better access to external financing in distress can change incentives of PE-backed companies, and how many of the empirical results that above-mentioned papers document can endogenously arise without a direct involvement from the PE-owner.

2 How PE buyouts are structured and why it is important

PE firms are famous for disclosing as little information as possible about their business, and even the information that is sometimes scarcely available should be properly adjusted in order to lead to meaningful conclusions. Two aspects of the structure of a PE-buyout are particularly important for the analysis in this paper: 1) the fact that the majority of money that the PE pays in the buyout is structured as shareholder loans, and is reflected as debt on company's balance sheet, and 2) a complicated parent-subsidiary structure that PE firms create on top of the companies they acquire. This Section discusses these two issues in detail, the proper way to account for them, and why results could be misleading if the specifics of these two issues are ignored.

A. Shareholder loans

A textbook definition of a buyout says that a PE finances the deal by taking some bank debt and investing their own money. In reality, only a small portion of the PE money comes in a form of equity, and the majority comes in a form of debt that is called shareholders loans.[2] To be precise, the PE still controls the majority of company's shares - usually above 80%; the way this is achieved is that company's old shares are purchased using external debt and shareholder loans, and canceled, and a small number of new shares is issued, which the PE buys for a small price. In case when company's management participates in the buyout (which is usually the case), they also mostly receive shareholders loans and a small number of shares.

To illustrate this, consider an example of a company Buckingham Bingo, an operator of bingo clubs in the UK, that was acquired by a PE firm Alchemy Partners in December 2005. The total deal value was approximately £118mln, of which £56mln was a loan from Barclays bank. The remaining £62mln was provided by the Alchemy Partners and the company's management. Of the £62mln, only £1mln was paid for company's shares, and the remaining £61mln were structured as shareholder loans, which were called subordinated debt and loan notes in this particular case. Figure **??** shows the balance sheet of the company in the first annual report that the company filed;

[2]Shareholder loans is a collective name that I use for the rest of the paper to refer to money that PE provided to finance the buyout that was structured as debt. In reality, shareholder loans have all types of names, such as loan notes, bond notes, institutional loans, deep discounted bonds, or supermezzanine debt. Confusingly, debt from private debt providers may also be called this way, and I was carefully to make sure that debt that I identify as shareholder loans is actually the money that was given by the PE and not someone else.

Figure 4
Example of a balance sheet of a PE-backed company

15 Creditors: amounts falling due within one year

2008	£000
Bank loans	2,680

16 Creditors: amounts falling due after more than one year

2008	£000
Bank loans	49,063
Other loans	76,099
Accruals and deferred income	83

17 Creditors – Capital instruments *(continued)*

2008	£000
Barclays Bank Plc	
Facility A: 2.25 % above LIBOR repayable in half-yearly instalments (commenced 30 June 2007).	16,550
Facility B: 2.75% above LIBOR repayable other than by instalments (terminates 15 December 2013).	16,800
Facility C: 3.25% above LIBOR repayable other than by instalments (terminates 15 December 2014).	16,800
Capital expenditure facility: 2.5% above LIBOR repayable in half-yearly instalments (commencing 30 September 2009).	3,921
	54,071
Alchemy Partners Nominees Limited	
Subordinated debt: 18% repayable other than by instalments.	13,531
Loan notes: 10% repayable other than by instalments.	63,138
	76,669
Total loans	130,740

Company Buckingham Bingo, an operator of bingo clubs in the UK, was acquired by a PE firm Alchemy Partners, in December 2005. Balance sheet in the 2008 annual report shows total liabilities of £131mln, but further notes show that half of the securities in the liabilities are issued to Alchemy Partners.

both forms of loans - from Barclays bank and from the Alchemy Partners - are treated as debt.

Shareholder loans are structured as debt for accounting purposes, and have some nominal features of a debt security, such as interest expenses, maturity, and seniority over some other securities in default. Nevertheless, for all practical purposes shareholder loans should be treated as equity. The maturity of shareholder loans is usually above ten years, and it is not uncommon to see shareholder loans with maturity after the year 2050. There are interest expenses associate with shareholder loans, but they are almost always structured as payment-in-kind, which means that interest expenses are added to the face value of shareholder loans every year instead of being paid out. In fact, because large amount of bank debt is usually used to finance buyouts, companies are restricted from making any payments on shareholder loans - including interest expenses - before the bank debt is repaid. Furthermore, shareholder loans are usually junior unsecured, which means that they are only senior to equity in case of bankruptcy. Since the PE itself is the holder of the shareholder loans, the company will never default on the shareholder loans. It is quite often that shareholder loans are partially or completely written off or converted into equity if company's financial position deteriorates.

In fact, most companies controlled by PE are pretty straightforward that the majority of liabilities on their balance sheet are not real. Here is how one such company, All3Media, acquired in 2007 by a PE firm called Permira, describes the shareholder loans in its first annual reports:

> *"The bulk of investment from Permira and management is through unsecured Subordinated Preference Sertificates ("SPC's") which carry a rolled up interest coupon with all interest and principal only repayable in 2016 or on sale or listing of the Group. These are treated as debt instruments and account for over £20.2 of the accrued interest costs but do not represent a cash flow strain on the company"*

It is an open question why PE firms structure their stake in a form of shareholder loans rather than equity. One such reason might be that interest expenses on shareholder loans are subtracted from the pre-tax profit on the income statement, and can potentially reduce the amount of taxes the company pays. Tax-laws, however, are complicated, and not all interest expenses on shareholder loans are tax-deductible. In particular, at least one company was discussing in its annual report that it had legal disputes with HM Revenue & Custom (agency responsible for tax collection in the UK) regarding the tax relief that the company claimed for "interest payments on certain loans". Another reason is that shareholder loans allow the PE to be formally considered a creditor, albeit a very junior, in bankruptcy proceedings, and participate in negotiations with company's other creditors.

The preference of PE firms to structure their money as shareholder loans, and the fact that shareholder loans are formally considered as debt on the balance sheet, should significantly affect how the information that is reported by PE-backed companies is analyzed. Start with the income statement. Because shareholder loans have interests - usually very big - the amount of interest expenses that companies claim they pay on the income statement significantly overestimates what they actually pay. An average company in my sample claims that interest expenses make up 64% of its gross profit (EBITDA), while the actual interest expenses they pay are 2.5 times as small (27% of EBITDA).

Furthermore, interest expenses on shareholder loans that companies claim but do not pay create a problem with analyzing information from company's balance sheet: liabilities constantly grow year-over-year because interest expenses on the shareholder loans are rolled up to their face value. Furthermore, in cases when company's performance deteriorates, shareholder loans can be reevaluated, converted into equity, or written off - partially or completely. That affects the balance sheet value of both liabilities and shareholders' equity, without any actual cash flow from investors.

Not only the original PE-investment is structured in a form of shareholder loans, but also the subsequent equity injections by the PE take this form. Moreover, the dividends that PE-backed companies pay to the PE are also structured as a repayment of shareholder loans, or payment of interest expenses on shareholder loans. In contrast, what sometimes appears as dividends on the cash flow statement is usually dividends to join ventures or to the minority shareholders[3].

To be completely clear, shareholder loans and interest expenses on shareholder loans are by far not the only features that make the analysis of PE-backed companies complicated. For instance, buyouts usually have large transaction costs - of the order of millions of pounds. Oddly enough[4], PE-backed companies capitalize transaction costs on the balance sheet - as goodwill on the left-hand side and as liabilities or shareholders equity on the right-hand side - and amortize them later on. This paper specifically focuses on the cash flows between the company and its investors, and so I carefully examine shareholder loans for each company I consider (see the data description section below). However, any further analysis of PE-backed companies should adjust for other specifics of PE-buyouts depending on the focus of the analysis.

B. Parent-subsidiary structure

The second important issue of every PE-buyout is the structure of the acquisition. In order to finance an acquisition, the PE create a complicated vertically integrated parent-subsidiary chain of holding companies. The PE ultimately controls the company at the top of the structure, and the company at the bottom of the structure acquires and controls the target company, which is then called the operating company. Companies in the middle issue different types of securities to investors, and the money they raise is transferred through inter-company loan down the structure to finance the buyout. Of the companies that issue securities and receive money from investors, those that are closer to the bottom of the chain (and, therefore, closer to the operating company) issue securities with higher seniority. For instance, the company closest to the operating company

[3]Minority shareholders are shareholders of companies, in which the PE-backed company controls more than 51% of the stake but less than 100%

[4]Though I have to admit I do not know if companies that are not controlled by PE do a similar thing with transaction costs

issues bank debt, company slightly above issues corporate bonds (if corporate bonds are used to finance the structure), the company closer to the top issues shareholder loans, and the company at the very top issues equity.

There are different reasons why PE firms prefer to follow such obscure structure. Tax-optimization is certainly one of the reasons, according to industry professionals. Other than that, I saw several companies, for which some of the intermediary holding companies were established outside of the UK, and the company later expanded the business to those regions. The fact that holders of senior debt prefer to be closer to the bottom of the chain implies that bankruptcy considerations are another factor. This later point is supported by Ayotte (2019), who theoretically shows how complex levels of company structure arise when investors disagree about the value of assets that back loans.

Understanding the parent-subsidiary structure is important to properly analyze the business of PE-backed companies. Conceptually speaking, the acquired company is liable for the debt that was used to finance the buyout: its cash flow is used to repay the debt, and its assets are used as the collateral. Nevertheless, the balance sheet of the acquired company does not change much following the buyout[5] because, formally, debt is issued by one of the parent companies. Every company in the chain files their own annual report after the buyout, with their own balance sheet and income statement.

Therefore, it is not the target company that should be analyzed, but all companies in the chain collectively. Fortunately, UK laws require that at least one company files a consolidate report for the whole group. The consolidated report shows all securities that are issued by any member of the group, and all money earned and spent. Therefore, it is the company that files consolidate reports that should be analyzed, and not the operating company, or any other individual company in the chain.

There is one big advantage, for research purposes at least, of the parent-subsidiary structure. A new company is incorporated for every buyout, and the company begins the annual reporting from scratch. This means that every dollar that is used for the buyout - whether that dollar comes from a bank, a private debt provider, the PE, or company's managers - is reflected on the balance sheet of the new company, and nothing else is. Therefore, by adding up the values of all securities on the balance sheet of the company based on the first report it files, it is possible to recover the

[5]To be precise, it does change significantly, but mostly because most things on the balance sheet are reevaluated.

value of the company at acquisition, which otherwise would not necessarily be publicly available.

3 Empirical results

3.1 Sample selection and data sources

Preqin and UK companieshouse

This paper focuses on PE-backed companies incorporated in the UK because all companies in the UK[6] - public and private - are required to file annual reports. These reports, with some rare exceptions, include balance sheet, income statement, and cash flow statement, and, thus, allow to see how companies are being managed after they are acquired by private equity firms. Scanned versions of these reports are publicly available on the UK companieshouse web-site.[7]

I use Preqin database to construct an initial sample of companies. The focus of this paper is on buyouts, and, therefore, I filter the Preqin sample to exclude all deals that are not classified as buyouts or public-to-private transactions. In particular, VC (Venture Capital) and PE-growth deals are excluded. Only deals, in which the acquired company is in the UK, and in which the PE-sponsor has already exited the company, are included. Deals, in which the PE controls the company for less than a year are only included if the acquired company published at least one report while it was controlled by the PE. I take the following information from Preqin: the name of the acquired company, the name of the PE firm, the dates of investment and exit, and the type of exit.

The resulting Preqin sample has 2174 deals. Each deal represents one company, from the year it is bought by a PE, and until the year the PE exits the company. Some deals involve the same company, in case one PE sells the company to another PE, or in case the same company is bought several times in different years.

Buyouts have an obscure structure, with a lot of tax-optimization and financial engineering involved, as explained in the previous section, and as is also discussed below. Due to the level of complexity, simple aggregation of reported information is misleading, and so each deal that is studied in this paper is analyzed individually. Naturally, it required a lot of time and efforts,

[6]Generally everywhere in Europe, though UK in particular is the focus of this research
[7]https://www.gov.uk/government/organisations/companies-house

Table 1
Sample of companies in Preqin vs. analyzed in this paper

	Panel A: Industries						
	Consumer & Retail	Industrials	Business Services	Information Techn.	Healthcare	Telecoms & Media	Food & Agriculture
whole sample	24.2% (526)	23.4% (508)	15.1% (329)	11.9% (259)	8.3% (181)	5.2% (114)	4.5% (98)
sample in this paper	22.2% (91)	20.6% (84)	16.2% (66)	8.4% (34)	10.1% (41)	6.1% (25)	4.7% (19)
	Energy & Utilities	Materials	Clean Techn.	Real Estate	Infra-structure	Unspecified	Total
whole sample	2.9% (63)	1.6% (34)	1.1% (24)	0.8% (17)	0.7% (16)	0.2% (5)	2174
sample in this paper	3.7% (15)	1.5% (6)	2.2% (9)	0.7% (3)	3.2% (13)	0.3% (1)	407
	Panel B: Exit type						
	Trade Sale	SBO	Default/ Restruct.	Sale to mngm.	IPO	Unspecified	Other
whole sample	42.4% (921)	26.7% (581)	3.9% (84)	3.17% (69)	2.5% (54)	16.5% (358)	4.9% (107)
sample in this paper	40.9% (167)	35.3% (144)	4.2% (17)	2.9% (12)	3.2% (13)	6.9% (28)	6.6% (27)
	Panel C: PE-sponsors (top 7 in the whole sample)						
	LDC	CVC	3i	Equistone	Livingbridge	Cinven	Graphite
whole sample	4.0% (98)	3.3% (81)	3.0% (74)	2.9% (70)	2.1% (52)	1.8% (43)	1.7% (42)
sample in this paper	5.9% (27)	0.9% (4)	3.5% (16)	4.6% (21)	1.8% (8)	0.9% (4)	1.1% (5)
	Panel D: Investment year						
	before 1990	1990-1999	2000-2003	2004-2007	2008-2011	2012 - 2015	after 2015
whole sample	4.0% (88)	14.2% (309)	15.5% (336)	31.1% (677)	20.1% (437)	13.2% (288)	1.8% (39)
sample in this paper	0% (0)	9.6% (39)	15.7% (64)	32.1% (131)	21.8% (89)	18.1% (74)	2.7% (11)
	Panel E: Exit year						
	before 1990	1990-1999	2000-2003	2004-2007	2008-2011	2012 - 2015	after 2015 & no data
whole sample	0.6% (13)	4.1% (89)	4.7% (103)	18.7% (406)	14.6% (317)	25.9% (563)	31.5% (683)
sample in this paper	0% (0)	1.5% (6)	4.7% (19)	20.6% (84)	13.5% (55)	30.4% (124)	29.4% (120)
	Panel F: Investment length						
	< 1 years	1-2 years	3-4 years	5-6 years	7-8 years	9-10 years	>10 years or no data
whole sample	1.2% (27)	15.6% (340)	25.4% (553)	23.4% (509)	13.3% (290)	5.7% (123)	15.3% (332)
sample in this paper	0% (0)	14.0% (57)	33.3% (136)	28.2% (115)	15.7% (64)	3.7% (15)	5.1% (21)
	Panel G: Size in USD mln (based on Preqin)						
	< 1	1-50	50-100	100-200mln	200 - 1000	> 1000	no data
whole sample	0.3% (6)	24.5% (532)	10.1% (220)	9.3% (202)	11.5% (251)	3.5% (77)	40.8% (886)
sample in this paper	0% (0)	22.3% (91)	13.2% (54)	15.0% (61)	15.4% (63)	2.9% (12)	31.1% (127)

This table shows how a sample of PE-led buyouts analyzed in this paper compares to the sample of all PE-led buyouts in the UK, based on the information from Preqin database. Only 410 buyouts are analyzed because the analysis of each requires a long of data hand-collection. “whole sample” refers to all 2174 buyouts, and “sample in this paper” refers to 408 transactions analyzed in this paper. Numbers in the table show the fraction of deals in a specific category, and numbers in brackets show the number of deals in that category; for instance, 526 deals in the whole sample are in the Consumer & Retail industry, which makes 24.2% of all deals in the whole sample. In Panel B, “Trade Sale” is the exit type, in which the PE sells the company to another company; “SBO” is the exit type, in which the PE sells the company to another PE. Panel C has PE that have the most deals in the whole sample.

and instead of analyzing the whole sample of 2174 deals, I only analyzed a subsample of 407 deals. To ensure representativness of the subsample, names of all acquired companies were sorted alphabetically and analyzed from top down. While I skipped some deals, the eventual subsample is representative of the full Preqin sample, as Table 1 shows.

The analysis of deals is based on the annual reports filed by the acquired companies, and information from the reports was corroborated by news articles in some cases. In order to obtain the reports, I matched names of acquired companies as reported in Preqin to the UK companieshouse web-site. Preqin only reports approximate names, and the legal names might be slightly (or significantly) different, i.e. All3Media vs. All3Media Holdings Limited, or Amtech vs. DeFacto 1731 Limited. Furthermore, as discussed in the previous Section, a whole parent-subsidiary structure is created to finance the acquisition, and all companies in the structure have similar names. Therefore, I manually search for each company on the UK companieshouse web-site, and then identify the ultimate parent company that published the consolidated financial reports.

Once a company is matched to the UK companieshouse web-site, I see its tax-identification number. The tax-identification numbers can be used to link companies to the AMADEUS database, which has some of the information from the reports. I rely on AMADEUS data for some of the variables that are later used in the analysis, such as sales or SIC number. Nevertheless, the majority of information is manually collected, by a company called Qynn, and by two research assistants and I.

Acknowledging the support of Qynn

Established in 2017, Qynn provides in-depth financial analysis, research and data on UK companies. The data within Qynn is generated from a number of public data sources including several UK Government Departments which Qynn then aggregates to create proprietary information and insight on 5.5 million UK companies stretching over 20 years. With more than 100 million data points a week being added to the system, Qynn updates in real time.

Qynn's help was mostly used to collect the data that is reported in a standardized form in annual reports and is incorrectly classified by other data providers. One good example is the interest expenses paid by companies with PE-ownership. As the previous subsection discusses, shareholder loans have massive interest expenses that are recorded on the company's income statement, but are rarely paid to the holders of shareholder loans. By analyzing the data from the statement of cash flows instead of the income statement, Qynn was able to identify the interest expenses that were actually paid, and separate those from PIK-structured interest expenses on the income statement.To show the significance of this adjustment, the accrued interest expenses that an average company in the sample reports are 2.4 times larger than the interest expenses it pays.

In total, Qynn was able to provide 30,685 data points to help with this research against a total of 407 UK companies at an average of 75 points per company. In addition, Qynn also identified a small, but significant number of instances where annual accounts had been presented, and then later restated.

Manually-collected data

Many important aspects of the structure and financing of buyouts are reported in a way that does not allow for automatic analysis, and, hence, required the careful reading of the reports. Therefore, I, with the help of two research assistants, examined the reports and hand-collected specific information. First, we studied the balance sheet of each company to identify which securities are actual external debt, and which securities are shareholder loans. In some cases it was easy, when the company explicitly discussed the holders of the securities it issued (as in the example of Figure 4). In other cases, companies did not explicitly say that certain loans were provided by the PE, but it was clear from other discussions in the report.[8] In other cases, especially for larger transactions (i.e. transactions above £1bln), identifying shareholder loans was harder or even impossible, because there were too many securities on the balance sheet. For instance, company Debenhams was acquired by a group of Private Equity firms in 2003 in a £1.7bln public-to-private transaction. The first report filed by this company shows the following securities on the balance sheet: three types of senior term loan, property mortgage, deep discounted bonds, and high yield notes, with no further explanation.[9] For some of such cases, including the Debenhams buyout, we found news articles that discussed the transaction and how much debt was used to finance it; using these news articles, we were able to identify the shareholder loans on the balance sheet based on which securities added up in value to the correct amount.

The second type of information we hand-collected is the flow of external financing between the company and its investors, in years following the buyout but before the PE exited the company. In particular, we collect information on how much external debt is issued and repaid every year, how much money the company receives from the PE, and how much money the company pays to the PE. There are two types of payments that companies make to the PE. The first is what would

[8]For instance, the company could discuss that it received £10mln from its shareholders, and a certain type of securities increased by £10mln in that year

[9]All these securities are shown in liabilities. Money raised by selling shares is less than £5mln

traditionally be considered as dividends. These payments are not structured as dividends, though, and instead take a form of repayment of shareholder loans and/or accrued interest expenses on shareholder loans. This type of payments we always observe and record.

The second type of payments is what's collectively called monitoring fees. Monitoring fees can take different forms; for instance, the PE may appoint several directors to the company's board, and charge annual payments for their service (in addition to the salary that is paid directly to the directors). Monitoring fees do not always exist, and, similar to interest expenses on shareholder loans, they sometimes accrue instead of being paid. Monitoring fees appear early on the income statement, usually as a part of COGS or SG&A expenses. Theoretically, companies are required to disclose all such payments, but there seem to be cases, in which there is no information about such fees, even though the fees were likely paid. It is, therefore, possible, that we sometimes underestimate the frequency of the monitoring fees. Nevertheless, as the following Section shows, these fees are much smaller than other payments the company makes to the PE.

At last, we manually collect information about the exit value for deals that ended with the company being sold by a PE to another PE. This type of exit is the second most common exit type in my sample, constituting 35% of all exit types. The reason why the exit value can be computed for these deals and not for others is because, as discussed in the previous Section, a new chain of holding companies is created for every buyout. The first consolidated report filed by the ultimate parent company of the new group, therefore, allows to back out the buyout amount. Therefore, by finding the new ultimate parent of the company after it is sold by one PE to another, we can find the value that was paid for the company. This is generally not possible for other exit types.

Comparison with companies without PE-ownership

Understanding how companies with PE-ownership operate is important because of the large number of companies that are owned by private equity firms. Equally important, however, is understanding how companies with and without PE-ownership are different from each other. The problem with comparing two group of companies is the endogenous nature of PE-ownership: private equity firms do not choose acquisition targets randomly. Therefore, any difference between companies with and without PE-ownership can be attributed to the presence of the PE-owner, as well as to unobserved factors that influenced the decision of private equity firms to buy certain companies.

One approach to partially address the selection bias would be to analyze a group of comparable companies - that is, a group of companies without PE-ownership that are similar based on observed characteristics to the sample of companies with PE-ownership. In the context of private equity, however, such approach is, at best, complicated, and can often be misleading. First, private equity firms extensively study potential target companies before the buyout, and analyze large amount of public and private information. Most of this information - think of customer concentration, supply chain management, or quality of the management team - is company-specific and rarely observable, and, hence, cannot be conditioned on in making a comparable group. Variables that are observable by a researcher, such as size, sales growth, or profitability, in practice explain less than 10% of the selection choice.

Second, numbers reported by companies with and without PE-ownership are not readily comparable before appropriate adjustments. As discussed in the previous section, some of the accounting practices of PE-backed companies are unusual. For instance, intangible capital constitutes 60% of the total value of assets, on average, among companies with PE-ownership. Therefore, matching companies using book value of assets, or any moment that involves the book value of assets (such as profitability), is a statistical exercise before one understands what goes into intangible capital, or how intangible capital evolves over time. Intangible capital is one example; many other adjustments that companies with PE-ownership make should be taken into account before a reasonable group of comparable companies can be constructed.

In the absence of a clear group of matched companies, I compare companies with PE-ownership to two very broad group of companies: 1) all companies in COMPUSTAT Global that are incorporated in the UK (referred as "UK" companies later in the paper), and 2) all companies in COMPUSTAT North America (referred to as" US" companies later).[10] I acknowledge that there is a limit to how much can be concluded from comparing these two group of companies, and, therefore, "US" and "UK" numbers are mostly interpreted as a benchmark in the following subsections. Nevertheless, even though the two group of companies are different, it does not mean that they are completely incomparable. Where appropriate, regressions include year fixed effects and company or industry fixed effects, to account for the fact that private equity firms target unevenly target certain companies. Furthermore, it is often clear, at least qualitatively, what other factors and to

[10]Both for the period between 2000 and 2019.

what extent can account for the observed difference between the two group of companies.

At last, all hand-collected data about companies with PE-ownership that is used in this paper is publicly available on the author's web-site. This makes it easy for anyone with specific views on the direction of the selection bias to compare the group of companies in this paper against another group of companies.

3.2 Capital structure and external financing

A. Buyout leverage

According to the UK accounting rules, securities are added to the balance sheet at the value that the company receives when it issues them. Therefore, I measure deal size by adding up the values of external debt, shareholder loans, nominal value of shares, and share premium, as shown in the first report filed by the company post-buyout. Since, as discussed in the previous Section, a new parent company is created for the purpose of buyout, all securities in its first report were issued to finance the buyout, meaning I do not occasionally overestimate the deal value[11] by considering securities that could have been issued by the company before the buyout. To measure the buyout leverage, I divide the amount of external debt (i.e. all debt excluding shareholder loans) in the first report by the deal amount.

PE-backed companies are significantly less levered than traditionally thought. As Table 2 indicates, the average leverage in a PE-transaction is only 41%, and the median leverage is 43%. To put it into perspective, there are as many companies with leverage below 5% (40 companies), as companies with leverage above 65% (42 companies).

The data shows that larger deals have greater leverage. As follows from Table 2, the average and median leverage increase by roughly 10 percentage points if the deal size is restricted to be above £100mln, and even more if the deal size is restricted to be above £200mln. Nevertheless, the mean and median leverage are below 60% even among deals that are larger than £200mln. It is not infrequent to see large transaction that have very small amount of debt; for instance, PE firm Epiris acquired a footwear producer Beaconsfield Footwear in 2015 for approximately £165mln with only £40mln of debt.

[11] To be precise, the value of these securities might be affected by what happens between the buyout and the date report is filed, which are, on average, seven month apart. I discuss later how this can affect the results.

There is s substantial time-variation in leverage values. Deals that were financed prior to the 2008 financial crisis used more debt than deals financed during or after the crisis, and the difference in leverage is roughly 10-15 percentage points. A part of the time-variation in leverage values, especially when deals are broken down into size groups, can likely be explained by the fact that I do not correct deal size for inflation. Therefore, deals above £100mln prior to 2008 are larger than deals above £100mln after 2011; as noted above, larger deals have greater leverage. The time-variation in leverage is also consistent with the argument of Axelson, et. al (2008) that economy-wide credit conditions determine the buyout leverage. Nevertheless, leverage rarely exceeded 60% even before 2008.

The results about average leverage seem to be in contrast with findings of other authors, most of whom report that the leverage of PE transaction is usually above 60%. A number of factors could contribute to the fact that the value of leverage I find is lower than what other authors find.

First, I might underestimate the leverage value because companies file the first report some time after the buyout, on average eight month. Therefore, I do not observe the portion of debt that was used to finance the buyout and repaid during this period. This probably does not affect results much, because the majority of debt that is used to finance buyouts is structured in a way that only a small fraction of it is repaid annually.[12]. More importantly, I might also overestimate the value of shareholder loans (and, therefore, the total deal value) by the amount of interest expenses on shareholder loans that accrue to the face value over the period after the buyout and before the first report is filed.

It is unlikely, however, that debt repayments and interests on shareholder loans in the first seven months after the buyout can fully account for the difference in average leverage in this paper and in other papers. Another problem might be coming from the nature of databases that are frequently used to study the capital structure of buyouts. Several papers used AMADEUS database, but as the previous subsection discusses, AMADEUS does not distinguish between external debt and shareholder loans. In fact, as Figure 5 illustrates, the average and median leverage increase by 20 percentage points if measured incorrectly, by divining reported debt by the total value of assets, as reported in the first post-buyout year.

LPC/Dealscan is another database that is sometimes used to study the leverage of LBO transac-

[12]That does not include interest payments, which are usually quarterly, but do not change the face value of debt

Table 2
Leverage

Panel A: Size

	mean	q25	q50	q75	min	max	N
size	£133.5 mln	£23.0 mln	£50.8 mln	£120.3 mln	£3.6 mln	£4.4 bln	410

Panel B: Leverage

	mean	q25	q50	q75	N
whole period					
all companies	40.9%	28.6%	42.7%	55.7%	410
size > £50mln	46.3%	34.7%	47.2%	59.9%	206
size > £100mln	49.7%	39.9%	52.9%	63.1%	125
size > £200mln	51.7%	41.1%	57.3%	63.5%	66
years 2011 - 2019					
all companies	30.3%	15.7%	32.2%	41.1%	118
size > £50mln	36.6%	29.7%	36.7%	41.1%	53
size > £100mln	38.2%	30.1%	39.9%	42.3%	32
size > £200mln	41.1%	30.2%	40.8%	50.5%	15
years 2008-2010					
all companies	36.6%	23.5%	38.8%	46.9%	85
size > £50mln	39.4%	23.9%	42.4%	54.3%	46
size > £100mln	44.2%	33.8%	42.9%	56.3%	26
size > £200mln	45.7%	37.0%	42.9%	56.1%	12
years 2000-2007					
all companies	49.6%	42.5%	51.2%	62.3%	171
size > £50mln	55.3%	46.8%	58.2%	64.8%	91
size > £100mln	57.9%	50.9%	60.6%	66.2%	58
size > £200mln	58.5%	52.9%	62.5%	66.5%	25
before 2000					
all companies	43.9%	34.6%	49.3%	55.9%	36

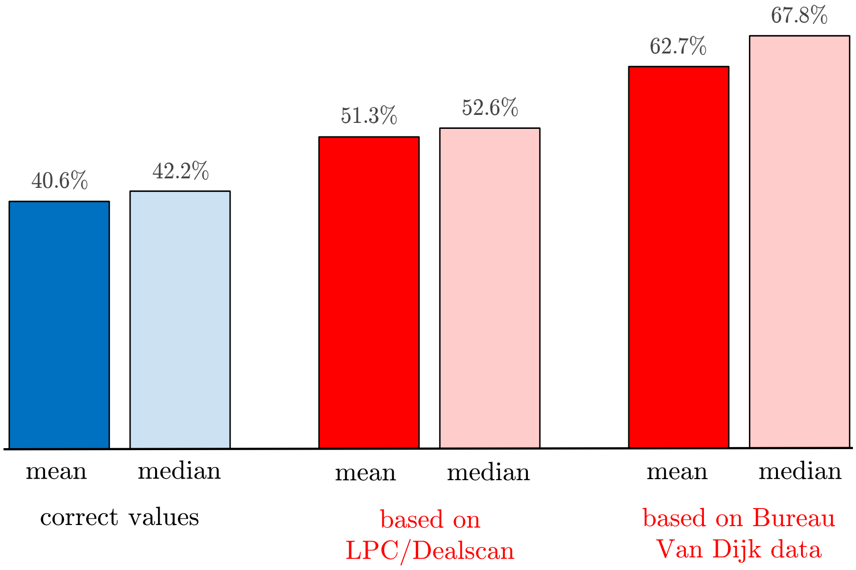
Panel C: Comparison with the LPC/Dealscan database

	mean	q25	q50	q75	N
leverage, whole period					
in LPC	51.3%	40.6%	52.6%	62.1%	89
in LPC & size > £50mln	52.7%	41.3%	54.4%	63.0%	81
in LPC & size > £100mln	53.5%	41.3%	55.7%	63.7%	61
in LPC & size > £200mln	53.2%	43.2%	55.8%	64.3%	35
size, whole period					
all companies	£133.1mln	£22.9mln	£50.5mln	£119.8mln	410
in LPC	£290.0mln	£90.5mln	£147.0mln	£287.5mln	89

All numbers in this table are computed based on the first report that a company files after the buyout, which is usually six month after the buyout. Size is the amount of money paid to acquire the company, and is inferred from the sum of the value of all securities issued to finance the buyout. Leverage is the ratio of company's debt to the buyout size, and company's debt is computed as the sum of all securities that were issued to parties other than the PE and company's management (most often to banks, more rarely to private debt providers and to public investors). LPC/Dealscan is a database that is often used to study the leverage of PE-buyouts."in LPC" refers to deals in the sample, which also have information in the LPC/Dealscan database. q25, q50, and q75 refer to the corresponding quantiles of the distribution, and N is the number of observations.

tions. LPC/Dealscan has reliable information about external debt (i.e. debt only includes external debt, and does not include shareholder loans), but, as most authors acknowledge, it has a selection bias towards larger deals with more debt. Indeed, among 410 companies in my sample, only 76 are also in the LPC/Dealscan database and have information about debt issuance in the buyout

Figure 5
Leverage based on the data from several commonly-used databases



The first pair of bars shows the mean and median values of leverage in PE-buyouts based on the manually collected data (in total, 410 deals). Refer to text, and also notes to Table 2, for details of how leverage is computed. The second pair of bars uses the same information, but restricts the sample to those deals that also have information about debt issuance in the LPC/Dealscan database (in total, 89 deals). The third pair of bars restricts the original sample to those deals that also have information in the AMADEUS database (in total, 381 deals). In addition, AMADEUS data (total debt and total assets), rather than hand-collected data, is used to compute the leverage for the third pair of bars. See text for the discussion of the difference between values in the first, second, and third pair of bars.

year[13], and these companies have significantly higher average leverage than other companies.

B. Debt management post-buyout

In order for the PE to earn money on their investments, one of the two things should happen. Either their portfolio companies should reduce the amount of debt that was used to finance the buyout in the first place, or the value of the company should increase. This and next sections analyze the empirical evidence in favor and against both of these alternatives.

A textbook description of the life-cycle of a PE-backed company states that company's cash flow is primarily used to repay the debt that was used to finance the buyout; by the time the PE exits the company, all or most of the debt is repaid, therefore, naturally increasing the value of equity and generating "healthy" returns on equity capital.

The data does not support this narrative. To show this, I compute how the value of debt on the balance sheet of PE-backed companies changes year-over-year. As Table 3 shows, PE-backed

[13]Other 50 companies are in the LPC/Dealscan database but have no records about debt issuance in the year when the buyout happens, and other 300 companies are not in the database.

companies have more debt by the time the PE exits the company than what they had at the time of the buyout. On average, the value of debt grows by 20% between the acquisition and the exit years, from 41% relative to the deal value in the acquisition year to slightly less than 50% in the exit year. This big increase in leverage is mostly driven by smaller companies; yet, even large companies do not reduce their amount of debt.

Furthermore, in the majority of cases, the debt that is used to finance the buyout is not even structured to be repaid out of the company's cash flow. Aside from interest expenses, only a small portion of the debt has any face value repayments before the maturity. The maturity, in turn, is usually more than five years after the buyout, implying that it exceeds the expected exit time of the PE that usually plan to exit the company withing three-five years. Having said this, most of the debt that is used for acquisition has a clause that says that the debt should be immediately repaid in case of the PE sells the company to a new owner.

Even though the absolute amount of debt that PE-backed companies have increases, the overall leverage - that is the value of debt over the value of the company - seems to go down, at least for those companies, for which the exit value is known. For this subset of companies, I compute the leverage in the exit year, which is the value of debt the company has in its last year divided by the value at which it is sold to the new owner, vs. the leverage in the buyout. As Table 3 shows, the leverage at exit is only 26%, down 16 percentage points from the acquisition year. All in all, among the two alternatives that say that the PE generate money by repaying the debt vs. by increasing the value of the assets, the first has very little support in the data.

The fact that the PE-backed companies start and finish with roughly the same amount of debt implies that they either have static capital structure, or that they issue and repay roughly the same amount of debt. Further analysis of the data shows that the capital structure of PE-backed companies is anything but static.

PE-backed companies frequently issue debt following the acquisition year. In fact, as Table 3 shows, almost 70% of companies issue debt at least one more time, and more than 40% of companies issue debt at least twice. This pattern is consistent among small and large companies, with 72% of companies with the value above £100mln, and 68% of companies with the value below issuing debt at least once after the buyout year.

The size of the follow-on debt issuance is also significant. For each company, I compute the total

Table 3
Debt management

PanelA: Amount of debt several years after the acquisition (relative to the original deal size)

	mean	q25	q50	q75	N
all companies					
acquisition year	41.2%	29.2%	43.1%	55.8%	388
exit year	49.5%	20.1%	39.4%	61.5%	388
size > £50mln					
acquisition year	46.6%	34.7%	47.4%	59.9%	196
exit year	50.1%	26.7%	45.3%	62.9%	196
size > £100mln					
acquisition year	49.8%	39.9%	51.9%	63.1%	120
exit year	49.4%	28.4%	48.7%	66.2%	120
size > £200mln					
acquisition year	51.5%	41.4%	56.3%	63.3%	65
exit year	52.3%	35.4%	51.1%	66.8%	65
companies with known exit value					
acquisition year, D_0/V_0	41.1%	28.3%	42.2%	52.9%	107
exit year D_{end}/V_0	60.5%	29.4%	44.9%	67.7%	107
exit year, D_{end}/V_{new}	25.9%	10.6%	18.4%	30.4%	107

Panel B: Frequency of follow-on debt issuance

	1	2	3	≥ 4	0	N
all companies	112	78	40	38	120	388
size > £50mln	52	44	20	20	60	196
size > £100mln	30	28	16	12	34	120
size > £200mln	19	16	6	9	15	65

Panel C: Total size of follow-on debt issuance (for companies with at least one debt issuance)

	mean	q25	q50	q75	N
all companies					
rel. to original deal size	51.7%	7.4%	24.6%	65.6%	268
rel. to original debt amn.	575.1%	18.9%	60.5%	178.7%	256
size > £50mln					
rel. to original deal size	42.3%	6.3%	22.2%	65.9%	136
rel. to original debt amn.	188.7%	13.1%	49.1%	148.4%	133
size > £100mln					
rel. to original deal size	40.8%	6.3%	22.9%	65.7%	86
rel. to original debt amn.	100.8%	12.0%	49.4%	136.2%	84
size > £200mln					
rel. to original deal size	36.4%	6.2%	21.5%	62.9%	50
rel. to original debt amn.	100.9%	13.3%	49.1%	109.0%	49

Numbers in the table are based on acquisitions, in which the PE controls the company for at least two years. q25, q50, and q75 denote corresponding quantiles of the distribution, and N shows the number of observations. Panel A compares the amount of debt that a company has in the year when it is acquired by a PE (acquisition year), and when it is sold by the same PE (exit year). *companies with known exit value* only include companies that are sold from one PE to another, as exit value is not known for most other transactions. Follow-on debt issuance is any debt issuance that happens after the buyout year. In Panel B, frequency of follow-on debt issuance is the number of years that have non-negative debt issuance (excluding the acquisition year but including the exit year if debt is issued in the exit year). "0" is the number of companies that issue no debt after the buyout year. In Panel C, only companies that have at least one follow-on debt issuance are considered. Total size of follow-on debt issuance is the amount of money received from all follow-on debt issuances, normalized by either the buyout size, or by the amount of debt issued to finance the buyout. Debt repayments are not included in the calculation, and numbers are not discounted if a company has several follow-on debt issuances. Some buyouts are financed with no debt (original debt amount is 0), which explains the mismatch in the last column of Panel C.

Table 4
Debt issuance by companies with PE-ownership post-buyout

	Amount of debt added		Amount of debt repaid		Change in debt	
	I	II	III	IV	V	VI
distress	0.02*	−0.01	−0.00	−0.00	0.01	−0.01
t-stat	(1.74)	(−0.42)	(−0.50)	(−0.21)	(1.22)	(−0.41)
acquisitions	0.58***	0.47***	−0.33***	−0.32***	0.58***	0.51***
t-stat	(26.10)	(4.13)	(−15.92)	(−3.25)	(26.70)	(4.37)
CAPEX	0.40**	0.30	−0.18***	−0.13	0.38***	0.26
t-stat	(14.04)	(1.56)	(−7.46)	(−0.95)	(13.46)	(1.40)
debt repaid	0.71***	0.63***				
t-stat	(24.83)	(7.23)				
debt added			0.47***	0.43***		
t-stat			(24.83)	(6.98)		
money from the PE	−0.41***	−0.43***	0.38***	0.44***	−0.50***	−0.57***
t-stat	(−10.84)	(−4.06)	(12.43)	(5.38)	(−13.50)	(−5.71)
money to the PE	0.62***	0.68***	−0.21***	−0.21***	0.63***	0.69***
t-stat	(18.89)	(7.01)	(−6.93)	(−2.64)	(19.39)	(6.69)
cash flow	−0.14***	−0.27***	0.13***	0.15**	−0.19***	−0.31***
t-stat	(−4.88)	(−3.23)	(5.63)	(2.29)	(−6.71)	(−3.20)
sales growth$_{(t-1)\to t}$	0.00	0.00	0.00*	0.00	0.00	−0.00
t-stat	(1.24)	(0.36)	(−1.71)	(−1.26)	(1.23)	(0.83)
log(DealValue)	0.01***		−0.00*		0.01***	
t-stat	(2.70)		(−1.69)		(2.84)	
deal leverage	−0.03*		0.09***		−0.06***	
t-stat	(−1.86)		(6.12)		(−3.13)	
N	1270	1270	1270	1270	1270	1270
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Company FE	No	Yes	No	Yes	No	Yes

Regressions are based on company-year observations from 351 companies for years when they were controlled by PE. Observations from the first year are always excluded; that is, if a company is acquired and controlled by a PE for three years, only observations from the second and third years are included in the regressions. LHS variable is: I and II) the amount of debt issued (positive if debt is issued and zero otherwise), III and IV) the amount debt repaid (positive if debt is repaid and zero otherwise), V and VI) difference between issued and repaid debt."distress" is a dummy variable that equals one if company's cash flow is below interest expenses. "money from the PE" shows the amount of money the company receives from the PE. "money to the PE" shows the amount of money paid by the company to the PE. " "Sales growth" measures sales growth between the current and the previous year. "DealValue" is the amount that was paid for the company at the time of buyout, and "deal leverage" is the fraction of the deal value that was financed by debt. All variables, except sales growth, log($DealValue$), deal leverage, and dummy variables, are based on the information from the cash flow statement, and are scaled by the deal value. "debt added", "debt repaid", "money from the PE", "money to the PE", and sales growth are winsorized at 1% and 99% levels. Positive values of "acquisitions", "CAPEX", and "debt repaid", and "money to the PE" indicate cash outflows; that is, debt repaid of 10 implies that debt value decreased. Positive value of "debt added" and "money from the PE" indicate a cash inflow, that is, debt added of 10 implies that debt value increased. Specifications II, IV, and VI, have errors clustered at the company-level. *, **, and *** indicate significance at the 10%, 5%, and 1% level.

amount of debt that it issues over all years following the acquisition year (excluding the acquisition year). For an average company that issues debt at least once after the acquisition year, the total additional debt that it issues exceeds 50% of the original deal value. More strikingly, it is almost six times as large as the amount of debt issued to finance the buyout, though this is probably driven by companies which issued very little debt originally. Yet, for the median company the total additional amount of debt issued after the acquisition year is still 60% of the debt amount issued to finance the buyout.

Every time a company issues a significant amount of debt, it usually discusses the rationale in its annual report. Some of the reasons that companies often mention include one of the following. First and foremost, the loan that the PE and the bank agree on to finance the buyout usually includes the CAPEX and/or working capital facility, which are not fully drawn down at the time of the acquisition, but are available to the company down the road. If the company decides to take on that debt later, it is shown on the cash flow statement as debt issuance. Second, as the following section shows, PE-backed companies frequently acquire other companies, and debt is often issued to finance these follow-on acquisition. Third, companies sometimes refinance their original debt, by taking on new debt - often from a different bank - and fully repaying the old debt. Debt refinancings usually happen when credit conditions improve, and often come together with what is called dividends recapitalization, when a part of the proceeds from new debt issuance go to pay dividends to the PE.

C. Flows between the company and the PE

The presence of shareholders' loans, and more generally the tendency of PE-backed companies to structure their stake as debt rather than equity, has implications for how the flow of money between the company and the PE should be analyzed. In the majority of cases when the PE injects additional equity into the company, it is structured as new shareholders' loans. Similarly, whenever there are some dividends paid, they are structured as repayments of shareholders' loans or repayments of accrued interests on shareholders' loans.

In addition to receiving the money from PE in a form of shareholders loans, PE-backed companies very often report some small proceeds from equity issuance. These proceeds usually come from the company's management. Very often, PE-led buyouts involve the managers of the company; usually the managers pay for their shares at the time of the buyout, but sometimes they do it later, and that is reflected as proceeds from equity issuance on the cash flow statement.

Distinguishing the money coming from the PE and from the management is important: equity injections by the PE indicate that the company needs external financing as well as more generally gives information about the role of the PE in managing the company. Shares issued to the management tell very little about whether the company needs external financing. Therefore, when I describe the frequency of the transfer of money between the company and the PE below, I only

Table 5
Eequity injections

Panel A: Frequency of follow-on equity injections

	1	2	3	≥ 4	0	N
all companies	89	47	23	9	220	388
size > £50mln	51	23	14	4	104	196
size > £100mln	26	11	10	4	62	120
size > £200mln	14	10	5	2	34	65

Panel B: Total size of follow-on equity injections (for companies with at least one equity injection)

	mean	q25	q50	q75	N
all companies					
rel. to original deal size	28.1%	4.2%	10.7%	28.6%	168
rel. to original eq. amn.	69.9%	7.4%	20.9%	50.5%	168
size > £50mln					
rel. to original deal size	18.4%	3.5%	9.3%	22.7%	92
rel. to original eq. amn.	71.5%	6.7%	19.0%	43.7%	92
size > £100mln					
rel. to original deal size	20.8%	2.8%	8.8%	22.5%	58
rel. to original eq. amn.	96.4%	6.8%	19.8%	44.9%	58
size > £200mln					
rel. to original deal size	27.2%	3.2%	6.2%	22.5%	31
rel. to original eq. amn.	59.2%	6.8%	14.8%	74.7%	31

Panel C: Total money flow between the company and the PE

	N	fraction	mean	q25	q50	q75
all companies (N = 388)						
total flow $\neq 0$	275	70.9%	-14.1%	-19.2%	-0.7%	10.1%
total flow > 0	127	32.7%	25.1%	5.6%	11.7%	27.1%
total flow < 0	148	38.2%	-47.7%	-0.4%	-17.7%	-40.8%
size > £50mln (N = 196)						
total flow $\neq 0$	136	69.4%	-1.8%	-16.2%	-0.1%	9.3%
total flow > 0	67	34.2%	18.2%	4.1%	9.3%	22.8%
total flow < 0	69	35.2%	-21.2%	-3.0%	-15.3%	-31.4%
size > £100mln (N = 120)						
total flow $\neq 0$	82	70.9%	-0.1%	-17.0%	0.2%	9.3%
total flow > 0	43	35.8%	19.1%	3.9%	8.7%	21.9%
total flow < 0	39	32.5%	-22.4%	-2.9%	-18.6%	-34.4%
size > £200mln (N = 65)						
total flow $\neq 0$	44	67.7%	1.5%	-14.4%	0.6%	8.6%
total flow > 0	23	35.4%	21.9%	3.9%	7.9%	21.9%
total flow < 0	21	32.3%	-21.0%	-1.9%	-18.6%	-34.4%

Numbers in the table are based on acquisitions, in which the PE controls the company for at least two years. q25, q50, and q75 denote corresponding quantiles of the distribution, and N shows the number of observations. Follow-on equity injection is any transfer of money from the PE to the company that happens after the acquisition year, but does not include small but frequent inflows of money from stock compensations (see text for details). In Panel A, frequency of follow-on equity injections is the number of years that have non-negative equity injections (excluding the acquisition year but including the exit year if there is an equity injection in the exit year). "0" is the number of companies that receive no equity injections after the buyout year. Total size of follow-on equity injections is the amount of money received across all follow-on equity injections, normalized by either the buyout size, or by the amount of equity issued to finance the buyout. Dividends and/or other repayments are not included in the calculation, and numbers are not discounted if a company has several follow-on equity injections. In Panel C, total money flow is the total size of follow-on equity injections minus any money paid by the company to the PE in a form of interests expenses and/or repayments of shareholder loans: negative total money flow means the company pays more money to the PE than what it receives from the PE, positive total money flow means the company receives more money from the PE than what it pays to the PE, and zero total money flow means that company neither pays, nor receives any money from the PE between the acquisition and exit years. Total money flow does not include small monitoring/service fees that companies sometimes pay to the PE, see text for details. *total flow* $\neq 0$ only shows numbers for companies that have non-zero total money flow, and similar for *total flow* > 0 and *total flow* < 0.

count issuance and repayment of loan notes. At the same time, when I describe the total amount of money provided in a form equity, I count issuance of both new equity and loan notes. Even though issuance of shares to the management constitutes the vast majority of all instances of equity issuance in number, they are still orders of magnitude smaller than the combined amount of money that companies receive from the PE in a form of equity, in those rare cases when the PE stake is structured as equity.

PE-backed companies often receive additional financing from the PE: as Table 5 indicates, almost 45% of PE-backed companies received some additional money from the PE at least once after the acquisition year. Bigger companies receive money from the PE more often, though not by much: among companies than are smaller than £100mln, 41% receive additional PE money vs. 48% among companies larger than £100mln.

The amount of equity injections is also big. An average company, which receives money from the PE at least once, receives the amount of money that equals 28% of the original buyout value, or 70% of the original equity value. The distribution of these additional equity injections is very skewed, with a few firms receiving a lot of money, and many firms receiving smaller amount. Indeed, as Penal B of the Table 5 indicates, that three quarters of companies receive the amount of money from the PE that is below the mean.

I do not systematically collect information on why the PE provides additional financing to the company. Nevertheless, based on my reading of the reports, companies usually mention two potential reasons why they receive money from the PE. First, they would sometimes receive money for follow-on acquisitions. Follows-on acquisitions are usually financed through debt issuance, but if a company has several follow-on acquisitions throughout the course of several years, the later follow-on acquisitions are usually financed by the money that the PE provides. This observation seems to indicate that the PE-backed companies have some target leverage.

The second - very frequent and important reason - explaining why the PE gives money to the company is rescue in distress, when the PE would provide money to the company because company's cash flow is not enough to make required debt payments. This is usually - though not always - accompanied by changes to the debt structure of the company. It seems likely that in cases like this the PE renegotiates company's debt with creditors. An example is useful here; company Amtico International was acquired by the PE firm "AAC Capital" in an approximately £100mln transaction financed by different forms of debt. As usual, there were certain covenants associated with the debt that was used for the acquisition, and the company breached those covenants in 2009. Here is what the company reports in its 2009 annual report:

> “On 13 November 2008, deep discounted bonds with an issue price of £30,024,000 were transferred by the registered holder, ABN Amro Bank MV, to AAC Capital Nebro Fund I LP, the majority investor, for a consideration of £41,637,000. The deep discounted bonds were then repaid and redeemed by AAC Capital Nebro Fund I LP through the issue of PIK loan notes with a value of £41,637,000. ”

The direct equity injections of the type that I observe is not the only way for PEs to provide equity to the company. What also happens sometimes is the PE may attempt to repurchase the public debt of the company, if public debt was used to finance the buyout in the first place. This would usually happen if company’s financial position deteriorates after the buyout, and price of debt falls as the result. By repurchasing company’s debt, the PE effectively reduces the indebtedness of the company and helps it recover its financial health. Since such transactions are off-balance sheet, there is no way of learning about them from annual reports of companies.

To further investigate the capital flows between the PE and the company, I construct the money flow variable. This variable adds up all money that is provided by the PE to the company, and subtracts the money paid by the company to the PE, every year after the acquisition year (excluding the acquisition year) and before the company exits the company. The positive money flow means that the PE invests more money into the company than what it receives from it before selling the company, and negative flow means that the company pays more money to the PE. Zero money flow means that there is no transfer of money between the company and the PE.

As it turns out, there is almost the same number of companies with negative, positive, and zero money flows: 33% of companies receive more money from the PE than what they pay to the PE, 38% pay more than what they receive, and 29% neither pay no receive any money from the PE. Surprisingly, as the size of the company increases, fewer companies have negative money flow (pay money to the PE), and more companies have positive money flow (receive money from the PE). Among companies smaller than £100mln, 41% have negative money flow and 31% have positive money flow, while among companies larger than £100mln 36% of companies have positive money

Table 6
Money flow between the company and the PE

Money flow:	PE → company: dummy		PE → company: amount		company → PE: amount		Net flow	
	I	II	III	IV	V	VI	VII	VIII
distress	0.17^{***}	0.12^{**}	0.04^{***}	0.04^{***}	0.01	0.00	0.04^{***}	0.04^{**}
t-stat	(4.90)	(2.50)	(5.45)	(2.79)	(0.74)	(0.16)	(3.94)	(2.10)
acquisitions	0.48^{***}	0.45^{***}	0.24^{***}	0.25^{***}	-0.12^{***}	-0.13^{**}	0.36^{***}	0.37^{***}
t-stat	(6.93)	(2.92)	(14.50)	(2.77)	(−6.97)	(−2.09)	(17.39)	(5.07)
CAPEX	0.26^{**}	0.05	0.06^{***}	0.02	-0.05^{**}	−0.08	0.11^{***}	0.10
t-stat	(2.81)	(0.46)	(2.60)	(0.50)	(−2.14)	(−1.49)	(3.92)	(1.31)
debt issued	−0.06	−0.08	-0.04^{***}	−0.03	0.11^{***}	0.09	-0.15^{***}	−0.12
t-stat	(−1.26)	(−0.92)	(−4.01)	(−1.08)	(9.35)	(1.24)	(−11.38)	(−1.24)
debt repaid	0.22^{**}	0.45^{***}	0.18^{***}	0.23^{***}	0.06^{***}	0.06	0.13^{***}	0.17^{*}
t-stat	(2.54)	(3.41)	(8.90)	(3.06)	(2.66)	(0.90)	(5.18)	(1.80)
cash flow	−0.03	−0.09	0.00	−0.01	0.09^{***}	0.02	-0.07^{***}	−0.03
t-stat	(−1.05)	(−1.06)	(0.67)	(−0.65)	(11.92)	(0.56)	(−8.20)	(−0.66)
sales growth$_{(t-1)\to t}$	0.01	0.00	0.00^{**}	0.00	0.00	−0.00	0.00	0.00
t-stat	(0.81)	(0.01)	(2.48)	(0.04)	(0.66)	(−0.18)	(1.50)	(0.30)
log(DealValue)	0.03^{**}		0.00		0.00		0.00	
t-stat	(3.15)		(1.25)		(0.33)		(0.80)	
deal leverage	0.04		0.00		-0.07^{**}		0.06^{***}	
t-stat	(0.71)		(0.05)		(−4.49)		(3.58)	
N	1270	1270	1270	1270	1270	1270	1270	1270
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Company FE	No	Yes	No	Yes	No	Yes	No	Yes

Regressions are based on company-year observations from 351 companies for years when they were controlled by PE. Observations from the first year are always excluded; that is, if a company is acquired and controlled by a PE for three years, only observations from the second and third years are included in the regressions. LHS variable is: I and II) dummy variable showing whether there is an inflow of money from the PE to the company in a given year, III and IV) the amount of money the PE provided to the company in a given year (positive if there is equity injection and zero otherwise), V and VI) the amount of money paid by the company to the PE (positive if there is a payment and zero otherwise), VII and VIII) money given by the PE to the company minus the amount of money paid by the company to the PE (positive if the company receives more money than pays, negative if pays more than receives, and zero if neither). Amount of money paid by the company to the PE does not include monitoring fess that companies sometimes pay to the PE. LHS variables for specifications III - VIII are winsorized at 1% and 99% levels. "distress" is a dummy variable that equals one if company's cash flow is below interest expenses. "Sales growth" measures sales growth between the current and the previous year. "DealValue" is the amount that was paid for the company at the time of buyout, and "deal leverage" is the fraction of the deal value that was financed by debt. All variables, including from the LHS, except sales growth, log($DealValue$), deal leverage, and dummy variables, are based on the information from the cash flow statement, and are scaled by the deal value. Positive values of "acquisitions", "CAPEX", and "debt repaid" indicate cash outflows; that is, debt repaid of 10 implies that debt value decreased. Positive value of "debt issued" indicates a cash inflow, that is, debt issued of 10 implies that debt value increased. Specifications II, IV, VI, and VIII have errors clustered at the company-level. *, **, and *** indicate significance at the 10%, 5%, and 1% level.

flow, and 33% of companies have negative money flow.

The evidence about money flow completely refutes one of the traditional stories of the PE business. It is often argued that the PEs prioritize short-term gains over long-term benefits of their portfolio companies, and use every single opportunity to squeeze out all the resources withing the company to benefit their shareholders. This is not true: not only PEs do not take away company's resources, they are actively contributing resources to the company.

Table 7
Unconditional statistics about investments

Panel A: Size of CAPEX

	relative to sales			relative to EBITDA			relative to cash flow		
	PE	UK	US	PE	UK	US	PE	UK	US
mean	7.7%	10.4%	14.5%	39.1%	30.5%	35.0%	35.5%	34.4%	44.7%
q25	1.2%	1.1%	1.7%	7.0%	3.7%	0.9%	6.2%	1.4%	-0.3%
q50	2.9%	2.9%	3.9%	22.8%	19.0%	22.5%	23.4%	21.2%	27.9%
q75	7.2%	7.1%	10.7%	50.4%	45.9%	53.9%	48.9%	57.4%	73.6%
N	1709	23857	121117	1715	23850	120954	1666	23838	120970

Panel B: Size of follow-on acquisitions (for observations with non-zero acquisitions)

	relative to sales			relative to EBITDA			relative to cash flow		
	PE	UK	US	PE	UK	US	PE	UK	US
mean	13.3%	15.4%	15.2%	64.0%	57.9%	57.9%	79.5%	71.4%	75.2%
q25	0.5%	0.5%	0.5%	2.4%	2.2%	1.6%	2.8%	1.6%	1.4%
q50	2.6%	2.6%	2.7%	20.1%	16.2%	13.7%	21.6%	18.7%	16.5%
q75	12.6%	9.9%	11.0%	70.5%	61.7%	62.2%	72.7%	78.2%	81.2%
N	450	6629	41048	450	6628	41017	434	6628	41005

Panel C: Frequency of follow-on acquisitions

	all companies			size > £50mln			size > £200mln		
	PE	UK	US	PE	UK	US	PE	UK	US
mean	13.3%	15.4%	15.2%	64.0%	57.9%	57.9%	79.5%	71.4%	75.2%
q25	0.5%	0.5%	0.5%	2.4%	2.2%	1.6%	2.8%	1.6%	1.4%
q50	2.6%	2.6%	2.7%	20.1%	16.2%	13.7%	21.6%	18.7%	16.5%
q75	12.6%	9.9%	11.0%	70.5%	61.7%	62.2%	72.7%	78.2%	81.2%
N	450	6629	41048	450	6628	41017	434	6628	41005

"US" refers to the data from COMPUSTAT North America, and "UK" refers to the data from COMPUSTAT Global for companies that are headquartered in the UK. Observations with sic in the range 6000-6999 (financial services and institutions), with sic above 9000 (public administration), and with assets or sales below one million are excluded. "PE" refers to the main sample of companies in this paper. For all companies, CAPEX and acquisition numbers are taken from the cash flow statements. Numbers in Panel A are winsorized at 0.5% and 99.5% values. Panel B only includes company-year observations for which acquisition value is positive and not missing. Additionally, Panel B excludes all observations in the acquisition year for "PE" companies. In Panel C, frequency of acquisitions for "US" and "UK" companies is the number of years, for which the acquisition value is not zero and is not missing, divided by the total number of years that the company is in COMPUSTAT. Acquisition frequency is computed similarly for "PE" companies, except that the acquisition year is always excluded; for instance, if a company is controlled by a PE for three years, and it has an acquisition in the second year, but not the third year, acquisition frequency is 0.5. q25, q50, and q75 refer to corresponding quantiles of distribution, and N denotes the number of observations.

3.3 Investments and performance

A. Investments

There are two types of investments that companies report: usual capital expenditures, which most companies have every year, and infrequent but large acquisitions. Companies report these two types of investments separately on the cash flow statement, as CAPEX and acquisitions. While CAPEX size is probably correctly reflected on the cash flow statement, a word of caution should be mentioned about acquisitions. The cash flow statement only reflects the actual amount of money paid for acquisitions, which in some cases may underestimate their actual size for two reasons.

First, if a portion of the acquisition is financed through equity (that is, the target company receives shares in the new company), the equity amount will not be reflected on the cash flow statement. Second, if a company with some amount of debt is acquired, and debt is not repaid during the acquisition, then only the part paid in cash will be shown on the cash flow statement. Both of these concerns are negligible in the case of PE-backed companies: additional acquisition are almost never paid for by giving an equity stake in the new company to the owners of the acquired company, since the PE prefers to have concentrated control in their portfolio company. Furthermore, in my experience of reading through the annual reports, companies acquired through follow-on acquisition rarely have debt, and whenever they do have debt, it is usually repaid during the acquisition.

Table 7 shows how the size of CAPEX and acquisitions is different between companies with and without PE-ownership. The results suggest that if there is any difference in the size of investments between companies with and without PE-ownership, it is probably small. Indeed, the Table implies that CAPEX is greater for US-based companies without PE-ownership when CAPEX is measured relative to sales and the cash flow, but smaller when CAPEX is measured relative to EBITDA. Acquisitions follow a similar pattern: they are slightly smaller for US- and UK-based companies without PE-ownership when measured with respect to EBITDA and cash flow, but are slightly smaller when measured relative to sales.

What is different, however, is the frequency of having an acquisition. I measure acquisition frequency for each company without PE-ownership as a fraction of years with positive acquisition amount relative to the number of years the company has data for. I measure acquisition frequency for PE-backed companies similarly, with the exception that for each company in my sample I exclude the first year (that is, if a company is in my sample for five years, I measure acquisition frequency as the number of years with non-negative acquisition between years 2-5, and divide that by 4). I do not include the first year of observation for PE-backed companies because it always has a positive acquisition amount, which simply reflects the original buyout.

The data shows that PE-backed companies have follow-on acquisitions much more often than companies without PE-ownership. A company in the UK on average has one acquisition every five years, and a company in the US has one acquisition every three and a half years. At the same time, a PE-backed company in the UK has one acquisition as often as once every two and a half year.

Furthermore, the follow-on acquisitions are more frequent for larger companies, and more so for

Table 8
Conditional statistics about investments

			LHS variable: CAPEX			
	PE	PE	US	US	UK	UK
cash flow$_{(t\ -\ 1)}$	-0.11^{***}	0.01	0.05^{***}	0.02^{***}	0.04^{***}	0.02^{***}
t-stat	(-7.24)	(0.45)	(36.87)	(9.87)	(14.87)	(5.44)
distress	0.01	0.00	-0.01^{***}	-0.00^{***}	-0.00	-0.00
t-stat	(1.32)	(0.70)	(-14.61)	(-3.37)	(-0.27)	(-0.75)
leverage	0.00		0.02^{***}		0.02^{***}	
t-stat	(0.33)		(23.03)		(9.71)	
log(Size)	0.01^{***}		-0.00^{**}		0.00^{***}	
t-stat	(5.63)		(-2.06)		(5.84)	
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Company FE	No	Yes	No	Yes	No	Yes
N	1379	1379	99064	99064	20011	20011
			LHS variable: Acquisitions			
	PE	PE	US	US	UK	UK
cash flow$_{(t\ -\ 1)}$	0.06^{**}	0.08	0.02^{***}	0.02^{***}	0.01^{***}	0.01^{***}
t-stat	(2.26)	(1.40)	(14.07)	(12.51)	(4.29)	(4.09)
distress	0.01	0.01	-0.01^{***}	-0.00^{***}	-0.01^{***}	-0.00^{***}
t-stat	(0.86)	(0.51)	(-9.42)	(-3.11)	(-5.08)	(-2.70)
leverage	0.02		0.01^{***}		0.01^{***}	
t-stat	(1.07)		(14.41)		(4.24)	
log(Size)	0.01^{***}		0.00^{**}		0.00^{***}	
t-stat	(4.24)		(9.27)		(2.99)	
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Company FE	No	Yes	No	Yes	No	Yes
N	1379	1379	99064	99064	20011	20011

"US" refers to the data from COMPUSTAT North America, and "UK" refers to the data from COMPUSTAT Global for companies that are headquartered in the UK. Observations with sic in the range 6000-6999 (financial services and institutions), with sic above 9000 (public administration), and with assets or sales below one million are excluded. "PE" refers to the main sample of companies in this paper. Observations from the first year of PE-control are excluded; that is, if a company is acquired and controlled by a PE for three years, only observations from years two and three are used in the regressions above. LHS for the first six regressions is company's capex normalized by the assets value for US and UK companies, and normalized by the deal value for PE companies. LHS variable for other six regressions is the amount of acquisitions normalized by the assets value for US and UK companies, and by the deal value for PE companies. Deal value is the amount that was paid for the company at the time of the buyout. "CF_{t-1}" is the cash flow in the previous period, scaled by the total value of assets for US and UK companies, and by the deal value for PE companies. "distress" is a dummy variable which shows whether company's cash flow is below the level of interest expenses. Leverage is book value of debt over the book value of assets for US and UK companies, and the fraction of deal value that was financed by debt for E companies. Size is the log of assets value for US and UK companies, and log of the deal value for PE companies. LHS variables, and "CF_{t-1}" are winsorized at 1% and 99% levels. "Y. FE" and "C. FE" indicate year- and company- fixed-effects. Regressions with company fixed-effects also have errors clustered at the company-level. *, ** , and *** indicate significance at 10%, 5%, and 1% levels.

companies with PE-ownership. Among PE-backed companies with size larger than £200mln, half have at least one acquisition every two years - twice as often as companies without PE-ownership in the UK and the US. One concern might be that there is some mechanical effect because PE companies exit larger companies earlier (and, therefore, the denominator would be smaller for frequency calculation). This is not the case - the median exit time is four years for all companies, and also a group of companies that are larger than £50mln, larger than £100mln, larger than £200mln, while mean exit time is 4.7 years, 4.6 years, 4.6 years, and 4.5 years respectively.

It is possible that numbers above overestimate the actual frequency of PE-backed companies to have positive acquisitions. Sometimes, when PE-backed companies acquire other companies, they do not pay the whole acquisition amount right away, but schedule deferred payments, which may sometimes depend on the performance of the acquired company. In case they later make the deferred payment, it is reflected as an acquisition on company's cash flow statement, and I count it as a new acquisition, therefore, increasing the frequency of acquisitions. I do not think, however, that this can explain the big difference in the acquisition frequency between companies with and without PE-ownership. First of all, these deferred acquisition payments are not scheduled often. Second, it might be the case that companies without PE-ownership also extend the payment for acquisitions, which would mean that the acquisition frequency is also overestimated for companies without PE-ownership; implicit evidence suggest that it's indeed the case, as the average size of an acquisition is similar between companies with and without PE-ownership, as indicated by the Table 7.

D. Performance

To study the performance of PE-backed companies, I analyze two measures. First, how operating performance, measured by the growth rate of sales and EBITDA, of PE-backed companies is different from the operating performance of companies without PE-ownership. Second, I study how the market value of PE-backed companies change when they are managed by the PE.

As Table 9 shows, companies with PE-ownership grow faster than other companies: the median sales growth rate is 10.2% for PE-backed companies, and is between 6% and 7% for companies without PE-ownership. Similarly, the median growth of PE-backed companies is 8.6%, and median growth rate of EBITDA is between 4% and 6% for companies without PE-ownership. While average numbers are also greater for PE-backed companies, they are not reported because of a big number of outliers, for which the average growth rate exceed 1000%.

To partially account for the fact that private equity firms unevenly invest in companies in certain industries over the business cycle, Panel B runs a regression that controls for industry and year fixed effects. Because of the outliers, sales growth and EBITDA growth are winsorized in Panel B: sales growth is winsorized at 0.5% and 99.5% values, and EBITDA growth is winsorized at 5% and 95% values, which correspond to EBITDA growth of -179% and 236%. Regressions confirm the results

Table 9
Operating performance

Panel A: Summary statistics about operational performance

	Sales growth			EBITDA growth		
	q25	median	q75	q25	median	q75
PE	-0.3%	10.2%	29.9%	-23.5%	8.6%	46.4%
Failed Deals	-1.9%	4.3%	15.9%			
US	-5.6%	6.1%	21.7%	-26.6%	4.5%	32.3%
UK	-4.6%	7.2%	25.8%	-29.1%	5.8%	36.8%

Panel B: Statistics controlling for year and industry growth

	LHS variables: Sales growth			LHS variables: EBITDA growth		
PE	0.25^{***}	0.14^{***}	0.14^{***}	0.12^{***}	0.11^{***}	0.11^{***}
Failed Deals	-0.06					
UK	0.05^{***}	-0.01	-0.01^{*}	0.01^{*}	0.01	0.00
size		-0.05^{***}	-0.05^{***}		-0.01^{***}	-0.01^{***}
leverage			-0.03^{***}			-0.03^{***}
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	1.2%	2.9%	3.0%	1.1%	1.1%	1.1%

In Panel A,"US" refers to the data from COMPUSTAT North America, and "UK" refers to the data from COMPUSTAT Global for companies that are headquartered in the UK. In Panel B, "UK" and "PE" refer to dummy variables that equal one for this type of companies (variables for US are included, but dummy for "US" is dropped because of col linearity). Sales growth and EBITDA growth have many outliers, and so not mean values are reported in Panel A. In Panel B, sales growth is winsorized at 0.5% and 99.5% values, and EBITDA growth is winsorized at 5% and 95% values (correspond to -179% and 236% values). *, ** , and *** indicate significance at 10%, 5%, and 1% levels.

in the previous paragraph: the average sales growth is 25% higher for PE-backed companies than for US-based companies, and is 20% higher than for UK-based companies. Similarly, the average EBITDA growth is 12% higher for PE-backed companies than for US-based companies, and 11% higher than for UK-based companies.

There are two known factors that correlate with operating growth: size and leverage. Large companies grow slower than small companies, and companies with high leverage grow slower than companies with small leverage. In order to account for the effect of size and leverage, Panel B also shows results for the regression, in which proxies for size and leverage are used. For PE-backed companies, size is measured as the log of the buyout value, and for companies without PE-ownership size is measured as log of assets value. Similarly, leverage for PE-backed companies is measured as buyout leverage, and leverage for companies without PE-ownership is measured as the book value of debt over the book value of assets.

Neither the proxy for size, nor for leverage are great, mainly because they are market-based for PE-backed companies, and accounting-based for all other companies. Moreover there is no time-variation in size and leverage proxies for PE-backed companies (since for each PE-backed company there is just one buyout price, but several sales growth values), but there is time-variation in both size and leverage proxies for companies without PE-ownership. Nevertheless, it is possible, at least qualitatively, to estimate the direction of mismeasurement, which is discussed below.

In regressions that control for size and leverage, average growth rate of PE-backed companies is still higher than average growth rate of companies without PE-ownership: by 14% for sales growth and by 11% for EBITDA growth. What is the likely effect of measuring leverage and size differently for companies with and without PE-ownership? Leverage of PE-backed companies is measured with an upward bias, since the buyout leverage is used for every time-period, but leverage on average falls, as Section 3.1 shows. Therefore, the growth rates of sales and EBITDA would probably be even higher for PE-backed companies than for other companies if leverage was measured consistently.

Mismeasurement of size has two effects on the results, which go in the opposite directions: 1) market values of assets are usually higher than book value of assets, implying that size is overestimated for PE-backed companies, 2) assets of PE-backed companies grow over time, but buyout values are used as a proxy for size, implying that size is underestimated. Since the regression coefficient on size is negative, the first effect implies that operating growth of PE-backed companies is overestimated, and second effect implies that it is underestimated. One can try to roughly estimate the first effect quantitatively: taking average market-to-book ratio of three, the sales growth would need to be adjusted down by $0.05 * \log(3) = 5.5\%$, and EBITDA growth would need to be adjusted down by $0.01 * \log(3) = 1.1\%$. Both numbers - sales growth and EBITDA growth - would still remain significantly higher than the growth rates of companies without PE-ownership in the US and UK.

Ideally, one would include other controls in the regression that could potentially be correlated with operating growth, to see if the effect of the PE-ownership still remains significant in the regression. This is not feasible, however, given that the data for PE-backed companies is very limited.

The second way to analyze the performance of PE-backed companies is to study how their market value changes while they are controlled by the PE. Since the value is only observable at the dates of buyout and exit, it is natural to use the internal rate of return (IRR). IRR is usually measured on the equity stake of the company (that is, IRR that the PE-sponsor earns), but I

Table 10
Example of IRR calculation, Ambasador Theatre Group buyout

	Y2010	Y2011	Y2012	Y2013	Y2014
purchase price	£127,312				
debt issued		£77,500			
debt repaid		-£1,553	-£2,200	-£18,368	
equity issued					
dividends		-£64,505	-£3,412		
selling price					£406,093
CF to/from investors	-£97,312	-£11,442	£5,612	£18,368	£406,093
IRR	34.2%				

This table shows how IRR is measured based on the buyout of Ambassador Theatre Group in 2010 by Exponent Private Equity and subsequent sale to Providence Equity Partners in 2014. Every year, except the first and last years, the total cash flow to investors is computed as the sum of debt repaid (positive) and issued (negative), plus all other securities repaid (positive) and issued (negative), plus any dividends or interest expenses that were actually paid (positive). The first year cash flow is the total acquisition value with a negative sign; the last year cash flow is the total exit value with a positive sign. Cash flows do not include 1) small monitoring fees that companies sometimes pay to the PE-sponsor, and 2)small proceeds from equity issuance that result from stock compensations, 3) any transaction costs. All numbers in the table are in thousands.

instead focus on the IRR of the whole company to eliminate the effect of leverage and study how the value of the whole company changes. To compute IRR, I take distributions to/from all company's shareholders (the private equity firm, managers, external debt providers, etc.), and take the whole company value at the times of buyout and sale. The interpretation of the IRR is, therefore, the constant rate of return that an investor would earn if she held both debt and equity of the company. Under the conditions of Modigliani-Miller, one could interpret the IRRs as the annual growth rate of company's value if the company had zero leverage.

Table 10 shows an example of how IRR is computed, which is based on the buyout of Ambassador Theatre Group by Exponent Private Equity in November 2009, and the subsequent sale of the company to Providence Equity Partners in November 2013. In 2009, the company was acquired for approximately £125mln, which was structured as £124.5mln shareholder loans and £0.5mln equity. No external debt was used to finance the acquisition, but debt was issued in the subsequent year, and shareholder loans were partially repaid. Every year, except the first (2010) and final years (2014), cash flow to investors is measured as total distributions to investors from the company (repayment of debt/shareholder loans, interest expenses or dividends) minus all external financing that the company receives from investors (new debt, equity or shareholder loans). The value in the first year is the value at which the company is acquired, and value in the last year is the value at which the company is sold. Importantly, the company had an acquisition in year 2011, which does not affect the calculations of the IRR because the acquisition itself was not a flow of money to or from investors.

There are two types of distributions that I do not include in the IRR calculation. First, I do not include monitoring fees, which companies sometimes pay to the PE-owner. These fees are usually small, are not always reported, and, when reported, it is not always clear whether they are actually paid or simply added to the balance sheet liabilities. Second, I do not include small but frequent equity inflows from share issuance, which usually arise because of options or shares issued to the employee pension trusts.

There are several important caveats to keep in mind before interpreting the IRR numbers. Most importantly, I only compute IRRs for PE-backed companies, which were exited through a secondary buyout (the company is acquired by another PE) because the exit value is not systematically observable for other types of exit. As Section 2 explains, a new special purpose vehicle (SPV) is created for each buyout, and the SPV begins to publish annual reports from the date of buyout. It is, therefore, possible to recover the buyout price from the first report published by the SPV (for the case of secondary buyouts, the buyout price is the exit price).

What is the direction of the bias in IRR values given that they are only computed for deals that ended with a secondary buyout? In my sample, secondary buyout is the second most frequent exit type (35.3% of cases), with trade sale (exit type, in which the company is sold to another company, 40.9% of cases), default/restructuring (4.2% of cases), and IPO[14] (3.2% of cases) being three other most frequent cases. In terms of profitability, at least from the perspective of returns on equity, IPOs are by far the most profitable, followed by trade sale, then secondary buyouts, and finally default/restructuring cases.[15] Therefore, computed IRRs might have some downward bias.

There are also some timing problems with how IRRs are measured. Generally, IRRs are computed as if the buyout happens on the day when the first report is published, and exit happened exactly one year after the last report is published, which is not always true. Going back to the

[14]One could argue that it is also possible to compute the exit value - and, hence, the IRR - for companies, for which the exit type was default or IPO. For the default cases, for instance, it is tempting to say that IRR should be -100%, but that is not necessarily true, since IRR is measured on the company rather than on equity stake of the company. That is, as long as there are some payments to debtholders after the buyout date and before the default date and/or debtholders recover anything in default, the IRR will be above negative 100%. For IPO cases, it is indeed possible to recover the exit value, though not always. For 13 companies in my sample that were exited through the IPO, exit value is only available for 8 cases; because of the small number, they are not included in the analysis.

[15]See, for instance, Degeorge, Martin, Phalippou (JFE, 2016). Generally, it is a well-known fact among PE professionals. One, however, should keep in mind that profitability of exit channels is known from the perspective of returns of the PE funds, not returns on the company as a whole. The ordering can change if, for instance, companies with smaller leverage are more likely to be exited through an SBO than a trade sale.

Table 11
IRR on the whole company, across secondary buyout deals

	mean	q25	q50	q75	IRR < 0	N
whole period						
all companies	43.6%	15.7%	27.3%	45.4%	11	107
size > £50mln	33.4%	13.5%	22.0%	41.2%	7	51
size > £100mln	23.2%	4.5%	17.1%	33.1%	6	29
size > £200mln	14.3%	-0.9%	15.8%	20.7%	5	17
deals started before 2008						
all companies	48.8%	16.9%	26.6%	57.8%	4	51
size > £50mln	40.4%	13.5%	24.9%	45.4%	4	25
size > £100mln	19.1%	2.3%	21.4%	32.9%	4	16
deals closed before 2008						
all companies	65.3%	18.7%	36.8%	84.9%	2	32
size > £50mln	50.0%	13.5%	33.0%	68.2%	2	18
size > £100mln	21.6%	5.3%	21.4%	45.4%	2	10
deals started between 2008 and 2010						
all companies	28.8%	6.2%	18.5%	35.4%	5	31
size > £50mln	16.9%	8.9%	17.1%	29.4%	2	16
size > £100mln	15.3%	4.1%	14.9%	25.8%	1	8
deals closed between 2008 and 2010						
all companies	22.9%	17.1%	24.9%	26.6%	1	7
deals started after 2010						
all companies	51.7%	24.5%	35.6%	69.5%	2	25
size > £50mln	41.8%	16.7%	25.8%	69.5%	1	10
deals closed after 2010						
all companies	35.6%	14.8%	26.7%	41.5%	8	68
size > £50mln	25.8%	14.7%	21.3%	32.8%	4	29
size > £100mln	26.9%	3.8%	15.9%	35.0%	3	15

This table shows the IRR on the company, not IRR on PE-investment. Every year, except for the first and the last years, the total cash flow to investors is computed as the sum of debt repaid (positive) and issued (negative), plus all other securities repaid (positive) and issued (negative), plus any dividends or interest expenses that were actually paid (positive). The first year cash flow is the total acquisition value with a negative sign; the last year cash flow is the total exit value with a positive sign. IRR equates the discounted stream of these cash flows to zero. IRR's are only computed for the set of SBO transaction (the company is sold from one PE to another), since the exit value is not known for most other transactions (see text for potential selection biases). q25, q50, and q75 denote the corresponding quantiles of the distribution, IRR < 0 denotes the number of deals with negative IRR, and N denotes the total number of deals.

example of Ambassador Theare Group in Table 10, periods Y2010 through Y2014 are assumed to be exactly one year apart from each other. Nevertheless, numbers Y2010 are taken from the report published on March 27th, 2010, while the company was acquired - and the price paid - on 9th November 2009. Similarly, numbers Y2014 are taken from the report published on March 29th, 2014 (by a new SPV), but the company was sold on November 30th, 2013. To the extent the timing discrepancy affects IRR calculations, the effect is probably unsubstantial; for instance, the IRR on the Ambassador Theatre Group, would change from 34.2% to 33.6% if the timing issues were taken into account properly. Transaction costs are also ignored in measuring IRRs. It is not possible to account for them because they are not always separately reported, but whenever they are reported, they can be of the order of 7-12%.

With all these concerns in mind, Table 11 reports the computed IRRs. The average and median IRR on an investments in a PE-backed company are strikingly big 43.6% and 27.3%. Values are much higher for small companies, but average IRR is still around 15% even among companies that were acquired for more than £200 mln. There is substantial variation over time; IRRs are highest for deals that were closed before 2008 (65% on average), and relatively lower for companies that were acquired between 2008 and 2010 (22.9%).

Numbers in Table 11 are hard to rationalize by risk-exposure, as there is no indication that companies with PE-ownership are overly exposed to systematic risk. Companies that were exited during the crisis period of 2008-2011 do not have overwhelmingly negative IRRs (average is 28.9%). It is possible that private equity firms were selectively not exiting worst-performing companies in crisis, but that would imply that IRRs should be disproportionately low for companies that were exited shortly after the crisis, and there is still no sign of very low returns. One could argue that even though systematic risk is small, it is always possible to use leverage to increase risk-exposure. This would also be misleading, however, since IRRs are computed on the whole company, rather than on the equity stake of the company. In other words, company's exposure to systematic risks should not be affected by its leverage.

Interestingly, Table 11 indicates that what Preqin classifies as secondary buyout exits also include some default cases. Specifically, there are 11 cases (10.3%), for which IRR is negative. The median IRR among deals with negative IRR is -20%, which, extrapolated over five years (typical investments length), means the value of the company falls by 65%. Since the equity is a levered claim on company's assets, it is very likely that the PE's stake is completely wiped out, even though formal bankruptcy is not triggered. What follows - the acquisition of the company by another PE - is a common way of how restructuring cases are resolved.

What do numbers in Table 11 say about returns that private equity firms earn? On one hand, private equity firms hold equity of the portfolio companies, and so their returns should be higher. On the other hand, returns of private equity firms are value-weighted among all their portfolio companies, while Table 11 reports equally-weighted returns (and IRRs of small companies are larger than IRRs of large companies). The overall effect is ambiguous, and there is no direct way of measuring returns of private equity firms from reports of portfolio companies because it is not clear what happens to shareholder loans at the time of exit: sometimes shareholder loans are repaid as a part of the exit price, and sometimes they are written off, with all value being paid for equity. Furthermore, company's management has a stake in company's equity, and it is not always clear how much.

Overall, results above show two empirical facts: 1) operating performance of PE-backed companies, measured as growth in sales or EBITDA or cash flow, is higher than that of other companies, and 2) returns on PE-backed companies - or the rate at which their market values grow - exceed the values that could simply be explained by risk exposure. While each of the two facts separately can be explained in a number of equally-plausible ways, jointly they argue strongly in favor of the fact that private equity firms add value to their portfolio companies.

First, higher operating growth and higher returns of PE-backed companies are consistent with the explanation that private equity firms add value to their portfolio companies. For higher sales growth, it is almost straightforward: if private equity firms added value to their portfolio companies, one would indeed expect to see them growing faster. It is not as straightforward with higher returns, though: even if private equity firms added value to the portfolio companies, one could argue that this should be expected at the time of the buyout, and reflected in the buyout price. Returns would then adjust so that private equity firms are only compensated for the risk they take, but not for the operational improvement that they bring to the company. This type of argument, however, might be misleading in the context of private equity.

To see why, imagine that there is a kind of operational improvement that only a private equity owner can implement. The very same company can then have different values depending on whether it is owned by a private equity firm, or by other investors. At the time of buyout, there is a range of prices on which the old shareholders and the private equity can agree. As long as the private equity industry in smaller than the rest of the market, the buyout should happen at the lowest price of the range.[16] This implies that the PE buys the company at the value that does not reflect future operational improvement, helps the company implement the improvement, and later sells the company at the higher value, generating superior returns.

[16]Some clarification might be needed here. It is true that several PE funds would often try to acquire the same company, and the ultimate buyer is determined through an auction. One might argue, therefore, that each PE should bid their highest valuation for the company, and there should be no outperformance subsequently. This, however, implies that the PEs have no outside options. As long as that is not the case - and it likely is not the case if the PE industry is smaller than the market - the private equity firm will bid the price that other non-PE investor would pay for the company.

For the argument in the previous paragraph to hold, there should be ways to increase company's value that are only available to the private equity owner, but not to other non-PE investors. One such possibility that is supported by empirical evidence is the fact that, thanks to the PE-sponsor, financial distress is less severe for PE-backed companies. Expectations about the severity of financial distress can, in turn, affect policies that companies choose even before they fall in the financial distress. For instance, companies may optimally forgo profitable investments that require debt issuance to be financed, if doing so unreasonably increases their leverage. The model in the following Section shows this mechanism in action; by simply guaranteeing financial support in case of distress (which is, by the way, ex-ante and ex-post optimal to both the company and the PE), the PE changes the investment policies of the company, and increases its value.

There are not that many other explanations that could rationalize the superior returns that private equity firms generate, and also account for the fact that PE-backed companies have higher operational growth relative to companies without PE-ownership. As discussed above, risk-exposure alone is unlikely to explain the whole magnitude of average returns. Similarly, even though there is a bias in the type of companies for which returns are computed (secondary buyout cases), the selection bias probably understates returns than overstates them. The only alternative explanation that could explain outperformance of PE-backed companies is that private equity firms are able to fund significantly undervalued companies.[17]

The hypothesis that private equity firms find undervalued companies, however, does not explain why PE-backed companies have higher operational growth. In contrast, there is an asset pricing puzzle, which shows that, at least for public companies, expected returns are lower among companies with high growth rate. One could argue that private equity firms are better at predicting the future growth of companies than other investors; they would then buy companies, for which expected future growth is higher than what company's existing shareholders predict, and will have higher superior return. This would imply, however, that private equity firms understand companies better than their shareholders - which is unlikely.

Generally speaking, it is likely true that, at least partially, the ability of private equity firms to find undervalued companies explains the outperformance of PE-backed companies. Indeed, private

[17]The notion of undervaluation is tricky for private companies, but in the context of this paragraph it implies that the price that the private equity firm pays for the company is below the expected value of properly discounted future dividends.

equity firms mostly buy private companies, and insufficient competition among buyers could explain why prices they pay could be lower than what they would be if the company was publicly traded. However, even this mispricing is likely due to the fact that small private companies face financial constraints, which prevent them from optimal investments. In this sense, mispricing correction by private equity firms is likely very different from mispricing correction by hedge funds, which generally do nothing to companies whose shares they buy.

4 Model

This paper models an infinite-horizon economy in continuous time. Markets are complete, and there is a riskless asset that pays a constant rate of interest r per unit of time[18]. In what follows, $\mathbb{P}$ denotes the physical probability measure, and $\mathbb{Q}$ denotes the risk-neutral probability measure in this economy.

A company in the economy is characterized by there state variables: amount of capital K it has, capital productivity X_t, and interest payments on debt c_t. Company's production technology has a constant return to scale, and instantaneous profits equal $y_t = X_t K$ per unit of time. Company's debt is perpetual, which means that the company only pays interest expenses, but not the face value of debt. At each point in time, the company produces cash flow y_t and has to pay c_t to its debtholders. If $y_t < c_t$, the company is in distress, meaning that it does not have enough cash to pay interest expenses, and has to raise money externally by either issuing debt or equity; if the company cannot get external financing or chooses not to, it defaults.

The difference between the cash flow and interest payments $(y_t - c_t)$ is taxed at a constant corporate tax rate τ. If the remainder is positive, the company may invest some of it, in a way that is described in the following section. If there is still money left after taxes and investments, it is paid to equityholders as dividends; that is, the company cannot save money.

Debt allows companies to exploit benefits of tax-shield, but it also comes with cost, both explicit and implicit. Higher leverage increases the probability of default, and makes further debt issuance costlier. Moreover, firms with greater leverage invest less, as is shown below. When choosing the optimal debt policies, companies trade off these costs and benefits.

[18] Here and below "per unit of time" means that investors earn approximately $r\Delta t$ within a short interval of time Δt

Capital is traded on the external market, and its price depends on the productivity level: price of a unit of capital with productivity X is XH, where H is a constant.[19] Price of capital directly affects the costs of investments, and also determines how much of the debt value debtholders can recover in default.

There are two types of companies in the model, to which I refer as PE-backed, and non-PE-backed companies. The only difference between the two is the type of external financing that is available to them. PE-backed companies have access to both debt and equity, and they optimally choose which securities to issue and when. Companies without PE-ownership cannot issue equity, and only have access to debt. While the assumption that companies without PE-ownership cannot issue equity is rather extreme, the model would have similar results if the assumption was instead that all forms of external financing become more expensive when company's leverage increases. This assumption is exogenous in the model, but the following section explicitly discusses it by showing how it can be rationalized, and putting it in the context of available empirical evidence about equity issuance.

I start by describing the investment and financing policies of companies without PE-ownership. In order to derive the optimal policies, as well as the pricing of debt and equity, one needs to first derive the processes for the three state variables: dX_t, dK_t, and dc_t. It is assumed that X_t follows Geometric Brownian motion under $\mathbb{Q}$:

$$\frac{dX_t}{X_t} = \mu dt + \sigma dW_t \tag{1}$$

The evolution of the other two state variables is endogenous.[20] K_t will change because of company's investments. c_t will change because the company will issue additional debt - to finance investments that cannot be financed out of the cash flow, and to cover interest expenses when the cash flow is not sufficient. Therefore, dK_t, and dc_t should be endogenously determined in equilibrium. For instance, the process for dc_t is affected by company's current and future debt issuance, and, therefore, affects

[19] Price of capital is proportional to X because, as is shown later, the value of the company that can operate this capital is also proportional to X. In the data, the distribution of market-to-book ratios is mostly stable, implying that the value of the company cannot diverge from the price of capital over time. It is also natural to think that high-productive capital has a larger price than low-productive capital

[20] Strictly speaking, the process for the productivity of company's capital X_t is also partially endogenous. The way investments are modeled, the productivity of the capital the company acquires is different from the productivity of company's existing capital, and so the overall productivity of company's capital will depend on the decision to invest.

the pricing of debt, which in turn affects company's decision to invest, which in turn affects the pricing of debt and the process for dc_t. Nevertheless, there is a closed-form equilibrium solution for both processes, which makes the pricing of other securities easier.

4.1 Investments

In the model, companies invest when they have investment opportunities. Investment opportunities allow companies to acquire more capital. There are two types of investment opportunities that companies can have: small investment opportunities available constantly, and large but infrequent investment opportunities. Loosely speaking, small investment opportunities can be thought of as CAPEX, and large investment opportunities can be thought of as acquisitions.

Large investment opportunities arrive at a rate λ per unit of time.[21] A large investment opportunity allows a company to buy at most K_{new} units of capital with low-productivity X_{low} and install this capital inside the company. There are no costs of investment aside from the price of capital. Once the capital is installed, its productivity grows up to $X_{high} > X_{low}$. The fact that companies pay for low-productive capital, but are able to transform it into high productive capital is what makes investment opportunities profitable (or, in other words, NPV-positive).

Importantly, investment opportunities do not change the productivity of company's existing capital: by taking a large investment opportunity, a company gets a new capital stock with its own productivity. A simple way to think about large investment opportunities is that they allow a company to establish a new plant, which works independently of company's other plants. It would imply, however, that a pair (K, X) does not fully characterize a company, as it shows company's total amount of capital and productivity, while the company may have several capital units after a number of investments. The following assumption guarantees that capital and productivity can be aggregated:

Assumption. *Consider a company at time t that has K units of capital with productivity X_t that receives a large investment opportunity, which allows the company to buy K_{new} units of capital with productivity X_{low} and install them within the company with productivity X_{high}. Then:*

1. *Size of the investment opportunity is proportional to the amount of capital the company already*

[21] Informally, it means that the probability to find an investment opportunity is $\lambda \Delta t$ within a short interval of time Δt.

has:

$$K_{new} = \delta_2 K$$

2. *Productivity of capital that the company buys is the same as the productivity of capital that the company already has:*

$$X_{low} = X_t$$

3. *Productivity of capital once it is installed is proportional to the productivity of capital the company buys:*

$$X_{high} = (1+\gamma)X_t$$

4. *After new capital is installed, its productivity will evolve according to the same equation (1) as the productivity of company's old capital; in other words, there are no additional idiosyncratic shocks to the productivity of new capital*

The assumption guarantees that company's different capital units can be aggregated into one: there is only one process X_t that characterizes productivity of all capital units, and production technology is constant return to scale. Note that company's cash flow grows proportionally when it takes a large investment opportunity:

$$\begin{gathered} X_t K \to X_t K + (1+\gamma)X_t\delta_2 K = \big(1+\delta_2(1+\gamma)\big)X_t K \\ y_t \to \big(1+\delta_2(1+\gamma)\big)y_t \end{gathered} \tag{2}$$

Small investment opportunities are modeled similarly, except that the size of small investment opportunities is proportional to dt. At any point in time, a company can buy $\delta_1 K dt$ units of capital with productivity X, and install this capital within the company with productivity $(1+\gamma)X$.[22] To keep the aggregation intact, small investment opportunities also satisfy the assumption.

While the mathematical definition of the two types of investment opportunities is similar, they have a profoundly different effect on company's financial policies, mainly because companies can finance small investment opportunities out of the cash flow, but they have to raise external financing

[22] In principle, profitability of large and small investment opportunities γ might be different, but they are assumed to be the same between the two types of investments; that is, there is just one parameter γ that characterizes the profitability of both types of investments.

to pay for large investment opportunities.

Similarly to equation (2), though informally, company's cash flow grows proportionally when the company takes a small investment opportunity:

$$\begin{aligned} X_tK \to X_tK + (1+\gamma)X_t\delta_1Kdt &= \big(1+\delta_1(1+\gamma)dt\big)X_tK \\ y_t \to \big(1+(1+\gamma)\delta_1 dt\big)y_t \\ dy_t = \delta_1(1+\gamma)y_tdt \end{aligned} \tag{3}$$

Notice that the price that the company pays to take investment opportunities - both large and small - is also proportional to the cash flow ($HX_t\delta_1Kdt = \delta_1Hy_tdt$ for small and $Hx_t\delta_2K = \delta_2Hy_t$ for large investment opportunities). I argue that this suggests that y_t alone is a sufficient state variable to substitute both X_t and K_t. It can be formally shown through the "guess and verify" method.

By construction, investment opportunities are profitable for companies: companies buy cheap low-productive capital, but install it as high-productive capital. Nevertheless, company's leverage may prevent companies from taking some investment opportunities. First of all, leverage may cause debt overhang problem: when an overlevered company takes an investment opportunity, equity-holders bear the full cost of the investment, but creditors gain some benefits (because probability of default goes down). Second, debt is the only source of external financing available to companies without PE-ownership, and price of debt (i.e. costs to issue debt) increases with company's leverage; therefore, highly-levered companies will choose not to finance investment opportunities because costs do not justify the benefits. Therefore, highly levered companies may optimally choose to forgo some of their investment opportunities, even if all investment opportunities are ex-ante good.

Intuitively, there should be some threshold level of leverage, so that the company invests if the leverage is below this value, and the company does not invest if the leverage is above this value.[23] In terms of the state variables c (interest expenses on company's debt) and y (company's cash flow), the investment threshold can be summarized as a number z_{inv}, such that the company invests if

[23] Strictly speaking, there should be two investment thresholds - one for big investments, and another for small investments. However, separating the two does not conceptually change the math, but makes it messier, by adding an extra region to consider. Therefore, to simplify the description, I consider that the two thresholds coincide, though I do have both thresholds when I solve the model.

$c/y < z_{inv}$, and does not invest if $c/y > z_{inv}$. To simplify the discussion below, I assume that $z_{inv} < 1$.

Since company's investments are described by the threshold rule, the evolution of company's cash flow y_t follows the process:

$$\begin{cases} \dfrac{dy_t}{y_t} = \big(\mu + \delta_1(1+\gamma)\big)dt + \sigma dW_t + \delta_2(1+\gamma)dN_t \quad \text{if} \quad \dfrac{c_t}{y_t} < z_{inv} \\ \dfrac{dy_t}{y_t} = \mu dt + \sigma dW_t \quad \text{if} \quad \dfrac{c_t}{y_t} > z_{inv} \end{cases} \tag{4}$$

In order to fully characterize company's equity and debt, one also needs to know the process for dc_t. Company's interest expenses will change every time the company increases the amount of debt. There are two main reasons for the company to issue debt: to finance investment opportunities, but also payments in distress, when company's cash flow is not sufficient to cover interest expenses.

4.2 Process for dc

Before discussing the process for dc, it can be useful to introduce three regions, on which dc will have a different dynamic. Region I is $c/y \in [0, z_{inv}]$, which characterizes company's investments. In Region I, dc will change every time a large investment opportunity arrives and requires the company to issue debt to finance the investment. Region III is $c/y \in (1, z_{def}]$, which characterizes the distress region (with z_{def} being the ultimate default threshold). The company no longer invests in this region, and its cash flow is not sufficient to cover interest expenses ($y_t < c$). Therefore, the company is forced to continuously issue debt to cover interest expenses on previously issued debt. Such situation is obviously not sustainable for a long period of time, and debtholders will stop providing money to the company if interest expenses (relative to cash flow) become too high, which gives rise to the z_{def} boundary. Region II is $c/y \in (z_{inv}, 1]$, and the company no longer invests in this region, but also has sufficient resources to pay interest expenses without raising external financing. $dc = 0$ in Region II. Figure 7 illustrates the three Regions.

Two things should be mentioned about the three Regions. First, it is possible that company's cash flow will not be sufficient to *both* pay interest expenses and buy capital for small investments in the Region I. Second, companies with very low value of c/y (i.e. low-levered companies) may optimally prefer to issue debt to better exploit benefits of tax-shield. These issues do not affect the derivations and are added later.

Let $D(y, c)$ be the value of company's debt; $D(y, c)$ has a closed-form solution, but for now we will express it as a general function. Assume $c/y \in$ Region I, and the company receives a large investment opportunity. The company needs to issue $H\delta_2 y$ of additional debt to finance this investment. If newly issued debt has the same seniority as company's old debt, the following equation implicitly defines what is the new level of interest expenses c_{new} the company will have:

$$H\delta_2 y = D(y_{new}, c_{new}) - D(y, c) \tag{5}$$

where $y_{new} = y(1+\delta_2(1+\gamma))$ is the new cash flow in case the investment is financed. What equation (5) shows is that the company promises to increase future debt payments to a new level c_{new}, but in return debtholders provide $H\delta_2 y$, which the company uses to finance the investment.

Investment opportunities arrive according to a Poisson process dN_t, and every time an investment opportunity arrives, the company takes it. By taking an investment opportunity, the company increases its c to the level c_{new} explicitly defined in equation (5) Therefore:

$$dc = (c_{new}(y, c) - c)dN_t \quad \text{if} \quad \frac{c}{y} \in \text{Region I} \tag{6}$$

In Region II the company does not issue debt, and so $dc = 0$. In Region III, the company continuously issues debt because its cash flow is too small to fully cover interest expenses. Let dD be the value of debt the company needs to issue to avoid default at the moment when its cash flow is y and current interest expenses are c. The following formula connects how interest expenses should change in order to issue dD:

$$\Big(c - \big(y + (c-y)\tau\big)\Big)dt = (c-y)(1-\tau)dt = dD = dc\frac{\partial D(y,c)}{\partial c} \tag{7}$$

The very left-hand side of equation (7) is the difference between the required coupon payment c, and the amount of money the firm has on hands - its profits y, and tax return from the government $\tau(c-y)$. This difference is the shortfall that equityholders must but can not pay to debtholders; this difference should equal to change in debt value dD, which is in turn achieved by promising a higher coupon payment in the future. It is clear from equation (7) that it is only possible to issue new debt if $\frac{\partial D}{\partial c} > 0$, that is, if value of debt increases when the firm promises to pay more in the future. Equation (7) shows to derive the dynamics of dc in Region III:

$$dc = \frac{(c-y)(1-\tau)}{\frac{\partial D}{\partial c}} dt \tag{8}$$

Together, equations (4), (6), and (8) fully define the dynamic of company's state variables:

$$\begin{cases} \dfrac{dy_t}{y_t} = (\mu + \delta_1(1+\gamma))dt + \sigma dW_t + \delta_2 dN_t & \text{if} \quad \dfrac{c}{y} \in [0, z_{inv}] \\ dc_t = \big(c_{new}(y_t, c_t) - c_t\big) dN_t & \\ \dfrac{dy_t}{y_t} = \mu dt + \sigma dW_t & \text{if} \quad \dfrac{c}{y} \in (z_{inv}, 1] \\ dc_t = 0 & \\ \dfrac{dy_t}{y_t} = \mu dt + \sigma dW_t & \text{if} \quad \dfrac{c}{y} \in (1, z_{def}] \\ dc_t = \dfrac{(1-\tau)(c_t - y_t)}{\frac{\partial D(y_t, c_t)}{\partial c}} & \end{cases} \tag{9}$$

4.3 Debt and default

We will show that $D(y,c)$ satisfies the following system:

$$\begin{cases} rD(y,c) = c + \big(\mu + \delta_1(1+\gamma)\big) y D'_y + \dfrac{\sigma^2 y^2}{2} D''_{yy} & \text{if} \quad \dfrac{c_t}{y_t} \in [0, z_{inv}] \\ rD(y,c) = c + \mu y D'_y + \dfrac{\sigma^2 y^2}{2} D''_{yy} & \text{if} \quad \dfrac{c_t}{y_t} \in (z_{inv}, z_{def}] \end{cases} \tag{10}$$

The way to show this is to separately set up the HJB equations for $D(y,c)$ on each of the three Regions, and show that they coincide with the system (10). In order to set up the HJB equations, one needs to figure out the immediate payments to debthlolders on each Region.

Start with Region I. That's the region, in which the company's cash flow is enough to pay interest expenses $c_t dt$. Therefore, the correct HJB for the value of debt takes the following form in Region I:

$$rD(y,c) = c + \big(\mu + \delta_1(1+\gamma)\big) y D'_y + \frac{\sigma^2 y^2}{2} D''_{yy} + \lambda \Big(D(y_{new}, c_{new}) - D(y,c) - \delta_2 H y \Big) \tag{11}$$

where $y_{new} = y\big(1+\delta_2(1+\gamma)\big)$ is the cash flow the company gets after taking the large investment opportunity. The last part of the equation (11) shows how the value of debt changes when the company issues debt to finance a large investment opportunity - future payments to debtholders increase to a new level c_{new}, but debtholders give money to the company to finance the investment. Note, however, that this part equals zero, consistent with the equation (5). Indeed, when debtholders provide money to the company to take the investment, they do it on terms, which make them indifferent (because markets are competitive), and so the value of debt does not change when the company takes a large investment.[24] Therefore, $D(y, c)$ indeed satisfies system (10) in the Region I.

$D(y, c)$ trivially satisfies system (10) in the Region II, since the second equation of the system is literally the HJB equation for $D(y, c)$ in that region.

Consider Region III now. In this regions, company's cash flow is fully used to pay interest expenses, and it is not enough. The immediate payment to debtholders in this region is $y+\tau(c-y)$, which is company's cash flow plus the return from the government. Therefore, the correct HJB equation for $D(y, c)$ should take the following form:

$$rD(y, c) = y + \tau(c-y) + \frac{(1-\tau)(c-y)}{D'_c} D'_c + \mu y D'_y + \frac{\sigma^2 y^2}{2} D''_{yy} \tag{12}$$

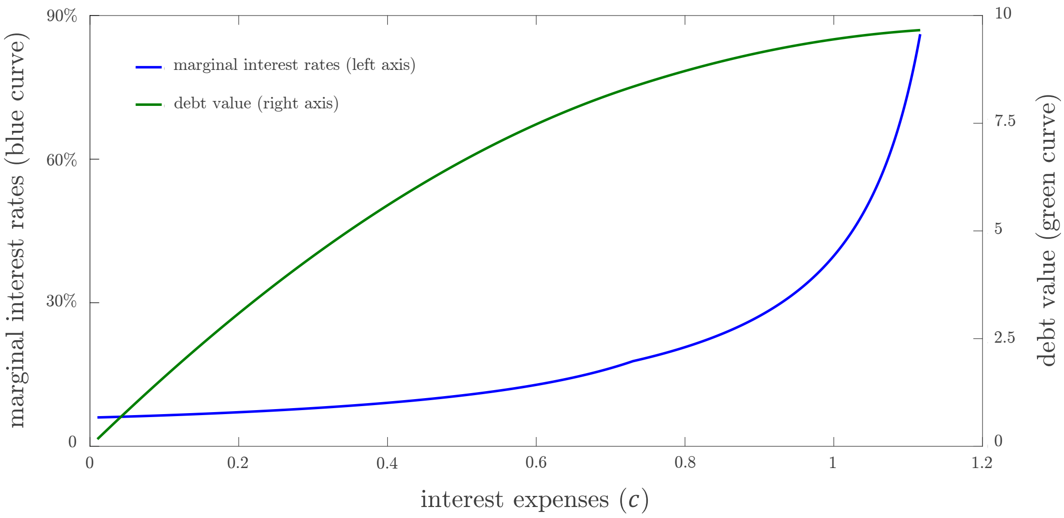
which simplifies to

$$rD(y, c) = c + \mu y D'_y + \frac{\sigma^2 y^2}{2} D''_{yy} \tag{13}$$

which again coincides with the second equation of the system (10) in the Region III. Intuitively, what this shows is that debtholders are indifferent between the company paying them the full amount cdt, or paying a smaller amount, but also increasing future interest payments by the level dc. This follows from how dc was modeled, which was to make debtholders even. A different way of interpreting this results is to say that debt is issued to a completely new debtholder, who gives the company $(1-\tau)(c-y)dt$ that is used to complement company's cash flow to pay old debtholders cdt in full. As long as it happens at every point in time, every company's debtholder receives what it was promised to at the time of debt issuance, as long as the company can raise additional debt.

[24] Notice, however, that the situation would be different, if the company had access to a alternative form of external financing, say equity. In case the investment is financed by issuing equity, y_t increases, without debtholders contributing any money. Nevertheless, the equation for debt value will still have a closed form solution, as is shown later for the case of the value of debt for companies with PE-ownership.

Figure 6
Debt and marginal interest rates



The graph shows the value of company's debt (green curve, right axis), and marginal interest rates at which next unit of debt can be raised (blue curve, left axis). Company's cash flow y_t is fixed at one, and values are shown as the second state variable - interest expenses - changes (horizontal axis). Company's debt value increases when interest expenses become higher, but debt also becomes riskier. Therefore, both the value of debt and interest rates to issue more debt increase with c. The company defaults when it can no longer issue more debt and is in distress; graphically, it means that the blue curve converges to infinity, or green curve becomes completely flat.

The previous paragraph naturally leads to the conclusion that the company will default once it is in distress and can no longer issue additional debt. Mathematically, the company can issue additional debt as long as $\partial D/\partial c > 0$, meaning the value of debt can be increased by promising higher interest payments in the future. Therefore, the following condition determines the default threshold for a company without PE-ownership[25]:

$$\frac{\partial D}{\partial c}\big(y_{def}(c), c\big) = 0 \tag{14}$$

Figure 6 visualizes the default in the model. The green curve on the graph shows how the value of company's debt changes when the company offers a higher coupon payment to its debtholders; the blue curve shows the marginal interest rates, at which the next dollar of debt can be raised. Firm with no debt ($c = 0$) can issue the first dollar of debt at $r = 6\%$, which is used as the risk-free rate to solve the model. Marginal interest rates stay low and close to the risk-free rate for companies that have sufficiently low interest payments. However, as the coupon payment becomes sufficiently high, the green curve becomes flatter, which means that the company has to promise to

[25]Notice that it is consistent with the default rule being $c/y = z_{def}$

increase future interest payments by a lot to raise an additional dollar of debt. As coupon-to-cash flow ratio approaches its default value, the green curve becomes completely flat, which means that future promises of higher coupon payments do not increase debt value, or, equivalently, next unit of debt can only be issued at the infinite rate. At that point, the company cannot issue new debt, and cannot pay interests on its debt out of the cash flow either, and so default happens.

Once we know that $D(y,c)$ satisfies system (10), it is easy to solve for the value of debt, since the system has a closed form solution of the following form:

$$\begin{aligned} D(y,c) &= \frac{c}{r} + B_1 y^{\beta_1} c^{1-\beta_1} + B_2 y^{\beta_2} c^{1-\beta_2} \quad \text{if} \quad \frac{c}{y} \leq z_{inv} \\ D(y,c) &= \frac{c}{r} + B_3 y^{\beta_3} c^{1-\beta_3} + B_4 y^{\beta_4} c^{1-\beta_4} \quad \text{if} \quad \frac{c}{y} > z_{inv} \end{aligned} \tag{15}$$

where β_1 and β_2 are the negative and the positive roots of the following quadratic equation:

$$r = \big(\mu + \delta_1(1+\gamma)\big)\beta + \frac{\sigma^2}{2}\beta(\beta - 1) \tag{16}$$

and β_3 and β_4 are the negative and the positive roots of the following quadratic equation:

$$r = \mu\beta + \frac{\sigma^2}{2}\beta(\beta - 1) \tag{17}$$

Coefficients $B_1, B_2.B_3, B_4$ need to be determined through boundary conditions. It is easy to argue that $B_2 = 0$, since the value of debt cannot exceed c/r (the value of risk-free debt), but $y^{\beta 2} c^{1-\beta 2}$ converges to $+\infty$ when y increases. Two boundary conditions are determined by the value matching and smooth-pasting[26] of $D(y,c)$ along the boundary $c/y = z_{inv}$.

$$\frac{c}{r} + B_1 y^{\beta_1} c^{1-\beta_1} = \frac{c}{r} + B_3 y^{\beta_3} c^{1-\beta_3} + B_4 y^{\beta_4} c^{1-\beta_4} \tag{18}$$

$$\beta_1 B_1 z_{inv}^{1-\beta_1} = \beta_3 B_3 z_{inv}^{1-\beta_3} + \beta_4 B_4 z_{inv}^{1-\beta_4} \tag{19}$$

The final boundary condition characterizes the value of debt in default. Absolute priority rule applies, and debtholder get the value of company's assets. It is assumed, however, that there are

[26]Notice that equation (18) is written for the derivative to be taken with respect to y, but the system would be equivalent to taking the derivative with respect to c.

some bankruptcy costs α, which are proportional to the value of assets, so debtholders only recover $(1-\alpha)(1-\tau)Hy$. The value of debt in default, and the default threshold (14) can be summarized as follows:

$$\frac{c}{r} + B_3 y^{\beta_3} c^{1-\beta_3} + B_4 y^{\beta_4} c^{1-\beta_4} = (1-\tau)(1-\alpha)Hy \tag{20}$$

$$\frac{1}{r} + (1-\beta_3)B_3 z_{def}^{-\beta_3} + (1-\beta_4)B_4 z_{def}^{-\beta_4} = 0 \tag{21}$$

Equations (18) - (21) can be simplified to the following system:

$$\begin{cases} B_1 z_{inv}^{-\beta_1} = B_3 z_{inv}^{-\beta_3} + B_4 z_{inv}^{-\beta_4} \\ \beta_1 B_1 z_{inv}^{1-\beta_1} = \beta_3 B_3 z_{inv}^{1-\beta_3} + \beta_4 B_4 z_{inv}^{1-\beta_4} \\ \frac{z_{def}}{r} + B_3 z_{def}^{1-\beta_3} + B_4 z_{def}^{1-\beta_4} = (1-\alpha)(1-\tau)H \\ \frac{1}{r} + (1-\beta_3)B_3 z_{def}^{-\beta_1} + (1-\beta_4)B_4 z_{def}^{-\beta_4} = 0 \end{cases} \tag{22}$$

which is a system of four equations with four unknowns $\{B_1, B_3, B_4, z_{def}\}$, of which three unknowns enter the system linearly.

4.4 Equity value and investment policies

Denote $E(y,c)$ the value of company's equity. In contrast to $D(y,c)$, there is no closed-form solution for $E(y,c)$. It should satisfy the following set of HJB equations:

$$\begin{cases} rE(y,c) = (1-\tau)(y-c) - H\delta_1 y + \big(\mu + \delta_1(1+\gamma)\big) y E'_y + \\ \qquad\qquad \frac{\sigma^2 y^2}{2} E''_{yy} + \lambda\big(E(y_{new}, c_{new}) - E(y,c)\big) & \text{if} \quad \frac{c}{y} \in [0, z_{inv}] \\ rE(y,c) = (1-\tau)(y-c) + \mu y E'_y + \frac{\sigma^2 y^2}{2} E''_{yy} & \text{if} \quad \frac{c}{y} \in (z_{inv}, 1] \\ rE(y,c) = \frac{(c-y)(1-\tau)}{D'_c} E'_c + \mu y E'_y + \frac{\sigma^2 y^2}{2} E''_{yy} & \text{if} \quad \frac{c}{y} \in (1, z_{def}] \end{cases} \tag{23}$$

A useful simplification to solve this system is to notice that $E(y,c)$ is homogenous of degree one, and therefore can be expressed as $E(y,c) = ye(c/y) = ye(z)$, and rewrite the system (23) in terms of z. Function $E(y,c)$ should satisfy some boundary conditions, which are described in the Appendix

D. The investment threshold is characterized by the following equation:

$$E(y_{new}, c_{new}) = E(y, c) \iff (1 + \delta_2(1 + \gamma))e(z_{new}) = e(z_{inv}) \tag{24}$$

where z_{new} satisfies the following equation:

$$\big(1 + \delta_2(1 + \gamma)\big)\Big(\frac{z_{new}}{r} + B_3 z_{new}^{1-\beta_3} + B_4 z_{new}^{1-\beta_4}\Big) = \frac{z_{inv}}{r} + B_1 z_{inv}^{1-\beta_1} + H\delta_2 \tag{25}$$

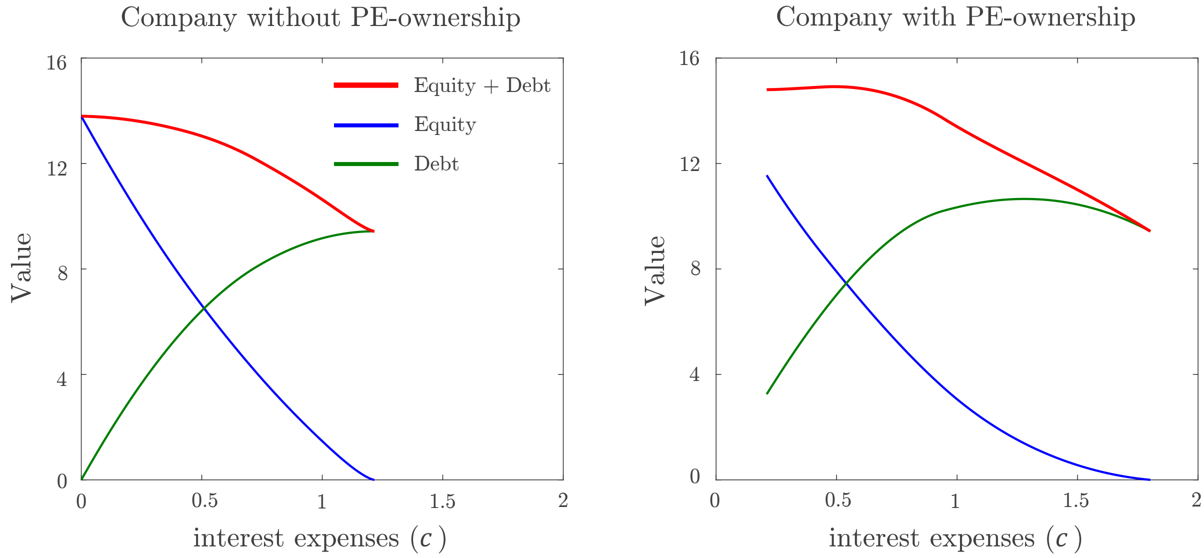
which is equivalent to $D(y_{new}, c_{new}) = D(y, c) + H\delta_2 y$

4.5 Issuance of debt to exploit benefits of tax-shield

Theoretically speaking, companies may choose to never let their leverage fall below a certain value, in order to optimally exploit benefits of tax-shield. That is, if their leverage is too low, companies may choose to issue additional debt even in the absence of large investment opportunities. This is easy to incorporate into the model, and the only thing that changes is that the first region becomes $[z_{res}, z_{inv}]$ instead of $[0, z_{inv}]$, where z_{res} is the optimal lower-boundary for debt issuance; that is, the company will issue additional debt every time its c/y falls below the level of z_{res}. Appendix A provides the optimality conditions for z_{res}.

Two things should be noted about z_{res}, though. First, I depart from the traditional assumption that debt issuance incurs some small costs, and instead assume that debt can be costlessly issued by increasing c_t. This means that the company will be constantly issuing some trivial amount of debt every time there is a positive dW_t shock to company's profitability X_t if the company is at the boundary. Second, most companies will optimally choose to have $z_{res} = 0$, implying that companies will never issue debt to pay dividends. This could happen because the value that company's equityholders can extract out of the investment opportunities directly depends on the cost of issuing debt, which is necessary to finance these investment opportunities. Therefore, by not issuing debt to pay dividends, companies can have lower interest rates in the future, and, therefore, finance more large investments.

Figure 7



These graphs show the value of equity and debt of the same company that is not (left graph) and is (right graph) owned by a PE. Company's cash flow is fixed at the level y_t is fixed at one, and values are shown as the second state variable - interest expenses - changes (horizontal axis).

5 Discussion of the main assumption of the model

The underlying assumption of the model is that financially distressed companies without PE-ownership cannot issue equity, while companies with PE-ownership can. As the result of this assumption, external financing costs exponentially increase with company's leverage for companies without PE-ownership, making financial distress costly, and affecting their ex-ante policies.

The assumption that companies without PE-ownership cannot issue equity in distress is strong, and is mainly made to achieve the tractability of the solution. Results of the model would hold if one assumed instead that companies without PE-ownership could issue equity, but costs of equity issuance increased with leverage. This section 1) discusses these two assumptions - that companies cannot issue equity at all or that costs of equity issuance increase with company's leverage - from the point of view of theoretical and empirical evidence, and 2) shows what happens when the company is acquired by a private equity firm.

Start with the equity issuance costs by companies without PE-ownership. Myers and Majluf (1984) show that if there is information asymmetry between company's insiders selling stocks and outside investors buying stocks, newly issued stocks are sold at a discount. As Appendix A shows, a simple modification of their model implies that equity issuance discount is higher if the company has some outstanding debt. The intuition behind debt and equity issuance costs is that any information asymmetry about the value of underlying assets of the company is amplified by company's leverage because equity is a residual claim on company's assets.[27]

While the model from Appendix A is fairly simple, it does show unequivocally that issuing equity becomes expensive for highly levered companies, and lays out the conditions that are necessary to reverse this result. Specifically, only if there is an investor with 1) enough funds that 2) does not suffer from the information asymmetry problem, equity issuance costs will not be affected by company's leverage. It is easy to see why companies with PE-ownership satisfy both of these conditions (PE-firms have money, and they are actively engaged in the management of their portfolio companies[28]), while both public and private companies without PE-ownership only satisfy one. In case of public companies, there are enough deep-pocket investors that can provide financing, but managers usually know more about the company than outside investors. In case of most private companies, their managers and indeed their owners, and so there is no information asymmetry, but owners usually do not have enough resources to invest into the company.

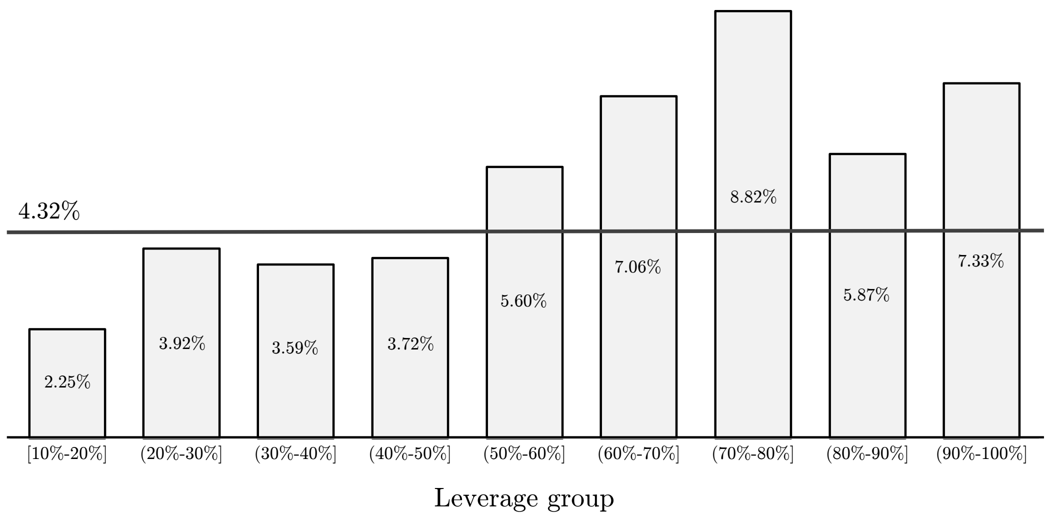
Figure 8 shows how company's stock price reacts to the SEO announcement, depending on company's leverage. The figure supports the result that costs of equity issuance indeed increase with company's leverage. Undoubtedly this result suffers from the selection bias, since companies endogenously choose which type of external financing they want to raise. Nevertheless, the equity issuance discount would probably be even higher if one could control for the selection bias, since costs of debt issuance increase with company's leverage, and so the highly levered companies that optimally issue equity should be those for which the equity issuance costs are the smallest.

Several other papers in the literature address the question of equity issuance costs by highly levered or distressed companies, but empirical evidence is mixed. Below is a review of papers that study this question. The overall conclusion that follows is that most companies issue equity when their leverage is low; there are instances of equity issuances by financially distressed companies,

[27]While Appendix A shows a very stylized model, a companion paper to this one extends the model from the appendix to a full dynamic model, and shows that the main intuition holds, and that equity issuance costs (i.e. the share price discount following the announcement of equity issuance by the company) increase with the leverage. In this model, highly-levered companies are also distressed companies, and consistent with the model predictions, distressed companies are characterized by severe information asymmetry, as shown by Hertzel and Smith (1993) and Lim and Schwert (2019).

[28]See, for instance, Gertner and Kaplan (1996), Acharya and Kehoe (2008), or Cornelli and Karakas (2008)

Figure 8
Stock price discount following equity issuance announcement



Data is based on SDC/Platinum database that tracks equity issuances, and shows the average stock price reaction following an equity issuance announcement. Each bar represents the average discount for a group of companies with a given leverage; for instance, among companies, whose leverage was between 30% and 40% at the time when they announced an equity issuance, the stock price fell by 3.59% on average. Negative 4.32% (red line) is the average stock price reaction following an equity issuance announcement.

but the costs are high, and such companies use equity financing because they cannot raise debt.

The first group of papers argues that most companies issue equity when their performance is good. For instance, Senber and Senber (1995) report a complete absence of equity issuance by distressed companies. Fama and French (2005) show that equity issuances are frequent, but most companies issue equity when their leverage is low. Similarly, Mikkelson and Partch (1986) and Eckbo, Masulis, and Norli (2007) find that equity issuances for cash are rare - both in absolute level and relative to public debt issuances. Some other studies provide indirect evidence that companies in distress do not issue equity. Korajczyk, Lucas, and McDonal (1990) find that company's leverage does not increase significantly two years before an SEO; should firms issue equity to make required debt payments when internally generated cash flow is insufficient, one would expect to find an increase in leverage prior to an SEO. DeAngelo, DeAngelo and Stulz (2010) find that the average leverage of a companies before an SEO is only 27%. Denis and McKeon (2012) show that companies, whose leverage is above the target, tend to cover financial deficit by issuing new debt and increasing leverage further.

Other authors argue in contrary that a sizable number of distressed companies issue equity, but they sell new shares at a large discount, and do so because debt financing is unavailable. Park (2017) finds that public equity offerings decrease for firms in distress, but private placements increase. Walker and Wu (2019) find that a third of all SEOs are conducted by financially distressed companies. Both of these papers, however, use the distress measure from Campbell, Hilscher, and Szilagyi (2008), which is only partially related to company's leverage. Indeed, the average leverage in the subsample of distressed companies in Walker and Wu is 32%, which implies that these companies are in distress for reasons other than their indebtedness, and they likely have very limited access to debt financing. This conclusion is further reinforced by Lim and Schwert (2019) who study all private placement of equity (PIPEs) by U.S. companies. They find that most companies issuing PIPEs are small distressed companies without access to debt markets: the median leverage of companies issuing PIPEs is only 7.2%, and 93% of all companies do not have credit rating. When such firms issue PIPEs, they offer shares to the market at a large discount.

The model derived in this paper assumes that companies without PE-ownership always have access to debt capital markets. Therefore, the assumption that such companies do not issue equity to pay required debt payments in distress is consistent with empirical evidence discussed above.

6 Model Results

6.1 Parameter values

The results of the model depend on the parameter values that are used to solve the model. Most of the parameters, however, are hard to estimate directly in the data, and there is a substantial cross-heterogeneity. Another concern, particularly related to the subject of this paper, is that PE firms do not choose buyout targets randomly. It is, therefore, possible that parameter values that describe PE-backed companies in the data are different from the parameter values that describe companies without PE-ownership. This paper does not address the selection bias, but it is important to discuss two approaches that could potentially alleviate it, and why the paper does not take them.

The first approach that could resolve the selection bias is to solve the model mathematically and find which companies PE firms prefer to acquire. Indeed, acquisitions of different companies can bring different returns to the PE: companies that need external financing the most would benefit the most from having a PE-sponsor, and, therefore, should be the preferred targets for PE-buyouts.

Therefore, one could solve, within the model, for the optimal set of parameters that a company should have to maximize the return of a PE in case the PE invests in this company. The problem with this approach is that the maximization problem might be unbounded - that is, the expected return might be monotonically increasing in one or several parameters (for instance, in δ_2 - size of large investments that require external financing). The parameter space would then need to be restricted based on the type of companies that are available for buyouts in the data, and this is outside of the scope of this paper.

The second approach that could resolve the selection bias, and which is also not taken in this paper, is to structurally estimate the model, based on the data for companies that do and do not have PE-ownership. The problem with this approach is that PE-backed companies report data differently from companies without PE-ownership. Both types of companies might have similar items on their income statement and the balance sheet, but the meaning of those numbers is different. Shareholder loans is one such example: they are treated as debt on the balance sheet, but are, in fact, equity that is structured as debt. There are some other problems, unrelated to the structure of PE-buyouts, but still making the data hard to compare: for instance, the assets value of PE-backed companies likely better reflects their market value than assets of other companies, which is due to the fact that company's assets are reevaluated to reflect the acquisition price at the time of the buyout.[29]

It is important to note that the previous paragraph does not imply that it is completely impossible to run a structural estimation to analyze the underlying difference between companies with and without PE-ownership. However, doing so would require a lot of efforts to adjust the data that is reported by both types of companies. This paper takes a first step in that direction by adjusting debt-related values, but data for the moments that could identify other parameters also needs to be collected.

In short, the paper does not address the selection bias, and instead explains to what extent the observed financing policies and performance of PE-backed companies can be explained by the presence of a PE-sponsor. Table 12 summarizes the parameter values used to solve the model, and all parameters are assumed to be identical between companies that do and do not have PE-

[29]Therefore, if one was computing the market-to-book ratio for PE-backed companies, for instance, they would find a value below but close to one, while most public companies have market-to-book ratio above one.

Table 12
Parameter values

Company-specific parameters			Economy-wide parameters		
unconditional growth rate	μ	-1%	risk-free rate	r_f	6%
size of small inv. opportunities	δ_1	2%	risk premium	rp	4%
size of large inv. opportunities	δ_2	10%	corporate tax rate	τ	20%
intensity of arrivals of large inv. opportunities	λ	0.4	price of capital	H	13.5
intensity of PE-exits	λ_{PE}	0.15			
bankruptcy costs	α	10%			
idiosyncratic volatility	σ_{ID}	22%			
systematic volatility	σ_s	12%			
total volatility	σ	25%			

ownership.

The unconditional growth rate of company's productivity under the risk-neutral probability measure μ is -1% - that is, on average, company's productivity falls if the company does not invest. Company's growth rate should increase when moving from the risk-neutral probability measure to the actual probability measure, and so risk-premium[30] 4% is added to the company's growth rate when the model is simulated, therefore, increasing the unconditional growth rate up to 3%. By adding small investments, the company can increase the growth rate up to $\mu + \delta_1(1+\gamma)$, which becomes 5.2% annually (under the actual probability measure). The growth rate can further be increased by taking large investment opportunities: the growth rate of a company that takes all large investment opportunities is, on average, $\mu + \delta_1(1+\gamma) + \lambda\delta_2(1+\gamma)$, which is 9.6%.

Price of capital H has a significant influence on the results of the model, since it controls the profitability of company's investments (to the same extent that γ does), and also the value of debt in default, since the model assumes that debtholders in default recover company's assets at their market price after bankruptcy costs are accounted for. The value of H in the model is 13.5, and two moments discipline it. First, a company without PE-ownership and zero leverage has market-to-book ratio of one, this way linking the price of capital to the value of a company that operates this capital. Second, the recovery rate of debt in default (relative to the face value) is 47%, which is roughly consistent with the recovery rate on rated debt.[31]

[30]Risk-premium is probably a confusing name for a variable, since I later speak about risk-premium on the market portfolio and the PE-portfolio. In the context of the current paragraph, risk-premium is the difference in the growth rate of company's productivity under the actual probability measure and the risk-neutral probability measure. Since market portfolio is a levered claim on company's asset, 4% difference in the growth rate becomes the 5.6% market excess return, which is roughly consistent with the data. This paper does not take a stance on where the 4% risk-premium comes from, which might be from the risk-aversion of the representative agent, or some other unrelated market factors.

[31]For full disclosure, the range of recovery rates in the data is wide: 14% on junior subordinated bonds, to 75% on first lien bank loan. The recovery rate in the model should roughly aggregate the recovery rate on different

Estimates of bankruptcy costs α, which in this paper is 10%, vary from very low to very high. For example, Gruber and Warner (1977) finds that direct bankruptcy costs are about 1% of the assets value, and Andrade and Kaplan (1998) report the value of about 20%. Some authors used a structural estimation approach to infer the bankruptcy costs from companies observed decisions. In particular, Davydenko, Strebulaev and Zhao (2012) find that default costs are in the range of 10% and 30%, Hennessy and Whited (2007) report values between 8.4% and 15.1%, and Glover (2016) finds the value of about 45%. Glovers estimates are well-above estimates of other authors, but as argued by Reindl, Stoughton, and Zechner (2017), it is because Glover assumes that all companies follow optimal leverage policy, while it is not necessarily the case in the data. The authors estimate a similar model without imposing optimal capital structure and using stock prices instead, and find substantially lower values of bankruptcy costs (20%).

Intensity of PE-exit is assumed to be $\lambda_{PE} = 0.15$, implying that the PE usually controls a company for six and a half years. It is slightly higher than the average number of annual reports that I observe for companies in my sample (5.6), but the number of annual reports underestimates the length of a PE-investments.

6.2 Capital structure and financial policies

The solution of the model shows that companies without PE-ownership only issue debt when they have large investment opportunities, and do not issue debt to pay dividends. In other words, companies optimally choose to maintain low leverage even though some debt could be issued at almost the risk-free rate while giving the company tax-shield advantage. Companies avoid leverage because greater leverage increases the rates at which additional debt can be raised in the future and, therefore, makes future investment opportunities less profitable. Moreover, companies with high leverage suffer from the debt overhang problem: equityholders control company's investments, but parts of the benefits of the investments go to debtholders. If a big enough share of benefits of an investment goes to debtholders, but equityholders pay the full price, they will optimally choose to forgo the investment.

The debt overhang problem that affect companies without PE-ownership deserves some spe-

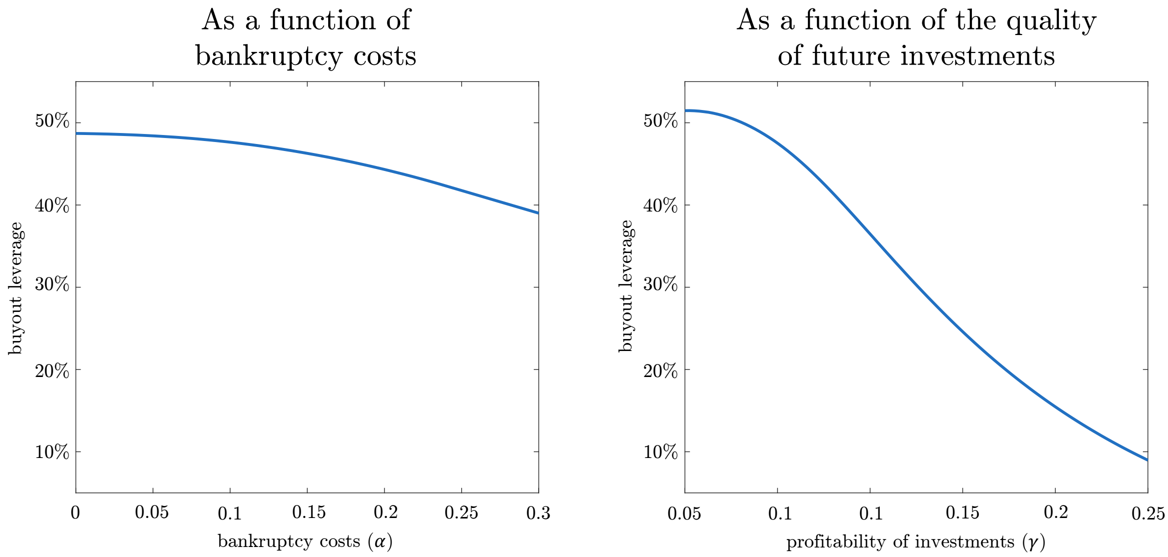
types of debt that companies in the data have. In this sense, 47% recovery rate in the model is similar to 54% average recovery rate of the first lien bonds and 46% average recovery rate of the unsecured bank loans `https://www.researchpool.com/download/?report_id=1751185&show_pdf_data=true`.

cial discussion. The way large investments are modeled, they are always financed by issuing debt. Therefore, independent of company's leverage, debtholders do not get benefits from large investments. Equation (5) shows this mathematically. Intuitively, it follows from the assumption that debt markets are competitive: if a company does not raise debt to finance a large investment opportunity, company's debt value will not change. Therefore, the current value of debt becomes the outside option for company's debtholders, and they will provide debt on terms that make them indifferent to the outside option. Therefore, whenever a company takes a large investment opportunity, the benefits fully go to equityholders, eliminating the debt overhang problem. Note, however, that companies with high leverage will still forgo large investments because debt issuance costs are high.[32] In contrast, small investment opportunities that the company can finance out of the operating cash flow can become a subject to debt overhang problem, and therefore companies have incentives to keep the leverage low.

Companies without PE-ownership take large investment opportunities as long as their leverage is below 41.5%, which corresponds to the inverse coverage ratio of $z = 0.4$. At that point, the marginal interest rate to issue more debt is 9.1%. The threshold is different for small investments: a company takes them as long as the cash flow is sufficient to both pay interest expenses and invest. The cutoff leverage for small investment opportunities is 67.4%, which corresponds to the inverse coverage ratio of of $z = 0.73$. If the company was to take small investment opportunities after that point, it would have to issue at least some amount of debt, since the cash flow alone would not be sufficient to cover both interest expenses and investments, but the marginal interest rate to issue more debt is 17.8% at that point. As long as company's inverse coverage ratio is between 0.73 and 1, the company does not take any investment opportunities - small or large - but also does not need to raise external financing to cover debt payments since the cash flow is still above the level of interest expenses. Once the inverse coverage ratio exceeds one, the company constantly issues debt to pay interest expenses, at the marginal interest rate that constantly grows. The default happens if the inverse coverage ratio exceeds 1.23.

[32] In this sense, otherwise profitable investment opportunities become ex-post not profitable to both equityholders and debtholders. This happens because an investment opportunity, if is taken and financed by issuing debt, increases company's leverage, therefore, increasing the default probability. Note that this problem could not be solved by debt renegotiation if the money still had to come from debtholders - issuing debt at terms that leave debtholders indifferent is already the best outcome that debt renegotiation could achieve. The only solution, in which the investment could be taken, while still increasing the value of at least one party and not hurting the other, would be to let the company issue equity. However, if equity issuance costs increase with leverage, as is the case in the data, there is no solution.

Figure 9
Leverage in a PE buyout



The solution looks very different for companies with PE-ownership. To start with, these companies issue significant amount of debt even when they do not need debt to finance investment opportunities. Therefore, the buyout leverage is 48.9%, which is very close to the empirical estimates. This leverage corresponds to the inverse coverage ratio of $z = 0.45$. Two factors explain the high leverage of PE-backed companies in the model. First, and most important, high leverage does not prevent PE-backed companies from investments. In case debt financing is too expensive, the PE-backed company can always get an equity injection from the PE-sponsor to pay for the investment. It does not mean that PE-ownership completely eliminates the debt overhang problem - companies with very high value of leverage still do not invest - but PE-ownership does significantly alleviate it.

Second, PE-ownership makes company's debt less risky: in distress, when company's cash flow is not sufficient to cover interest expenses, a PE-backed company does not need to continuously issue more debt at exponentially increasing rates to cover interest expenses on previously issued debt, and instead can get money from the PE-sponsor. This effectively cuts the debt spiral that companies without PE-ownership are prone to in distress, and, therefore, reduces the probability of default for PE-backed companies.

Figure 9 analyses to what extent the capital structure in a buyout is affected by direct and indirect costs of debt issuance. Bankruptcy costs α control the direct costs of debt issuance, as they change the recovery rates for debtholders in default. Profitability of company's future investment opportunities γ controls the indirect costs of debt issuance, as highly levered companies will have to forgo some of the future investments. As follows from the figure, the buyout leverage is much more sensitive to the indirect costs of debt issuance.

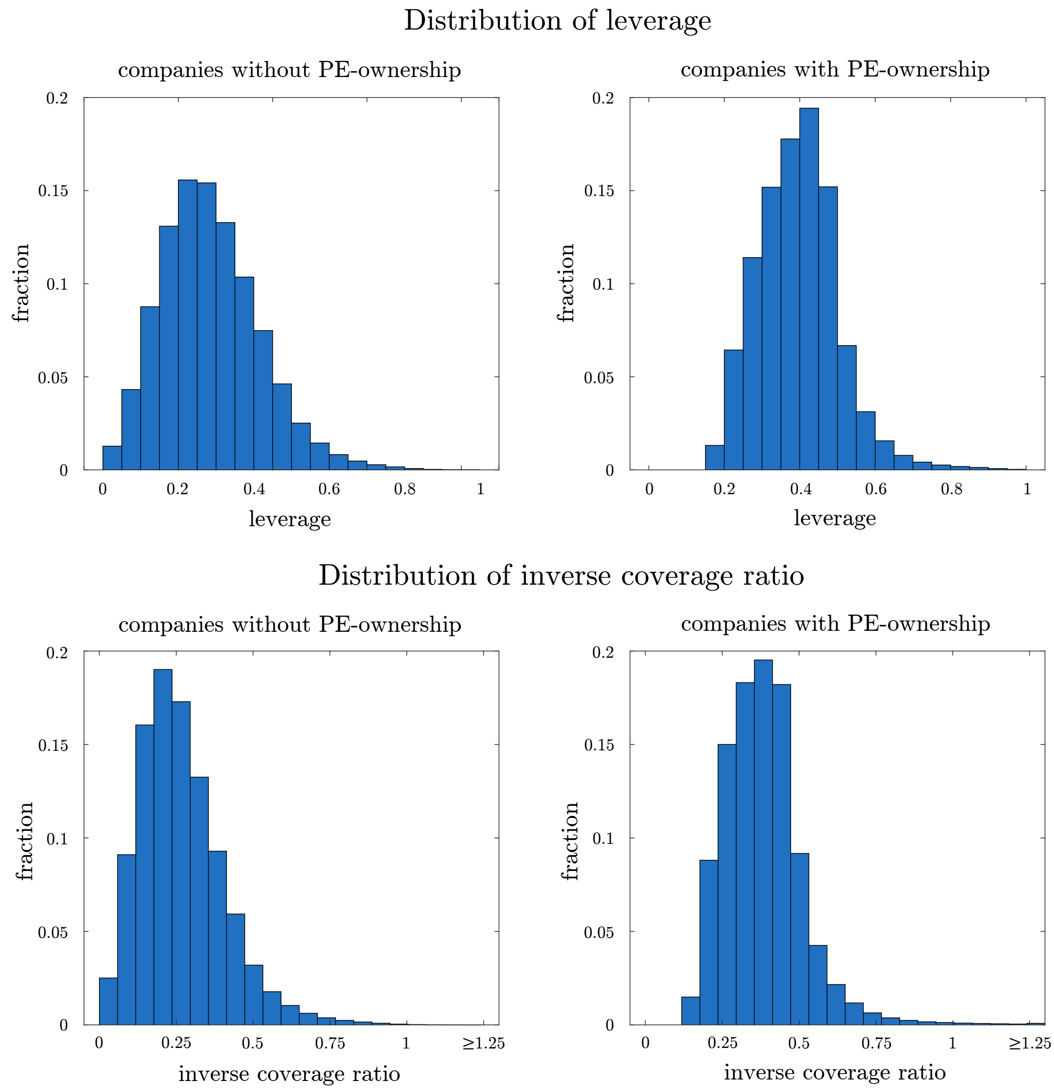
Furthermore, PE-backed companies issue additional debt to pay dividends when their leverage falls below 17.3%, which corresponds to the inverse coverage ratio of $z = 0.16$; every time this happens, PE-backed companies bring the leverage back to its optimal level of 48.9% ($z = 0.45$). PE-backed companies take all investment opportunities - large and small - as long as the leverage stays below 78.5% (or $z = 0.94$). Investment opportunities are paid for by issuing debt if company's leverage is below the optimum level of 48.9%, and by receiving money from the PE-sponsor if the leverage is above that value. As long as company's inverse coverage ratio stays between 1 and 1.8, the company continuously issues equity to pay interest expenses, and default happens when the inverse coverage ratio exceeds the 1.8 threshold.

6.3 Cross-sectional distributions

The previous subsection describes optimal financial and capital structure choices. However, the actual distribution of leverage and/or investments can look very different, as the result of idiosyncratic shocks and companies' responses to them. Therefore, I simulate a cross-section of companies to study how it compares to the data.

In order to run a simulation, I generate a group of 500 companies with PE-ownership, and another group of 500 companies without PE-ownership. All 1000 companies start with the same cash flow $y_0 = 1$, and are optimally levered (i.e. companies without PE-ownership have no debt, and companies with PE-ownership have 48.9% leverage).Throughout the simulation, companies make decision about investments and debt issuance consistent with the solution to the model. Every period, each company receives a Brownian shock that affects its cash flow and inverse coverage ratio. Furthermore, all companies have a small investment opportunity, and some companies, in addition, receive a large investment opportunity. Companies optimally choose if they want to invest, and how to finance the investment. Companies without PE-ownership that are in distress issue debt to pay interest expenses that are not covered by the cash flow. At the end of each

Figure 10
Steady-state distribution



Graphs are based on the result of model simulation. The simulation has 500 companies with PE-ownership, and 500 companies without PE-ownership, and runs for 600*36 periods (600 years), with each period being 1/36th of a year. When a company defaults or is sold (in case of PE-backed companies) during a simulation, it is replaced by another company with the same productivity, thus, maintaining a balanced sample. Distributions are based on the company-period observations from the final 300 years of the simulation. Inverse coverage ratio is the ratio of interest expenses to company's cash flow.

period, some companies may default, in which case they are replaced by newly born optimally levered companies of the same type, with the productivity of the defaulted companies, but only $(1-\alpha)$ fraction of the assets. In addition, companies with PE-ownership sometimes are sold to the market, in which case they are also replaced by another optimally levered company with the same productivity and same value of assets. Companies with PE-ownership may issue additional debt if their leverage falls to a very low value as the result of a sequence of several positive shocks, in which case their leverage is reset to the 48.9% level. Each period of a simulation is 1/36 of a year, and the simulation is run for 3600 periods (600 years).

Figure 10 shows the cross-sectional distribution of leverage and inverse coverage ratios of companies with and without PE-ownership. These cross-sections distributions are based on the observations from the last 1800 periods of the simulation. The average and median leverage of companies without PE-ownership is 26.6% and 24.4% correspondingly. These numbers seems to be consistent with leverage values in the data, though there are different opinions on how leverage should be measured, or what is the appropriate comparable group of companies. For instance, Rajan and Zingales (1995) report that the average and median values of book leverage in the US are 31% and 27%, but when assets are adjusted for the market value of equity, the values change to 24% and 20%. Numbers for the UK in their paper are smaller: they find that the average and median book leverage in the UK are 21% and 18%, but average and median market leverage are 14% and 16%. Faulkender and Petersen (2005) argue that many companies have low leverage because they do not have access to debt capital markets, and so they restrict the sample of companies to those with S&P credit rating; they find that the average and median book leverage values in the US are 37% and 35%, and average and median values of the market leverage are 28% and 26%.

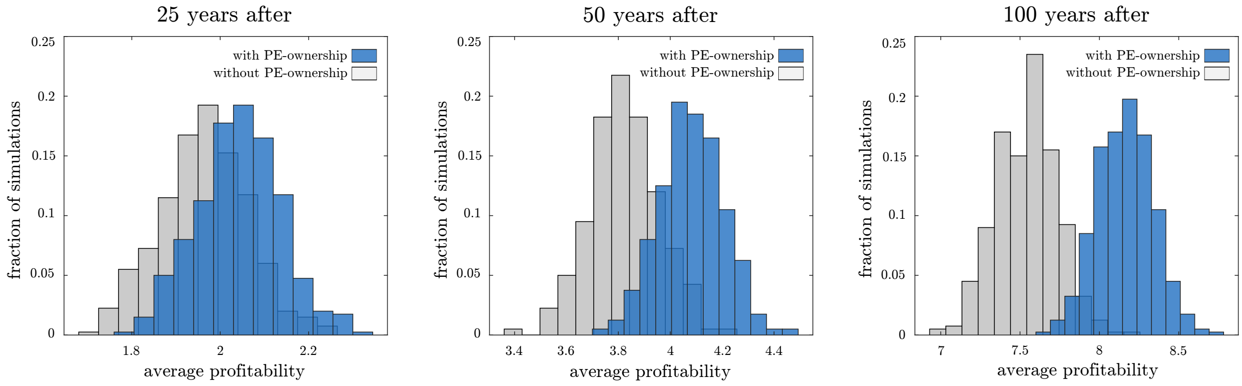
The average and median inverse coverage ratios of companies without PE-ownership in the model is 0.25 and 0.22. The inverse of that - the coverage ratio[33] - has mean 6.27 and median 4.57.[34] Rajan and Zingales (1995) report that the median interest coverage ratio in the US is between 2.41 and 4.05, and median interest coverage ratio in the UK is between 4.79 and 6.44.

The average and median values of leverage are both 0.4 for companies with PE-ownership in the model. The leverage falls from 48.9% in the acquisition year because companies, on average, increase the value of their assets. It is hard to find the data counterpart for the average value of leverage in a cross-section of PE-backed companies, mainly because there is no good way of measuring company's leverage after the buyout in the data. The market value of assets is not observed, and the book value of assets is misleading. One way to compare would be to look at

[33]Note that this paper uses the inverse coverage ratio rather than the coverage ratio variable because coverage ratio is not defined for companies with no debt. Also, all function in the modelcan be rewrtten in terms of the inverse coverage ratio, but not the coverage ratio - again, because the value for companies with no debt would not be defined: $E(y, c) = ye(c/y)$, which could not be rewritten to $E(y, c) = ce(y/x)$

[34]Difference between 6.27 and 1/0.25 is due to Jensen's inequality.

Figure 11
Divergence of profitability



Graphs are based on the results of model simulations. Each simulation has 500 companies with PE-ownership, and 500 companies without PE-ownership, and runs for 100*36 periods (100 years), with each period being 1/36th of a year. All 100 companies start simulations with the same $\log(y_t) = 0$, but y_t, changes during the simulation as the result of company's investments, and also idiosyncratic shocks. If a company defaults or is sold (in case of PE-backed companies) during the simulation, it is replaced by another company with the same productivity, thus, maintaining a balanced sample. Average $\log(y_t)$ is measured for both groups of companies in the final period of 24th, 49th, and 99th year of the simulation. Simulation is repeated 400 times, and distributions of average productivity is shown on the graph.

the value of the leverage of the company when the PE sells it, in the data and in the model. As Table 3 shows, the average and median values of leverage of a company at exit are 26% and 18%. Comparable numbers in the model are 33% and 34%, implying that the leverage distribution for PE-backed companies is skewed to the right. There might, however, be another reason why the model overestimates company's leverage at exit. As the next subsection shows, the model does not fully explain the outperformance of PE-backed companies, likely because there are other reasons how PE firms increase the value of their portfolio companies. Market timing might be one of such factor - PE firms might be able to find undervalued private companies and sell them later, therefore, increasing the value of the company by more than what the model explains (as all companies are fairly valued in the model). This could explain the discrepancy of the exit leverage in the model and in the data.

Turning to investments, almost all companies take small investment opportunities. Among companies without PE-ownership, 99.5% take a small investment opportunity every period, and the number is 99.8% for companies with PE-ownership. The same fraction of PE-backed companies take large investment opportunities when they arrive, but only 84.6% of companies without PE-ownership do so. Companies without PE-ownership finance all large investments by issuing debt, which is simply the results of the model assumption. PE-backed companies, in contrast, can choose whether they want to finance large investment opportunities by issuing debt or equity. The simulation shows, that the debt is issued in 72.8% of cases, and only 27.2% of large investments are financed by money from the PE-sponsor.

As PE-backed companies take large investment opportunities more frequently, they also grow faster. To show this, I simulate the model 400 times, and measure the average productivity of companies with and without PE-ownership after 25, 50, and 100 years of simulation. Figure 11 shows that indeed average productivity diverges. This is consistent with the empirical results. PE-backed companies on average have CAPEX and acquisitions of the same size as companies without PE-ownership, but the acquisition frequency is higher. As the result, PE-backed companies grow faster than the rest of the economy.

6.4 Performance

I next turn to the question to what extent the model can explain the outperformance of PE-backed companies vs. the rest of the market. Note, however, that companies with PE-ownership should grow faster than the market, since they are more levered and, therefore, more exposed to the aggregate shocks. A more interesting question is whether companies with PE-ownership outperform the market after accounting for risk.

To answer this question, I consider an index of companies with and without PE-ownership. The indices show how the wealth of an investor would change over time if she invested her wealth into a value-weighted portfolio of companies with and without PE-ownership that have the same productivity, and whose leverage is distributed according to the steady state distribution from Figure 10. Indices account for default, difference in average growth rate between companies with and without PE-ownership, and the fact that PE firms sometimes sell and buy their portfolio companies. Appendix D explains the construction in details. I repeat simulation 400 times.

Table 13 shows the relative performance of PE and non-PE indices across 400 simulations. "PE-equity" shows the performance of the PE firms itself (or investors in the PE), and "PE: equity+debt" shows the evolution of wealth of an investor who invests in both equity and debt of companies with PE-ownership. Hypothetical counterparts to the "market" would be S&P 500 index, to the "PE: equity" would S&P if all companies in S&P 500 were fully owned by PE firms, and to"PE: equity + debt" would be a portfolio that combined shares and debt of companies in

Table 13
Performance

	market	PE: equity	PE: equity + debt
total return =	11.55%	19.28%	13.36%
risk-free rate +	6%	6%	6%
risk-premium +	5.55%	6.57%	4.13%
alpha:		6.71%	3.23%
alpha due to tax-shield benefits		1.04%	0.57%
alpha due to greater investments		5.67%	2.66%
IRR	10.3%	16.9%	
beta	1	1.19	0.76
volatility	16.6%	19.7%	12.4%

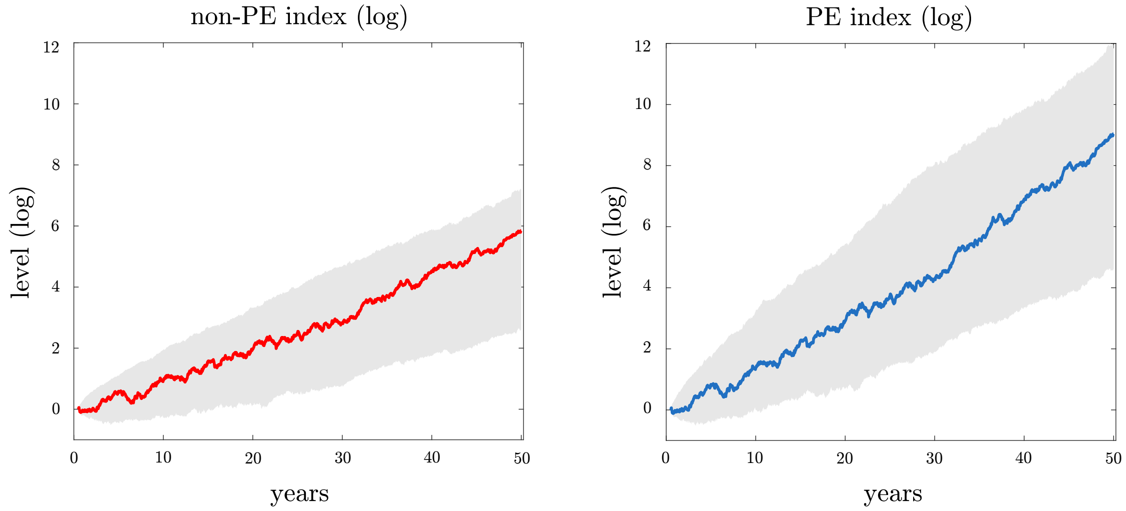
S&P 500 if they were all owned by the PE.

One issue with comparing returns on the market and PE industry in the data is is that returns are measured differently. Asset pricing literature usually measures average returns that the market (or portfolios) produce. In contrast, there is no way of studying immediate returns of PE funds since the value of their investments is not known before their investments are realized. Therefore, usually IRRs of PE industry is computed. Nevertheless, comparing IRRs of PE-industry with average returns on the market is misleading because of Jensen's inequality. The simplest way to see that is to notice that while the average return on the S&P 500 between 1960 and 2015 was 11.24% a year, the IRR on the market over the same time period was only 9.83%.

Fortunately, these issues can be addresses within the model, as the model shows both IRR and average returns on any type of investment. As Table 13 shows, the model explain the market performance well: the average annual return is 11.6%, which corresponds to the market IRR of 10.3%. The average risk-premia is 5.6% that arises because of the levered difference in the growth rate under the actual and risk-neutral probability probability measures. Average returns on the PE:equity index are greater than average market returns, which is partially explained by a greater exposure to the systematic risks of PE-backed companies (they are more levered, and so volatility and beta with respect to the market are greater for PE-backed companies). Nevertheless, even accounting for risk-exposure, PE:equity index produces 6.7% alpha.

This is how the model explains outperformance. Company's future cash flows increase when it is acquired by a PE, because the company will invest more, and because it will have greater tax-shield benefits. Nevertheless, the PE pays the price that all other investors on the market assign to the company. The price that is paid by the PE - and, therefore, observed by an econometrician

Figure 12
PE index and non-PE index



Indices show the log of the value of a dollar over time if this dollar is invested in a group of companies without PE-ownership (left graph) or with PE-ownership (right graph), according to weights that correspond to the steady-state distribution of these companies (refer to Figure 10 for the cross-sectional distribution). Indexes were computed by simulating the model 400 times, and the grey area shows the area within which 95% of the indices fall. Red line on the left graph and blue line on the right graph show indices from one of the simulations.

- is smaller than the value of future cash flows discounted at the appropriate rate. As the result, future realized returns will, on average, be higher than expected returns.

Going deeper, what happens is that company's ownership determines its future cash flows, and, therefore, its value. An important assumption is that the buyout happens at the lower price that the market assigns to the company and not the price that the PE assigns, which is rationalized by the fact that the PE industry is small relative to the rest of the market. That is, there is a large number of public investors who are indifferent between buying and selling a company at a low price, and a small number of big investors (PE), for whom the value of the company is bigger.

At first sight, the arguments in the previous is at odds with theoretical models, such as Grossman and Hart (1980), that say that corporate takeovers should not happen in equilibrium even if the value of the company could be greater under a different ownership. In the model of Grossman and Hart, a company is owned by a group of atomistic investors, and an outsider can increase company's value if she acquires the majority control of the company. Nevertheless, takeover does not happen in equilibrium - and the value of the company remains low - because there is no price at which the majority of current investors would agree to sell their shares; investors do not internalize their actions, and, therefore, no one wants to sell their share at a price below the post-takeover price. This argument would not work for PE-buyouts because they are structured differently: PE leaves no shares to outside investors (other than company's managements). Therefore, company's old investors do not have an option to hold their shares hoping that the buyout would go forward anyway, and their share price would go up.

As discussed above, the model explains alpha of PE:equity index through greater tax-shield benefits and greater investments (or faster growth that comes as the result of bigger investments). To what extent is alpha attributed to each of these factors? There is no definitive answer to this question, since the two channels interact with each other and with other factors;[35] for instance, because companies with PE-ownership invest more, they grow faster, and, therefore, issue debt more often, which in turn means they exploit greater benefits of tax-shield, and pay less taxes. Appendix D shows how the two effects are disentangled. I find that of the total alpha of 6.7%, greater investments explain 5.7%, and tax-shield benefits explain 1%. In other words, greater tax-shield benefits and greater investments explain 15% and 85% of the outperformance that this paper can explain.

Average return of 19.3% of the PE:equity index corresponds to 16.9% IRR. This value seems similar to the IRR that other researchers computed based on the LP data: 14-17% in Ang, et.al (2018), 15% Driessen, et.al (2012), and Franzoni, et.al (2012). One should remember, however, that returns based on the LP data are computed after accounting for the PE fees, and, therefore, the actual returns that the PE earns should be higher. Axelson, et.al (2014) claim that gross excess return over the market is 8.3% - 8.6%, implying gross total IRR of roughly 20%.

Another way to study whether the model fully exploits the outperformance of PE is to study withing the model the IRR on the whole company, that is company's debt and equity, and compare it to the results in Section 3. The third column of Table 13 shows that the IRR of the PE: equity+debt index is 13.36%, which is significantly lower than 32% in the Section 2. A number of factors can justify that. First, as already discussed, empirical results do not account for any transaction costs, which are high in the case of buyouts. Second, value-weighted returns rather than equal-weighted returns should be studied, and average returns on big companies are smaller

[35] The main additional factor, whose effect multiples the effect of tax-shield benefits and greater investments, is the difference in growth rate under the actual and risk-neutral probability measure.

than smaller companies.

Nevertheless, it seems that the model does not fully account for the alpha generated by PE-firms in the data, whether one uses returns based on the data from LPs, or IRRs inferred from the values of the company at the time of the buyout and sale. This difference in return is, therefore, accounted by factors outside of the model. The main such factor is likely the market timing. The model assumes that PE randomly choose companies that they acquire, while PE-firms likely carefully choose in which companies to invest. This implies that PE can find companies that are undervalued relative to their fundamentals, which can explain the difference between the observed outperformance, and outperformance predicted by the model.

7 Conclusion

This paper empirically analyzes a sample of companies with PE-ownership, specifically studying their capital structure, investment policies, and performance. This analysis contributes to the literature for three main reasons. First, the paper analyzes a representative sample of PE-backed companies, which mitigates the selection bias concerns that are frequent in other studies of PE-backed companies. Second, the paper identifies the owner of every single security that is issued to finance the buyout, and separates external debt from shareholder loans - securities that are recorded as debt but are paid for and held by the private equity owner. Third, the paper separates paper transactions that happen between the company and the company's investors (the PE and external debtholders) from transactions that involve the actual exchange of money.

The results of the analysis defy many of the common stereotypes about private equity business. It turns out that the leverage of companies with private equity ownership is significantly lower than traditionally considered, with many buyouts financed with either no or just a small amount of debt. Neither private equity owners show any evidence of over-extraction. An almost equal number of PE-backed companies pay dividends and receive money in follow-on equity injections from the PE-owner. If anything, private equity owners relax the financial constraints of their portfolio companies and allow them to invest when internal cash flow is low. The ability to receive equity injection from the private equity owner is particularly crucial for financially-distressed companies: as the analysis in this paper shows, such companies do not reduce their investments.

The theoretical model then explores the role of financial distress in explaining the behavior of companies with and without PE-ownership. Financial distress happens rarely, but it represents an event in which the company desperately needs external financing. For companies without PE-ownership, however, external financing is very expensive in distress, and so they risk falling in a continuous debt spiral every time financial distress happens. In contrast, PE-owners act as deep-pocket investors, and can rescue their portfolio companies from the financial distress.

Quantitative results of the model show the importance of the ability of PE-firms to relax the financial constraints of their portfolio companies in distress. The model abstracts away from all other potential benefits that private equity firms provide to their portfolio companies and/or their ability to select specific companies. Nevertheless, the model quantitatively reconciles the empirically-observed difference in the capital structure of companies with and without PE-ownership, and explains a large portion of the abnormal returns that private equity firms demonstrate in the data.

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8 Appendix

Example developed in this Appendix shows that presence of leverage amplifies the problem of information asymmetry, and make equity issuance costs grow with leverage. In the example, for the same uncertainty structure, a company with zero leverage optimally chooses to issue equity, while costs of equity issuance are preventive for a levered firm. The example is based on the seminal Myers and Majluf (1984) paper.

There is a company that has assets in place, and an investment opportunity. Company's quality is not known, but what is known is that it can either be good or bad with probabilities $p = (1-p) = 0.5$. Good company's asset value is 190, and bad company's asset value is 110. Required investment for the project is 100 for both types of companies, but the return is higher for the good company: 120 vs. 110. The project has to be financed now or never, and the company can only do it by issuing equity. For simplicity, investors are risk-neutral, and there is no discounting between periods, in which the investment takes place and return is realized. Figure 13 summarizes the example.

Figure 13

	Good $p = 0.5$	**Bad** $1 - p = 0.5$
Value of assets in place	190	110
Project required investment	100	100
Project return (gross)	120	100

Assume there is an equilibrium, in which both companies issue equity and finance the project. The value that outsiders assign to the company is then the following:

$$V^{outs.} = \frac{1}{2}(190 + 120 + 110 + 110) = 265$$

Because the company has to issue 100 of equity, the share that outside investors will require in return is $\frac{100}{265}$. In order for this to be an equilibrium, investors' beliefs should coincide with the actual behavior of companies. Therefore, both companies should be willing to take the investment opportunity. The good company knows its type, and it will invest if the value that is left to current shareholders is higher with the investment:

$$V^G = \left(1 - \frac{100}{265}\right)(190 + 120) = 193 > 190$$

where 190 is the value of the good company if the investment is not made, and no equity is issued. Equilibrium, in which both companies finance the project indeed exists.

Now consider a small modification of this example: assume that the company, whose type is still unknown, issued debt in the past. Face value of debt is 100, and it has to be repaid next period. Figure 14 summarizes the modified example. Notice that company's type cannot be revealed by the amount of debt it has, and no company defaults next period, independent of whether the project is taken or not.

Figure 14

	Good $p = 0.5$	**Bad** $1 - p = 0.5$
Value of assets in place	190	110
Project required investment	100	100
Project return (gross)	120	100
Debt to be repaid	100	100

Assume again that there is an equilibrium, in which both companies issue equity and finance the project. The value that outsiders assign to the company is then the following:

$$V^{outs.} = \frac{1}{2}(190 + 120 + 110 + 110) - 100 = 165$$

Naturally, company's equity value is now smaller, as debtholders also have a claim on company's assets.

In order for such equilibrium to exist, the good company should be willing to pool with the bad company. The good company still knows its type, and in choosing whether to invest or not, it compares the value to its current equityholders with and without the investment:

$$V^G = \left(1 - \frac{100}{165}\right)(90 + 120) = 82.7 < 90$$

Therefore, the good company chooses not to invest, which means there is no equilibrium in which both company issue equity. The only difference between the two examples is that the company is levered in the second example. This indeed shows that company's equity issuance costs increase with leverage.