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Essays on Value Creation and Risk Assessment in Private Equity-Sponsored Buyouts

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“Don't congratulate us when we buy a company. Any fool can buy a company.
Congratulate us when we sell it and when we've done something with it and created real value.”

Henry Kravis, Co-Founder & Partner of KKR

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List of Abbreviations

D	Debt
E	Equity
e.g.	exempli gratia
EBITDA	Earnings before interest, taxes, depreciation and amortization
et al.	et alii
etc.	et cetera
EURIBOR	Euro Interbank Offered Rate
EV	Enterprise Value
EVCA	European Private Equity and Venture Capital Association
FCF	Free Cash Flow
GBM	Geometric Brownian Motion
GP	General Partners
i.e.	id est
ICB	Industry Classification Benchmark
IRR	Internal Rate of Return
IPO	Initial Public Offering
IV	Instrumental Variable
KKR	Kohlberg Kravis & Roberts
LBO	Leveraged Buyout

LIBOR	London Interbank Offered Rate
LN	Natural Logarithm
LP	Limited Partner
MBO	Management Buyout
M&A	Merger and Acquisition
MSCI	Morgan Stanley Capital International
OLS	Ordinary Least Squares
p.	page
PE	Private Equity
PIPE	Private Investment in Public Equity
S&P	Standard & Poors
TVE	Thomson Venture Economics
UK	United Kingdom
US	United States (of America)
USD	United States Dollar
VC	Venture Capital
vs.	versus

I. Introduction

1. Motivation and Research Questions

The asset class private equity has become an important part of financial markets over the last 20 to 30 years. The term private equity typically includes several sub-asset classes, with venture capital and buyout investing as the two main investment types.[1] Venture capital is the investment in companies at a relatively early stage of development, i.e. the provision of start-up or growth capital. In contrast, buyouts encompass investments in more mature companies. Since a substantial part of a buyout target company's purchase price is often covered with debt, these investments are also called leveraged buyouts (LBOs). Both investment types have in common that they generally refer to investments in non-public companies (or the investment in public companies with the intent of taking them private).

Estimates of the global amount of capital managed by private equity funds differ, but lie around $2.4 trillion in 2011 according to the data provider Preqin (TheCityUK, 2011).[2] Buyout funds alone account for about two thirds of this capital. The particular importance of buyout financing becomes even clearer when considering that these funds accounted for approximately 25 percent of the worldwide merger and acquisitions (M&A) activity in the peak years of the last decade, i.e. between 2005 and 2008. In contrast, the relevance of venture capital has been steadily decreasing after the boom and bust of the late 1990s and early 2000s (Metrick and Yasuda, 2010).

With regard to the geographic distribution of LBOs, North America and Europe[3] account for about 90-95% of all transactions, in terms of both number of deals and transaction size (Strömberg, 2008). However, strong economic growth in Asian countries has substantially increased capital flows into Asian private equity over the last decade. This development is expected to continue in the upcoming years (Cumming et al., 2011).

[1] Other investment types entail mezzanine and distressed security investing as well as the provision of capital to public companies through so called PIPE investments (private investment in public equity).

[2] Metrick and Yasuda (2010) estimate that private equity funds globally manage approximately $1 trillion of capital, but do not provide a year specification. However, the first version of their article has been published in 2007, which could indicate that this number refers to the year 2006.

[3] Including Continental Europe, Scandinavia and the United Kingdom.

This thesis specifically focuses on LBO investments. In this context, the terms private equity and buyout are used interchangeably. LBOs first emerged as an important phenomenon in the 1980s.[4] In a leveraged buyout, a company is acquired by an investment firm, the private equity sponsor, using the private equity fund's equity capital and outside debt financing. In his seminal paper Jensen (1989) argues that LBOs represent a superior corporate organizational form as they solve the conflict between owners and managers over the use of free cash flows through the use of highly leveraged capital structures. Furthermore, private equity sponsors typically implement specific management incentive programs in their portfolio companies and buy majority stakes which makes it possible to be an 'active' investor, i.e. an investor who actively monitors the management and gets involved in the long-term strategy of the portfolio company.[5]

Four features make this sub-asset class a particularly interesting subject of research. *Firstly*, in spite of the cyclicality of the private equity business, fundraising activity and, associated therewith, investment activity has been steadily increasing over the last three decades, indicating the macroeconomic importance of private equity (Robinson and Sensoy, 2010). Private equity funds globally invested about $180 billion in 2010, thereof 70% (or $126 billion) by buyout funds alone, which represents 7.4% of the global M&A volume. (TheCityUK, 2011). *Secondly*, despite this increasing macroeconomic importance, however, the public opinion on private equity has remained rather negative, almost hostile. The best example for this skepticism is a speech delivered by the ex-chairman of the Social Democratic party in Germany, Franz Müntefering, calling private equity and hedge funds irresponsible, short-term oriented locusts who act to the detriment of their portfolio companies. Interestingly, this statement suggests the question of how do private equity firms create value - a question not adequately answered so far. *Thirdly*, several business aspects are highly relevant in private equity investments. For example, the questions of how to value and financially structure privately-held companies, how to efficiently incentivize the management, and how to practice active ownership and control are particularly important (Talmor and Vasvari, 2011). These aspects of the private equity industry make it an interesting and

[4] The roots of private equity as an asset class can be dated back to the 1930s and 1940s, when wealthy families provided capital to privately-held companies (Talmor and Vasvari, 2011).

[5] For example, boards of private equity-backed companies meet more frequently than boards of public firms and it is relatively common that private equity sponsors replace parts of the management of their portfolio companies (see, e.g., Acharya et al., 2010).

definable object of study. *Fourthly*, since private equity sponsors often use large amounts of debt capital to finance buyout transactions, the financial crisis of 2007-2009 had a strong impact on the private equity industry. For example, debt became scarce and more expensive leading to fewer highly leveraged capital structures and decreasing buyout sizes (Talmor and Vasvari, 2011). This observation raises the question whether the present private equity business model can survive in the long term and underlines the current relevance of research on private equity.

By now, there is a considerable amount of research dealing with private equity. Existing studies can be grouped around two major streams of literature. The first one focuses on *fund-level* analyses, especially on the *structure* and *performance* of private equity funds.[6] Significant progress has been made in this area in the last couple of years (see, e.g., Kaplan and Schoar, 2005, Kaserer and Diller, 2005, Axelson et al., 2009, Phalippou and Gottschalg, 2009, Metrick and Yasuda, 2010, Harris et al., 2011).

With regard to the *structure* of these funds (including compensation schemes), Axelson et al. (2009) developed a theoretical model to explain the financial structure of private equity funds. They show that the typical financial structure of those funds reduces agency conflicts between fund managers and their limited partners. In this context, the model indicates that the variable compensation component of fund managers should be based on aggregate excess fund returns and not calculated on a deal-by-deal basis. In addition, private equity funds should use external debt (on a deal-by-deal basis) to finance individual transactions. Interestingly, these theoretically proposed features correspond to the actual structure of private equity funds (Metrick and Yasuda, 2010).[7] Metrick and Yasuda (2010) also empirically analyse the actual compensation of private equity fund managers based on 144 buyout funds. The results show that about two-thirds of total revenues to fund managers can be explained by fixed revenues (mainly management fees) and only one-third by variable components (mainly carried interest).

[6] Other relevant aspects on fund level include private equity fund accounting, listed private equity and secondary fund transactions (see, e.g., Talmor and Vasvari, 2011).

[7] In contrast to carried interest, transaction and monitoring fees are calculated on a deal-by-deal basis in reality (Metrick and Yasuda, 2010).

In addition to the structure of private equity funds, the *performance* of these funds has been extensively analysed in the last couple of years. Kaplan and Schoar (2005) conducted the first large-scale empirical analysis on US private equity funds. Using fund cash flow data from Venture Economics they report that buyout funds (vintage years 1984-1995) exhibit lower returns (net of fees) than the S&P 500. In other words, limited partners (LPs) would have been better off when investing in public stock markets instead of private equity funds. Using a similar data set, Phalippou and Gottschalg (2009) report comparable results. More recently, Harris et al. (2011) conducted a performance study using a sample of US buyout funds obtained through the data provider Burgiss. They find that buyout fund returns exceed those of public markets for most vintage years in the 1980s, 1990s and 2000s. Compared to previous studies the data set used by Harris et al. (2011) has a better coverage for the 1990s and 2000s. This indicates that buyout funds at least outperformed public markets in those periods. However, it remains open whether the reported outperformance of private equity is adequate, given the higher riskiness of this asset class (e.g. due to illiquidity issues and increased financial risk).

In addition to research on fund-level, the second stream of literature focuses on *deal-level* analyses, i.e. on individual private equity transactions. In this context, the deal-level determinants of risk and return are particularly relevant aspects. Even if there have been first notable contributions in this area (see, e.g., Jones and Rhodes-Kropf, 2003, Nikoskelainen and Wright, 2007, Groh et al., 2008 , Acharya et al., 2010, Axelson et al., 2010, Müller, 2010, Guo et al., 2011), this is still an under-researched field, especially as regards the role and importance of different value creation drivers. The essential reason for this is the lack of representative and sufficiently detailed deal-level data. In general, existing research on value creation distinguishes between three different value drivers, namely changes in operating performance, change in valuation multiples and value increase through higher tax shields (Guo et al., 2011). In this context, Kaplan (1989a), Lichtenberg and Siegel (1990) and Acharya et al. (2010) show that LBOs create value by improvements in operating performance. However, Guo et al. (2011) recently reported that operational improvements of buyout targets do not exceed those of public benchmarks. With regard to changes in valuation multiples, recent academic publications have addressed the question of entry buyout pricing (see, e.g., Axelson et al., 2010, Demiroglu and James, 2010, Bargeron et al., 2008). Nevertheless, the question of pricing in explaining private equity sponsors' returns has not

been answered satisfactorily so far. Similarly, a closer look at existing empirical research on the relationship between leverage and returns in buyouts does not provide an unambiguous and comprehensive picture. Until now, only selected aspects related to leverage have been examined, e.g. the role of tax shields (see, e.g., Kaplan, 1989b, Guo et al., 2011) and the disciplining effect of debt (see, e.g., Nikoskelainen and Wright, 2007).

In addition to the relevance of questions related to value creation, the analysis of deal-level risks associated with private equity investments is of extraordinary importance toward any understanding of this asset class. The risk of an investment can be seen as the deviation of the actual return from the expected return. A typical measure of risk is the standard deviation of returns. In this context, it is useful to distinguish between the asset volatility, i.e. the volatility of the enterprise value, and the equity volatility, i.e. the volatility of the equity investor's position in a company. Existing research in this area (see, e.g., Jones and Rhodes-Kropf, 2003, Groh et al., 2008, Müller, 2010,) has helped to improve the understanding of risks in private equity investments. Recently, Müller (2010) has shown that idiosyncratic risk matters when explaining equity returns of privately-held companies. Given that previous studies often only account for systematic risks, excluding idiosyncratic risks, this is an interesting finding. This also indicates that - apart from the general problem of getting access to appropriate data sets - an additional major challenge remains. Academic literature is still in search of an appropriate model for the measurement of buyout transactions risks. An appropriate model should allow differentiation between asset and equity risk and include systematic as well as idiosyncratic risk factors.

This dissertation is closely related to that second stream of literature and focuses on deal-level analyses. It contains four essays on these issues in an effort to fill the existing research gaps. These essays address two overarching research questions.

(1) *How is value created in buyout transactions and what are most important deal-level value creation drivers?*

(2) *How can deal-specific risks in private equity transactions be measured and what are the factors influencing these risks?*

2. Structure of the Thesis and Main Findings

Following the introduction in this chapter, the main part of this dissertation consists of four essays, each of which is a distinct research paper (sections II.1 to II.4). Each essay addresses one of the two overarching research questions and, in addition, makes independent academic contributions of its own. The first three essays are concerned with the question of how value is created in buyout transactions, each of them examining different aspects. Essay 4 focuses on transaction risks in buyout investments.

Essay 1 addresses the question of how value is created in private equity transactions, both theoretically and empirically. It distinguishes between four value creation drivers in this context, namely EBITDA growth, EBITDA valuation multiple expansion and de-leverage, i.e. the repayment of debt. EBITDA growth is further split into sales growth and EBITDA margin improvements. In order to differentiate between the return related to operational or financial risk the leverage effect is introduced as fourth value driver. This approach helps to shed light on the following question. Do private equity sponsors simply generate their returns by buying underpriced firms and by implementing highly leveraged capital structures, thereby increasing a company's bankruptcy risk, or are theses returns due to operational improvements of the portfolio company?

The essay shows that 46% of value creation can be attributed to operational effects and 18% to multiple expansion. The remaining third is due to the leverage effect. When comparing smaller to larger deals, the leverage effect is higher for larger deals, while revenue growth plays a more important role for smaller ones. Furthermore, transactions completed after 2001 rely more on the leverage effect than deals completed between 1991 and 2000. Finally, a closer look on deals completed in a recessionary environment shows that these deals generate higher median returns due to the value contribution of multiple expansion.

This essay contributes to the literature in two ways. Firstly, a new methodological approach on how to measure value creation is being introduced. This method allows distinguishing between returns due to operational or financial risk and supports a more intuitive interpretation of the results. Secondly, the application of this approach on a sample of 206 European transactions provides novel empirical evidence on the relative importance of different value creation drivers.

Essay 2 builds upon Essay 1 and specifically focuses on the value driver multiple expansion. It analyses the value contribution as well as the determinants of buyout pricing at entry and exit of private equity ownership, i.e. multiple expansion. Given the illiquidity of the private equity market and diverse information asymmetries between the parties involved in a transaction, buyout pricing seems to be a particularly interesting field of research. Existing academic and practical studies consistently show that multiple expansion is an important value driver (see, e.g., Guo et al., 2011, Brigl et al., 2008). However, no detailed and comprehensive explanation for this phenomenon has been provided so far.

By applying a multivariate analysis approach this essay shows that multiple expansion is a relevant factor in explaining equity returns and the result of skill rather than pure luck. Furthermore, more experienced private equity sponsors use more debt to finance a transaction and debt is positively related to entry buyout pricing. However, accounting for this effect, more experienced private equity sponsors are able to negotiate lower prices. With regard to exit pricing, the results show that higher sales growth during private equity ownership leads to higher exit prices. On the other hand, a stronger EBITDA margin improvement has no significant influence on exit pricing. In addition, deals conducted by first-time funds which are realized in a later stage of a fund's life cycle, i.e. closer to the end of a fund's lifetime, are associated with lower exit prices. This can be explained by the increased exit pressure for the private equity sponsor, especially when raising a follow-on fund at that moment. In addition, a potential buyer of a buyout company owned by an inexperienced private equity sponsor might demand a discount on the purchase price in order to account for higher information asymmetries about the portfolio company's condition. Information asymmetries could be higher as young private equity sponsors cannot exhibit a meaningful exit track record that serves as a positive signal in the M&A market.

Essay 2 contributes to the literature in two ways. Firstly, existing research on entry buyout pricing is broadly extended by using a sample of buyouts of different sizes and entry types which have been conducted by experienced as well as inexperienced private equity sponsors. In line with this, the influence of private equity sponsor reputation and experience receives particular attention. Secondly, the unique data set used for this analysis makes it possible to examine additionally the determinants of exit buyout pricing from the private equity sponsor's perspective, a topic not covered in the literature so far.

Similar to Essay 2, *Essay 3* focuses on a more detailed analysis of a selected value creation driver. Here, the impact of leverage on returns to private equity sponsors as well as on company performance is examined. Given that the burst of the credit bubble in 2008 has had a huge impact on the availability of debt, this topic is currently highly relevant. In this context, discussions about the effect of debt on returns in general, and particularly in buyout transactions, still continue and the question, whether the advantages related to leverage outweigh the disadvantages, or vice versa, remains open. For example, Axelson et al. (2010) argue that private equity sponsors act in their own interest when imposing highly leveraged capital structures on buyout targets, even to the detriment of their limited partners. This essay gives full consideration to this statement and investigates whether, and if yes, how, the use of leverage in buyout transactions impacts equity returns. In addition, it tackles the question to what extent the operational performance of companies is affected by these capital structures.

The essay's results report a positive relationship between leverage and equity returns indicating the return-boosting effects related to leverage. This implies that it is reasonable from a private equity sponsor's perspective to use as much debt as possible to finance a buyout. However it is also possible to 'over-leverage' a company, i.e. at a debt to total capital ratio of approximately 90% the increased company default risk outweighs the positive effects related to the use of debt resulting in decreasing equity returns. On the other hand, no significant relationship between leverage and risk-adjusted equity returns can be reported. This suggests that the return increase through higher debt ratios goes along with increasing risk. When it comes to the question of how the use of debt boosts equity returns, this essay provides evidence that private equity sponsors successfully conduct debt-equity-arbitrage in times of favorable debt market conditions. In other words, they successfully time debt markets.

This essay extends existing literature in several dimensions. Firstly, this is the first article particularly focusing on the role of leverage (and not only on selected aspects such as the role of tax shields) in explaining equity returns in private equity buyouts, both from a theoretical and empirical perspective. In line with this and in contrast to previous buyout related articles, it accounts for the fact that the causal relationship between leverage and equity returns is a challenging empirical task. Secondly, the data set used for the empirical analysis allows the presentation of different risk-adjusted and non-risk-adjusted performance measures on the

investment level. This helps to check the robustness of the results and to disentangle different effects of leverage. Thirdly, this study provides new evidence for debt-equity-arbitrage conducted by private equity sponsors, a topic that has recently received considerable attention in literature.

Essay 4 addresses the second overarching research question and is concerned with risks in buyout investments. The development of an appropriate and realistic model to calculate deal-specific equity and asset risks presents a major challenge in this area. The reason is that market values of buyout targets cannot be observed during private equity ownership. This is a major problem since the observable fluctuation in a value is a prerequisite for the calculation of risk, i.e. the standard deviation, of any asset. As a result, the knowledge regarding drivers of deal-specific buyout risks has been very limited until now. Recently, Groh at el. (2008) introduced a discrete model to calculate buyout investment risk. However, their model only allows for debt redemption and interest payments as well as default at two points in time during private equity ownership. This essay addresses this substantial restriction and extends the existing model by allowing for continuous default and redemption payments. The empirical application of this new approach helps to close the research gap on deal-specific buyout risks.

The results show higher equity risks for the periods from 1995 to 1999 and 2003 to 2005, both of which were boom periods in the private equity market. This could be due to the increasing availability of debt and decreasing costs of debt, both potentially boosting deal activity and leverage levels. With regard to portfolio company and private equity sponsor characteristics influencing equity risk, we find that larger deals are subject to less equity risk. Furthermore, the ownership stake, i.e. the equity risk exposure, as well as the reputation of the private equity sponsor is negatively related to deal-specific equity risk. This indicates that the reputation of a private equity sponsor can help to mitigate a potential risk shifting problem from equity to debt holders.

This essay's contribution to the literature is twofold. Firstly, it develops a new approach for adequately modelling buyout deal-level investment risks based on the Black-Cox default model. Secondly, the empirical application of the model on a data set of over several hundred buyout transactions helps to improve the understanding of deal-specific equity and asset risks.

In particular, it is possible to gain insights into the effect of portfolio company as well as private equity sponsor characteristics on deal-level risks.

In its last chapter this dissertation summarizes the results, discusses practical implications and provides an outlook on future research topics in the buyout area.

II. Essays

II.I Essay 1 - Value Creation Drivers in Private Equity Buyouts: Empirical Evidence from Europe

Abstract

Most of the existing research on value creation drivers in private equity buyouts is restricted to the US and the UK, whereas Continental European countries are not included. In addition, most of the generally applied methods for measuring the importance of different value creation drivers do not comprehensively account for all relevant aspects, such as a clear separation between operating and financial risk. This article tries to fill these research gaps and analyses value creation drivers in European (continental Europe and the UK) buyouts from the perspective of private equity sponsors using a unique dataset of 206 realized transactions. Our methodology allows us to separate the value contribution of leverage on private equity sponsors' returns from operational improvements and market effects. The results of the empirical analysis show that one third of the private equity sponsors' returns can be attributed to the use of leverage, whereas two thirds are due to operational and market effects. Moreover, value creation drivers are analysed with respect to different time periods, transaction size and general market conditions. Our results provide important insights into the private equity business model in Europe.

Keywords: private equity, buyout, value creation drivers

JEL Classification Code: G24, G32

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1. Introduction

The academic discussion of value creation in private equity (PE) transactions is still in its infancy. The opaqueness of the industry implies that there is lack of sufficiently detailed data to perform these analyses. Despite this, the question of how value is created in private equity transactions is crucial to evaluate this asset class and, therefore, there are a handful of notable contributions analyzing private equity value creation on transaction level to date which are discussed in the literature review below. However, most of these publications (i) focus exclusively on the Anglo-Saxon markets and (ii) fail to analyse value creation in a comprehensive framework that clearly distinguishes between operational and financial value drivers. This distinction is even more relevant today: as a result of the financial crisis and the subsequent turmoil in the credit markets PE activity in 2008 dropped to levels last seen in 2002. In the first 6 months of 2009 this trend even accelerated (Burrows and Wright, 2009). In our view, one can rightly assume that this crisis will mean a permanent decrease in the availability of leverage for the PE market as a whole as well as on the transaction level. This raises the question whether this marks the end of the PE business model which is often perceived to generate excess returns mainly through financial engineering (Cumming, Siegel and Wright, 2007). Therefore, we set out to refine the general value creation analysis traditionally employed in evaluating PE transactions to separate the effect of leverage and then applied this refined methodology to analyse a unique proprietary dataset of 206 European buyout transactions.

To date, only a handful of studies focused on value creation in private equity. On the fund level, notable contributions that compare fund performance to a public market equivalent[8] include Kaplan and Schoar (2005), Phalippou and Zollo (2005) and Kaserer and Diller (2005). On the transaction level, empirical work on value creation has focused to a large extent on the US (e.g. Kaplan, 1989, Guo et al., 2008, Groh and Gottschalg, 2009) and the UK (e.g. Nikoskelainen and Wright, 2007, Acharya et al., 2009).[9] Table II-1 provides an overview of the key findings for the literature mentioned above. Acharya et al. (2009) use a similar approach to separate financial and operational value drivers, although with a different

[8] Public market equivalents represent a benchmark that consists of publicly traded peer companies.

[9] Bergström, Grubb and Jonsson (2007) conducted one of the rare empirical value creations studies for Continental European countries analyzing operational effects on value creation in Swedish buyouts.

research focus. The contribution of this paper is twofold: firstly, we analyse a large sample of European transactions that covers both small and large deals. Secondly, we believe that our methodological approach allows a more intuitive interpretation of the results.

Table II-1: Literature Overview

TRANSACTION LEVEL

Author	Publication date	Region	Sample	Period	Results
Acharya/Hahn/ Kehoe	2009	U.K.	66 companies	1996-2004	Operational PE alpha of 8.9 IRR percentage points.
Groh/Gottschalg	2009	U.S.	133 companies	1984-2004	Operational PE alpha of 12.7 IRR percentage points.
Brigl et al.	2008	Europe	32 companies	2000-2006	Value drivers: • 46% sales growth • 10% margin expansion • 21% change in multiples • 23% debt paydown.
Guo/Hotchkiss/ Song	2008	U.S.	92 companies	1990-2005	Operational improvements in PE backed companies comparable to those of publicly listed peers.
Nikoskelainen/Wright	2007	U.K.	321 companies	1995-2004	Average IRR of 70.5% and holding period of 3.5 years. Investment size and the presence of post-buyout acquisitions increase the IRR significantly.
Pindur	2007	Europe	42 companies	1993-2004	Value drivers: • 45% EBITDA growth • 28% change in multiples • 22% free cash flow effect • 5% combination EBITDA/multiple.
Loos	2006	U.S. / Europe	57 companies	1980-2001	Value drivers: • 83% de-leverage and multiple effects • 25% sales growth • -8% change in margin.
Kaplan	1989	U.S.	76 companies	1980-1986	PE-backed firms experience increase in operating income, increase in net cash flow and decrease in capital expenditures. Operational improvements mainly through improved incentives.

FUND LEVEL

Author	Publication date	Region	Sample	Period	Results
Kaplan/Schoar	2005	U.S.	746 funds (thereof 169 buyout funds)	1980-2001	Net returns (net of fees) of PE funds equivalent to those of "Public Market Equivalents".
Phalippou/Zollo	2005	U.S.	983 funds	1980-1996	PE funds (net returns) underperform the S&P 500 by more than 3% per year.
Kaserer/Diller	2005	Europe	200 funds	1980-2003	Net returns (net of fees) of PE funds equivalent to those of "Public Market Equivalents".

Our key finding is that two thirds of value creation can be attributed to operational and market effects, while the remaining third is due to the leverage effect. When comparing smaller to larger deals (enterprise value over and under €100m), the leverage effect is higher for larger deals, while revenue growth plays a more important role for smaller deals. Furthermore, transactions completed in the period 2001-2005 rely more on the leverage effect and have a significantly shorter holding period than deals completed between 1991 and 2000. Finally, we look at the value creation of deals completed in a recessionary environment (1991-1993 and 2001-2003) and find that these deals generate higher median returns based on a higher use of leverage and a more significant multiple expansion.

The remainder of the paper is organized as follows: after an overview of the methodology employed to separate the different value creation levers, we will describe the data set and discuss the key descriptive statistics for the sample. This will be followed by a presentation and discussion of our results. The final section concludes.

2. Methodology

Most of the existing PE value creation models used by practitioners as well as in some academic publications (e.g. Pindur, 2007, Loos, 2006) differentiate between three basic value creation drivers: EBITDA growth, EBITDA multiple expansion and debt repayments[10]. Often EBITDA growth is further split into the contribution of sales growth and EBITDA margin improvements (e.g. Brigl et al., 2008, Pindur, 2007). Pindur (2007) provides a detailed discussion of the theoretical background of this value creation model.

However, the value creation approach laid out above does not explicitly take into account that the return expectations of the owners of a levered company consist of two components: (1) the operational risk and (2) the financial risk. This shortcoming has two major implications: firstly, the impact of leverage on the return to equity holders cannot be quantified and, secondly, since debt-to-equity ratios vary from transaction to transaction a comparison across deals is not possible. Therefore, we extended the described approach in order to resolve these disadvantages. In addition, our enhanced framework is also applicable

[10] Please note that the value impact of debt repayments (also called de-leverage effect) is often wrongly referred to as leverage effect. This is a common misnomer since the leverage effect actually refers to an increase in the return on equity through the use of debt (see, e.g., Loos, 2006).

for PE deals in a world with restricted debt availability which could be even more relevant in the future.

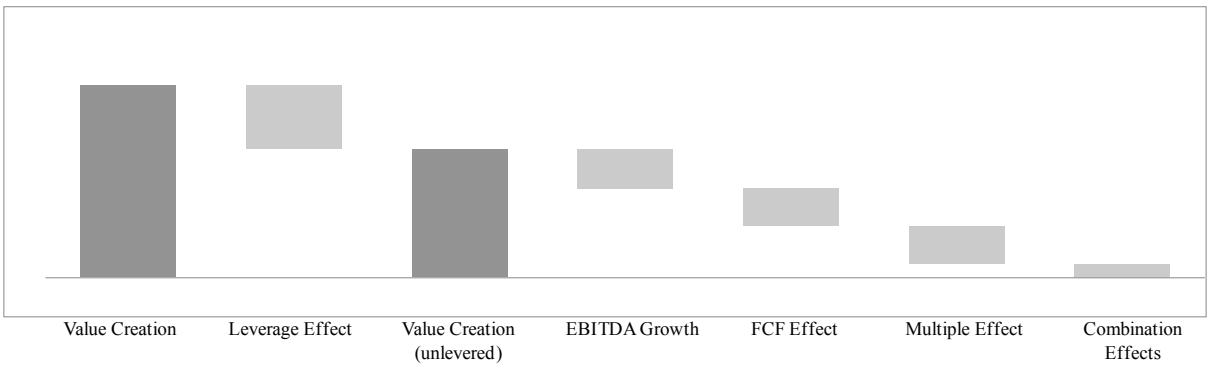
In order to quantify the return that can solely be attributed to a transaction's financial risk, we need to unlever the levered returns to equity holders, i.e. the returns to the PE sponsor (Acharya et al., 2009). We use the following unlevering-formula:

$$r_{u,i} = \frac{r_{l,i} + r_{D,i}\left(\frac{D}{E_i}\right)}{1 + \left(\frac{D}{E_i}\right)} \quad (1)$$

where $r_{u,i}$ represents the (unlevered) return generated by a 100% equity financed company and $r_{l,i}$ represents the (levered) return generated by a company financed with debt and equity, both from the perspective of the PE sponsor. In addition, D/E_i represents the average debt-to-equity ratio over the holding period as a measure of the average financial risk of a transaction and $r_{D,i}$ the average cost of all debt instruments used by the company. The tax shields are assumed to be risky given the relatively high debt-to-equity ratios, which leads to the possibility that the company does not generate sufficient income to fully realize the tax shield (further discussion in the robustness section below). In our analysis we assume $r_{D,i}$ = 7.5% based on the average LIBOR of 4.5% over the sample period plus the median all-in spread above LIBOR for Leveraged Buyouts (LBO) of 300 basis points between 1993 and 2005 based on the results of Ivashina and Kovner (2008).

Combining the traditional value creation model with our adjustments we can now set up our enhanced value creation model as indicated in Figure II-1.

Figure II-1: Methodology Overview



We unlever the returns to the PE sponsor in order to distinguish between the return due to financial and operational risks. This allows for a (financial) risk-adjusted comparison across individual deals. The difference between the levered and the unlevered return is the leverage effect. The unlevered return can then be divided into the three conventional value drivers: 'EBITDA growth', 'free cash flow (FCF) effect' as well as the 'multiple effect'. The value contribution of 'EBITDA growth' is the change in EBITDA between entry and exit multiplied with the EBITDA multiple at entry. The 'FCF effect' represents the free cash flows generated on a company level which are available for paying down debt and for financing dividends. The contribution of the 'multiple effect' is the multiple change between entry and exit multiplied with the EBITDA at entry. In line with Pindur (2007), we include a correction factor which accounts for simultaneous changes in EBITDA and EBITDA multiples. Often the combination factor is not explicitly shown, but either attributed to the EBITDA or the multiple effect which then overstates the respective value lever. The value lever 'EBITDA growth' can be further split into 'revenue growth' and 'EBITDA margin' change as well as a correction factor accounting for simultaneous changes in both drivers.

One final remark on the methodology applied: rather than employing multivariate tools, we have chosen this extended version of the conventional model as the analytical framework for our work. This approach allows a very intuitive and straightforward analysis of the individual value creation drivers in PE transactions, and ensures the applicability of the model for the PE industry. However, this does not prevent us from testing the validity and reliability of our results employing various univariate methods.

3. Data Set and Descriptive Statistics

In this section, we provide a description of the data set and discuss the validity of our data. First, we illustrate the data sources and the required level of detail to conduct our analysis. In addition, we present key descriptive statistics for our sample. Second, we discuss the sample selection bias issue which is a major concern when working with empirical data in private equity.

Our sample forms a subset of a database compiled by a leading European fund-of-funds as part of its due diligence effort. This database combines company financials with sponsor level cash flow data on over 1,000 buyout transactions. We arrived at our sample by

narrowing by region (Europe only) and then by imposing several restrictions regarding the necessary level of detail for our data: in a first step, we included only those transactions that had full company level financials at both entry and exit, i.e. enterprise value, net debt, equity, sales and EBITDA, as well as all interim equity cash flows, e.g. dividends. We then narrowed the sample further by including only those transactions where the value creation implied by these company level financials could be reconciled with the value creation implied by the sponsor level equity cash flow data.

Our final sample contains 206 buyout transactions completed in Europe over the time period 1991-2005. The transactions are from 27 different PE sponsors and 20 different countries with the top 5 being UK (44% of all transactions), France (17%), Sweden (10%), Germany (6%) and Netherlands (3%). The regional distribution is similar to that obtained from EVCA data, where our top 5 countries accounted for around 70% of total investment volume over the period from 1999 to 2007. Table II-2 presents the key descriptive statistics of the sample.

Table II-2: Sample Descriptives

Sample Descriptives	Min	Max	Average	Median	Std. Dev.
Entry Year	1991	2005			
Exit Year	1993	2008			
Holding Period [years]	0.8	11.2	3.6	3.3	1.8
Enterprise Value (EV) at Entry [€m]	1.1	4,189.3	282.6	74.9	571.8
Sales at Entry [€m]	1.8	2,726.9	284.1	77.2	509.5
EBITDA at Entry [€m]	0.2	805.6	40.8	11.9	94.8
EV/EBITDA at Entry	2.7	26.8	7.6	6.8	3.1
D/E at Entry	0.0	7.9	1.6	1.4	1.3
D/E at Exit	0.0	8.9	0.8	0.5	1.3
Money Multiple	0.0	22.6	3.5	2.8	2.8
Times Money (Money Multiple - 1)	-1.0	21.6	2.5	1.8	2.8
IRR	-100.0%	480.7%	42.8%	33.0%	50.8%

Our sample covers a time period from 1991 to 2005, as per entry year, which allows us to analyse value creation for the second wave of private equity transactions in detail (Guo et al., 2008). With regard to the distribution of the deals over the period, half of the transactions were completed in the period 2001 and 2005. The average holding period is 3.6 years, which is comparable to more recent studies (Nikoskelainen and Wright, 2007, Acharya et al., 2009) but slightly lower than the long-term average of 4.2 years for the period 1970 to 2007 (Strömberg, 2008). In terms of enterprise value, the sample covers a broad spectrum, ranging from €1m to over €4bn, with the average and median at €282.6m and €74.9m respectively. While both average and median debt-to-equity ratios at entry are fairly high at 1.6 and 1.4 respectively, this is not unusual for private equity transactions (Axelson et al., 2008). Further we note that the debt-to-equity ratio declines significantly over the holding period to 0.8 and 0.5 respectively.

When turning to return measures, please note that these data are gross returns on transaction level, which are not comparable to net fund returns for various reasons such as management fee and carry. Both in terms of IRR and multiple we can observe the positive skew that is typical for PE returns due to a few very successful transactions with IRRs above 300%. Overall, the average (median) IRR and money multiple of 43% and 3.5x (33% and 2.8x) respectively are somewhat higher than Acharya et al. (2009), who report an average (median) IRR and money multiple of 35.5% and 2.8x (32.5% and 2.5x) respectively for their sample of 66 UK transactions. On the other hand, this is considerably lower than Nikoskelainen and Wright (2007), who report an average and median IRR of 70.5% and -17.8% respectively for their sample of 321 UK transactions[11], and Groh and Gottschalg (2009) who report an average and median IRR of 50.1% and 35.7%, respectively for their sample of 133 US transactions. Please note that rather than using the money multiple for our value creation analysis we will use the 'times money' (equivalent to the money multiple – 1), which is calculated by dividing the net cash flow by the invested capital from the equity sponsors' perspective. Consequently the 'times money' is a measure of actual value created and accounts for all cash outflows and inflows of a transaction (Pindur, 2007).

[11] Please note that Nikoskelainen and Wright (2007) adjusted IRRs for the performance of the FTSE 100 index to control for market effects.

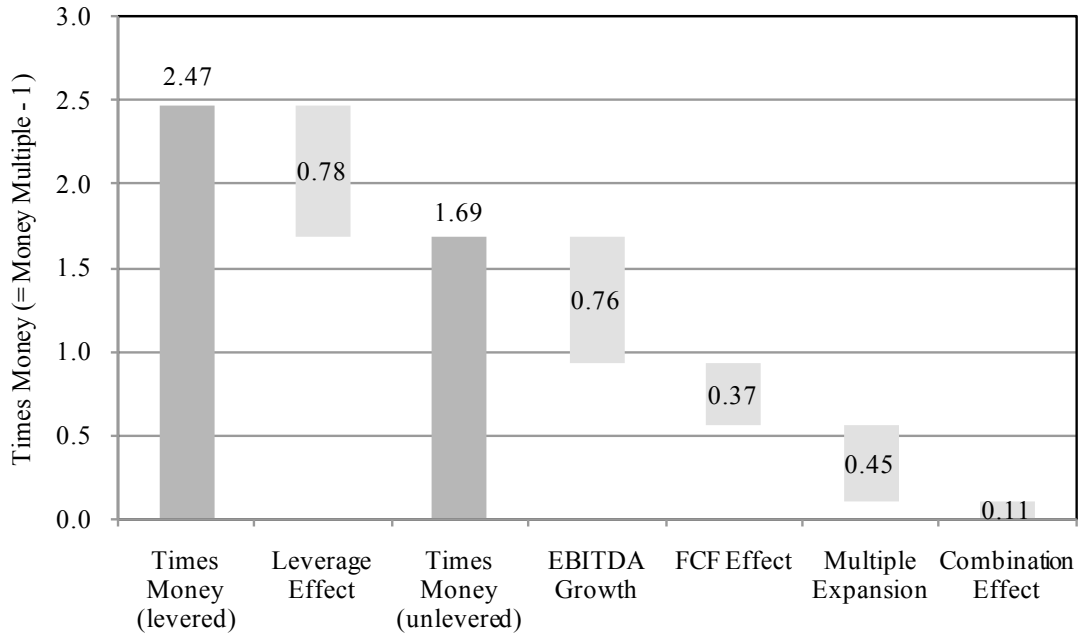
With regard to potential selection bias issues that arise from obtaining data from only one PE fund-of-funds we remain fairly comfortable that our results are not affected by any meaningful bias for two reasons: firstly, the sample is based on information that PE fund-of-funds generally request while conducting due diligence on PE sponsors, independent of whether they subsequently committed to an investment or not. Secondly, any potential positive bias should not affect our analysis in any major way since we intend to focus on the relative importance of different value creation drivers by transaction size, time period and market environment at entry rather than absolute amounts.

4. Results

The result section below is structured as follows: first, we explain the entire value creation of the overall sample by showing the importance of each value driver. For this we use sample averages rather than medians in order to explain 100% of value created. Second, we examine interdependencies between the importance of the value drivers and certain characteristics of the underlying transactions. To analyse the differences between subsamples we use the median comparison test given the heterogeneity of PE transactions. We have also included the p-values of the mean comparison test for information purposes.

Figure II-2 displays the value creation measured in terms of 'times money' across the entire sample split into the different financial and operational drivers using average figures. Total value creation is 2.47 'times money'. The main operational drivers, i.e. 'EBITDA growth' and 'FCF effect', account for 1.13 'times money' or 46% of total value creation, while the 'leverage effect' accounts for 0.78 'times money' or 32% of total value creation. The remainder can be attributed to 'multiple expansion' (0.45 'times money' or 18%) and the combination effect of 'EBITDA growth' and 'multiple expansion' (0.11 'times money' or 4%).

Figure II-2: Value Creation Drivers Across Entire Sample

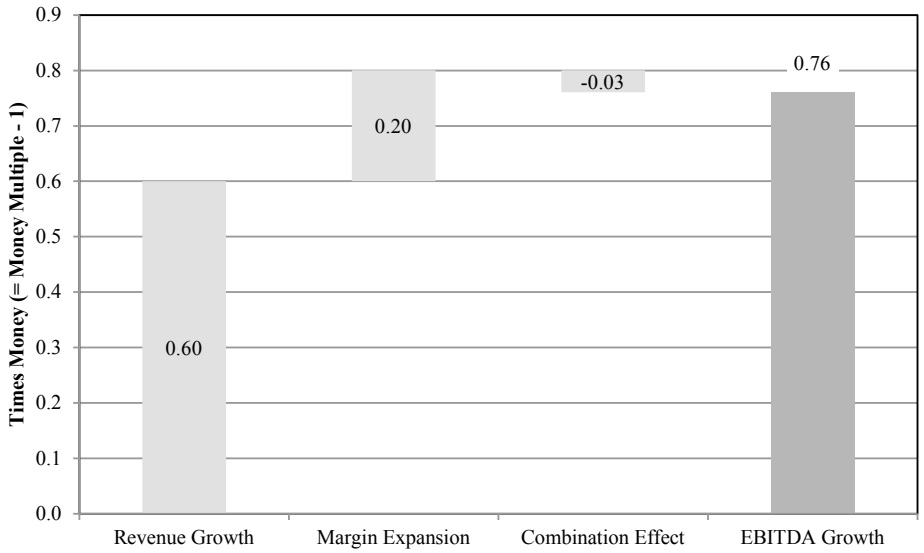


This shows that a third of total (levered) returns can be attributed to financial engineering. Due to the fact that higher debt-to-equity ratios go along with increased financial risk of a transaction, the additional return can also be interpreted as a leverage or risk premium. It is important to note that the methodology applied by us covers only the mechanical effect of leverage on the return on equity (see, e.g., Acharya, et al., 2009). The disciplining effect of debt as a control mechanism as described by Jensen (1989) is not explicitly taken into account. While financial engineering often has a negative connotation, it should be mentioned that banks may accept higher debt-to-equity ratios of PE sponsor-backed companies compared to non-sponsored companies due to the reputation and experience of the PE sponsor. This would also imply that PE sponsor-backed companies are better in managing high leverage ratios.

Leaving the leverage effect aside, PE sponsor-backed companies generate considerable EBITDA growth and FCF. When it comes to multiple expansion, different interpretations are possible: firstly, PE sponsors are thought to have market timing skills. Secondly, the higher multiple at exit could be an indication of the improved future prospects for the company. Finally, it could also represent the negotiation skills of the PE sponsor.

Figure II-3 then further analyses the drivers underlying 'EBITDA growth', namely 'revenue growth', 'margin expansion' and the 'combination effect' of both, for the entire sample. With a contribution of 0.60 'times money' or 79%, 'revenue growth' is the main driver of 'EBITDA growth', while 'margin expansion' only contributed 0.20 'times money' or 26%. It is worth noting that the negative 'combination effect' (-0.03 'times money') indicates that sales growth was achieved at the expense of margin deterioration on average, or vice versa. However, this effect is of relatively small importance.

Figure II-3: EBITDA Growth Across Entire Sample



We performed a set of robustness checks on the results obtained for our total sample. Our finding of the leverage impact accounting for one third of total value creation is robust to changing the average cost of debt from 7.5% to 5% or 10%. In contrast, the results significantly change when dropping the assumption of risky tax shields, i.e. the company does always generate sufficient earnings to fully utilize the tax shield. Based on a marginal corporate tax rate of 35% our results indicate that the leverage impact accounts for one quarter rather than for one third of total value created. The intuitive explanation is that the inclusion of a secure tax shield leads to a sure income stream to the equity holders which reduces the demanded risk premium for the increased financial risk due to a higher debt-to-equity ratio. As a result, the financial risk component of the levered return (i.e. the leverage effect) decreases. In this new setting, the leverage impact remains roughly the same when changing our assumed corporate tax rate from 35% to 25% or 45%. We have decided to stick to the

assumption of risky tax shields, as explained in the section outlining the methodological framework for this study, nevertheless this is certainly an area that should be further investigated in future research.

In order to analyse differences in the importance of the individual value creation drivers with regard to transaction size, we have divided the sample in transactions with enterprise value larger and smaller than €100m analogue to Acharya et al. (2009). Table II-3 lists mean and median values for each of the different value creation drivers by group. Our sample contains a roughly even number of transactions with enterprise value larger and smaller than €100m. Looking at the medians of 'times money', we find larger deals are significantly more successful at the 5% level. In contrast the 'times money' unlevered is not significantly different between the two groups. Therefore we conclude that larger deals are more successful due to the leverage effect, which is significantly higher at the 1% level. This is in line with the arguments that larger companies have a higher lending capacity as they are less risky (Nikoskelainen and Wright, 2007) and less exposed to asymmetrical information (Chen, 1983, Chan et al., 1985). In addition, larger PE sponsors are thought to be more reputed which leads to better credit terms and a higher amount of leverage (Demiroglu and James, 2009). When looking at EBITDA growth and its drivers, it appears that smaller deals achieve that predominantly via revenue growth, while at larger deals margin improvement plays a more important role. This appears intuitive when assuming a higher growth potential of smaller companies and a higher importance of restructuring and cost-cutting activities for larger companies. Combining these findings with the fact that mostly larger deals receive wide press coverage goes a long way in explaining the source of many general misconceptions about the private equity industry.

Table II-3: Value Creation by Transaction Size

This table presents the mean and median value creation data for transactions with an enterprise value (EV) smaller and larger than €100m. On the right hand side, we show the p values for the one-sided T Test (unequal) and Fisher's exact test, used to test for the difference in mean and median respectively. *, **, and *** indicate whether the tests are statistically significant at 10 percent, 5 percent, and 1 percent levels, respectively.

		Transactions with		Test Statistic (p value)	
	Statistic	EV < €100m	EV > €100m	T Test (unequal)	Fisher's exact
Number of Observations	n	98	108		
Holding Period	Mean	3.75	3.46	0.13	-
	Median	3.33	3.25	-	0.29
Times Money (levered)	Mean	2.48	2.47	0.50	-
	Median	1.33	2.13	-	0.02 **
Leverage Effect	Mean	0.60	0.95	0.00 ***	-
	Median	0.26	0.64	-	0.00 ***
Times Money (unlevered)	Mean	1.88	1.52	0.12	-
	Median	0.99	1.25	-	0.16
EBITDA Growth	Mean	0.92	0.62	0.11	-
	Median	0.42	0.59	-	0.16
Multiple Expansion	Mean	0.50	0.40	0.18	-
	Median	0.26	0.29	-	0.44
FCF Effect	Mean	0.35	0.39	0.34	-
	Median	0.22	0.32	-	0.06 *
Combination Effect	Mean	0.11	0.10	0.48	-
	Median	0.03	0.05	-	0.24
EBITDA Growth					
Revenue Growth	Mean	0.71	0.50	0.08 *	-
	Median	0.43	0.28	-	0.09 *
Margin Expansion	Mean	0.16	0.23	0.28	-
	Median	0.00	0.18	-	0.01 ***
Combination Effect	Mean	0.05	-0.11	0.12	-
	Median	0.00	0.01	-	0.22

Further, we were interested in the question to what extent the selection of certain time periods had an influence on the importance of the value creation drivers. Therefore, we divided the overall sample into two groups based on year of entry which helps to analyse how value creation has changed as the private equity industry matured. We defined two periods, namely 1991-2000 and 2001-2005 to distinguish between value creation pre and post the burst of the dot-com bubble (Kaplan and Strömberg, 2008). Table II-4 is structured in the same manner as the previous one to compare the two groups of interest.

Table II-4: Value Creation by Period

This table presents the mean and median value creation data for transactions completed in the periods 1991-2000 and 2001-2005. On the right hand side, we show the p values for the one-sided T Test (unequal) and Fisher's exact test, used to test for the difference in mean and median respectively. *, **, and *** indicate whether the tests are statistically significant at 10 percent, 5 percent, and 1 percent levels, respectively.

		Transactions		Test Statistic (p value)	
	Statistic	1991-2000	2001-2005	T Test (unequal)	Fisher's exact
Number of Observations	n	103	103		
Holding Period	Mean	4.23	2.97	0.00 ***	-
	Median	3.67	2.96	-	0.00 ***
Times Money (levered)	Mean	2.20	2.75	0.08 *	-
	Median	1.41	2.23	-	0.01 **
Leverage Effect	Mean	0.51	1.05	0.00 ***	-
	Median	0.43	0.73	-	0.00 ***
Times Money (unlevered)	Mean	1.69	1.70	0.49	-
	Median	0.97	1.29	-	0.13
EBITDA Growth	Mean	0.84	0.69	0.25	-
	Median	0.44	0.55	-	0.29
Multiple Expansion	Mean	0.45	0.45	0.47	-
	Median	0.12	0.39	-	0.00 ***
FCF Effect	Mean	0.44	0.31	0.11	-
	Median	0.28	0.29	-	0.39
Combination Effect	Mean	-0.04	0.25	0.00 ***	-
	Median	0.00	0.11	-	0.00 ***
EBITDA Growth					
Revenue Growth	Mean	0.69	0.52	0.13	-
	Median	0.46	0.30	-	0.12
Margin Expansion	Mean	0.23	0.17	0.28	-
	Median	0.08	0.15	-	0.12
Combination Effect	Mean	-0.07	0.01	0.27	-
	Median	0.00	0.02	-	0.12

Notably, holding periods are different at the 1% level with deals completed prior to 2000 being held more than half a year longer than the more recent deals. However, some deals completed in the period 2001 to 2005 are not yet realized. The inclusion of these deals could lead to a convergence of median holding periods of both groups. Despite a shorter median holding period, the 'times money' for the group of recent deals is significantly higher. When looking at the drivers of value creation, the source of difference becomes clear immediately: the impact of the leverage effect was significantly higher for the group of more recent deals. This finding is in line with observations that liquidity in the market for LBO loans increased considerably after 2000, especially after 2003 (Shivdasani and Wang, 2009). In addition, the value contribution of 'multiple expansion' is significantly more important for recent deals at the 1% level.

Finally, in order to analyse the impact of the general economic and stock market conditions on the transactions, we have defined two further groups: (1) deals with entry dates in 1994-2000 or 2004-2005 and (2) deals with entry dates in 1991-1993 or 2001-2003. The first group consists of deals completed in economic growth periods, whereas the second group consists of deals completed in a recessionary environment. While the period 1991-1993 is widely acknowledged as a recession of the European economy, evidence on the 2001-2003 period is less clear. European GDP never actually declined, which is why the Euro Area Business Cycle Dating Committee refers to this period as a growth pause. We base our reasoning for defining the 2001-2003 period as a recession on both the ifo business climate index[12]and the development of the MSCI Europe. For the period 2001-2003, the ifo index was negative both for assessment of the current situation as well as business expectations for the next six months, which is defined as a recessionary period as per the ifo business cycle clock. Similarly, we considered the development of the MSCI Europe to classify the market environment and observed that the MSCI Europe dropped from its peak of slightly over 1.500 index points in December 1999 to less than 782 index points in March 2003. Since the MSCI Europe index recovered for a short time between the end of 2000 and the beginning of 2001 we defined the period 2001 to 2003 as recessionary environment from a stock market perspective. Both measures serve as a proxy for the negative market sentiment which should

[12] The ifo business climate index for the manufacturing industry is an indicator based on the monthly feedback of over 7,000 German companies that serves as a good proxy for the overall European situation given the high share of exports of the German manufacturing industry.

influence many value creation levers such as availability of leverage, EBITDA growth prospects or valuation multiples.

The median 'times money' of deals completed in recession years is significantly higher than deals entered in growth periods at the 5% level. This indicates that recession periods offer interesting investment possibilities for PE funds. In addition, the results show that the median value impact of multiple expansion is significantly higher for deals done in a recessionary environment at the 1% level. Considering the fact that valuation multiples tend to decrease in recessionary periods this result is intuitive. Surprisingly, the test statistics also show that the median and average importance of the leverage effect at the 5% level was higher in recession years indicating that past economic crises seem not to be associated with a strong debt drought. This could potentially be attributed to the fact that most of the recessionary deals in our subsample were completed in the 2001-2003 period, which – at least from a leverage market perspective – arguably was a "non-recession". Therefore, the impact of the current financial crisis will probably be different in this aspect given the persistent drought of leverage markets.

Table II-5: Value Creation in Recessionary Periods

This table presents the mean and median value creation data for transactions completed in growth periods (1994-2000 and 2004-2005) and recessionary periods (1991-1993 and 2001-2003). On the right hand side, we show the p values for the one-sided T Test (unequal) and Fisher's exact test, used to test for the difference in mean and median respectively. *, **, and *** indicate whether the tests are statistically significant at 10 percent, 5 percent, and 1 percent levels, respectively.

		Transactions		Test Statistic (p value)	
	Statistic	Growth	Recession	T Test (unequal)	Fisher's exact
Number of Observations	n	122	84		
Holding Period	Mean	3.65	3.52	0.29	-
	Median	3.25	3.28	-	0.51
Times Money (levered)	Mean	2.36	2.64	0.24	-
	Median	1.48	2.17	-	0.03 **
Leverage Effect	Mean	0.65	0.98	0.01 **	-
	Median	0.47	0.69	-	0.03 **
Times Money (unlevered)	Mean	1.71	1.67	0.44	-
	Median	0.97	1.38	-	0.06 *
EBITDA Growth	Mean	0.82	0.68	0.24	-
	Median	0.51	0.50	-	0.56
Multiple Expansion	Mean	0.43	0.48	0.30	-
	Median	0.22	0.39	-	0.00 ***
FCF Effect	Mean	0.40	0.34	0.26	-
	Median	0.25	0.32	-	0.10
Combination Effect	Mean	0.06	0.17	0.16	-
	Median	0.01	0.10	-	0.00 ***
EBITDA Growth					
Revenue Growth	Mean	0.57	0.65	0.30	-
	Median	0.32	0.39	-	0.49
Margin Expansion	Mean	0.28	0.09	0.04 **	-
	Median	0.15	0.06	-	0.26
Combination Effect	Mean	-0.01	-0.06	0.34	-
	Median	0.01	0.01	-	0.53

5. Conclusion

In our view, current academic research has to a large extent neglected the question of value creation in two respects. Firstly, there is no universally applied method for measuring the importance of different value creation drivers. Secondly, there has been no large scale analysis of value creation in European buyout transactions outside the UK buyout market. This paper addresses these two shortcomings in (i) proposing a comprehensive framework for value creation going forward and (ii) applying this to a large sample of European buyout transactions.

We find that leverage does play an important part in explaining the returns to PE sponsors by boosting the return on equity – for our total sample the leverage effect accounts for approximately one third of the overall value created. On the other hand, this means that two thirds of value creation can be attributed to operational improvements within the PE-backed firms and changes in EBITDA multiples. This result and the fact that deals completed in recessionary environments can obviously offer attractive returns make us confident that the private equity business model is here to stay.

Due to the fact that most of the deals completed between 2006 and 2008 are not yet realized, we could not include these transactions in our analysis. We expect the leverage impact on value creation for these deals to be higher than one third. On the other side, we expect that for deals completed in 2009 – 2011 the importance of operational improvements within the PE-backed companies will increase. This will be a major task for PE sponsors in the next years.

Finally, our analysis serves to illustrate the high degree of heterogeneity across the private equity landscape, which calls for a thorough analysis in order to avoid generalizing statements based on selected examples. This paper is an initial attempt to analyse the effect of both time and transaction size, yet we strongly feel that this could be further detailed by analyzing variables such as entry/exit type and fund characteristics. Furthermore, one cannot necessarily assume that our results also apply to the US market, which is more mature and has different characteristics both in terms of regulatory environment and liquidity of the leverage markets. Therefore we also see the comparison of value creation in European and US buyouts as a further avenue for future research.

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II.II Essay 2 - Value Creation and Pricing in Buyouts: Empirical Evidence from Europe and North America

Abstract

Using a unique proprietary data set of 1,980 realized and unrealized buyouts completed between 1986 and 2010, we examine entry and exit pricing in buyouts and its influence on private equity (PE) sponsors' returns. We find that besides leverage and operational improvements, EBITDA multiple expansion (i.e. the difference between entry and exit pricing) is a fundamental factor in explaining equity returns and the result of skill rather than pure luck. We also provide evidence that more experienced PE sponsors use more debt to finance a PE transaction and debt is positively related to entry buyout pricing. However, for a transaction with a given leverage level, more experienced PE sponsors are able to negotiate lower prices. In addition, our results show that deals conducted by first time funds which are realized in a later stage of a fund's life cycle are associated with lower exit prices which can be explained by the increased exit pressure for the PE sponsor

Keywords: private equity, buyout, value creation, leverage, pricing, multiple expansion

JEL Classification Code: G24, G30, G34

Authors: Achleitner, Ann-Kristin; Braun, Reiner; Engel, Nico

First Author: Achleitner, Ann-Kristin

Current Status: Accepted in *Review of Financial Economics* (Forthcoming)

1. Introduction

The main objective of this paper is to better understand the sources of private equity (PE) sponsors' returns on the level of investment. In this context, we especially focus on the determinants of entry and exit pricing in buyouts, as the difference between the selling and purchase price of a company plays a major role in explaining investment returns.

In recent years a considerable number of empirical studies dealing with value creation in PE were published (see, e.g., Achleitner et al., 2010, Acharya et al., 2010, Groh and Gottschalg, 2009, Guo et al., 2011, Nikoskelainen and Wright, 2007). However, there is still a lack of research looking into the mechanisms of increasing the value of buyout targets and thereby PE returns, even if there are some notable contributions (see, e.g., Nikoskelainen and Wright, 2007, Acharya et al., 2010, Guo et al., 2011). In this regard, Nikoskelainen and Wright (2007) emphasize the need to differentiate between the return on enterprise value (EV) and that on equity value. PE sponsors are mainly interested in maximizing their returns, i.e. equity returns[13], which does not necessarily imply an increase in the enterprise value. Using a sample of 321 UK buyouts, Nikoskelainen and Wright (2007) find a correlation of 0.62 between the IRR on the enterprise level and on the equity value level, i.e. a positive but obviously less than perfect correlation. Consequently, it is essential to clearly define the perspective from which value creation is analysed in order to derive the relationship between value enhancing mechanisms on the enterprise value level and equity returns. In this paper we adopt the perspective of PE sponsors, i.e. we analyse equity returns.

Although the availability and reliability of data to analyse PE deals on the transaction level have improved somewhat, most PE value creation studies to date focus (i) on the mature Anglo-Saxon markets (see, e.g., Groh and Gottschalg, 2009, Nikoskelainen and Wright, 2007), (ii) on relatively large transactions (see, e.g., Acharya et al., 2010) and/or (iii) on public-to-private transactions (see, e.g., Guo et al., 2011). To the best of our knowledge, this is the first comprehensive study analyzing deal-level value creation drivers in small and large

[13] PE sponsors may also use other financing instruments apart from pure equity, e.g. in the form of mezzanine capital. In these cases they are interested in the return earned on all types of capital, not only the return on equity. However, when we refer to equity returns (e.g. equity IRR) throughout the paper, we refer to the total return on invested capital from the perspective of the PE sponsor.

PE transactions including buyouts from Europe (Continental Europe and the UK) and North America, covering deals of all sizes and entry/exit types.

Apart from the general need to better understand value creation in PE, there is obviously a lack of research dealing with entry and exit transaction pricing in the PE market from the perspective of PE sponsors. In addition, up to now the question of pricing in explaining PE sponsors' returns has not been answered satisfactorily, although discussions with PE practitioners suggest that ex post EBITDA multiple[14] expansion turns out to be an important value driver for generating equity returns. Until recently, the only study dealing with that topic in the context of buyouts was the article by Kaplan and Stein (1993). The paper examined buyout pricing in the 1980's observing the threat of overheating in the buyout market. However, the academic literature seems to have been paying more attention to this topic in recent years, considering that there have been some notable contributions with respect to entry buyout pricing, especially for public-to-private transactions, larger deals and U.S. transactions (Axelson et al., 2010, Demiroglu and James, 2010, Bargeron et al., 2008).

Entry and exit pricing in PE buyouts is particularly interesting given the opaqueness surrounding most of these transactions (except for public-to-private deals at entry and IPOs at exit), the illiquidity of the PE market and diverse information asymmetries between the parties involved in a transaction. Consequently, the main objective of this paper is to gain a better understanding of the determinants of entry and exit pricing in buyouts and of the way this is related to PE sponsors' returns.

Altogether, this paper aims to contribute to two major questions in PE research. First, we extend studies explaining PE sponsors' returns on the investment level (see, e.g., Acharya et al., 2010, Nikoskelainen and Wright, 2007) by using a larger and more diversified sample (in terms of regional aspects and transaction size). We show that operational improvements, leverage as well as EBITDA multiple expansion, have a significant and positive effect on equity returns. The effects are not only statistically, but also economically highly relevant. We also present evidence on whether and to what extent a PE fund's life cycle affects equity

[14] Throughout the whole paper we refer to the enterprise value (EV) to EBITDA multiple when we use the term EBITDA multiple or multiple.

returns. We find some indication that deals conducted later in a PE fund's life cycle generate lower equity returns.

Building upon these results, we particularly focus on the underlying effects explaining EBITDA multiple expansion, i.e. the difference between entry and exit pricing, in PE deals. With respect to entry pricing, we extend existing studies from Axels on et al. (2010) and Demiroglu and James (2010) by presenting a sample of buyouts of different sizes and entry types which have been conducted by experienced as well as inexperienced PE sponsors. We find that more experienced PE sponsors use higher leverage ratios which positively influence entry pricing. However, for a transaction with a given leverage level, experienced PE sponsors are able to negotiate lower prices. Entry pricing is also strongly influenced by industry EBITDA multiples in public markets. With regard to exit pricing, we provide evidence that higher sales growth during PE sponsor ownership leads to higher exit prices. In addition, we show that deals realized later in a fund's life cycle, i.e. closer to the liquidation date of the investing fund, and additionally conducted by first time funds are associated with lower exit prices.

The rest of our paper is organized as follows: Section 2 introduces previous research on value creation and pricing in buyouts and derives testable hypotheses. Section 3 describes the data set and discusses a potential selection bias. Section 4 provides empirical results for value drivers explaining equity IRRs. Section 5 analyses the drivers of entry and exit EBITDA multiples. Section 6 concludes.

2. Literature Review and Hypotheses

2.1 Value Creation in Buyouts

We distinguish between three different *financial* value creation drivers which explain PE sponsors' returns: (i) changes in operating performance, (ii) changes in EBITDA valuation multiples and (iii) leverage.

With regard to the first component, i.e. (i) changes in operating performance, the underlying factors explaining this driver are mechanisms[15] that increase the EBITDA or the free cash flow (for an overview, see, e.g., Cumming et al., 2007). In this context, several academic studies have analysed the operating performance of PE-backed firms. For example, Kaplan (1989a), Lichtenberg and Sigel (1990) and Acharya et al. (2010) show that leveraged buyouts (LBOs) create value by improving the operating performance. However, Guo et al. (2011) find for a subsample of 94 US buyouts that operational improvements of PE-backed firms do not exceed those of comparable publicly listed peers. Altogether, even if research suggests that the improvement of operating performance is an important value driver, the relative importance of revenue growth and operating margin improvements as drivers of operating performance still has not been analysed sufficiently. Building upon previous studies we form the following two testable hypotheses.

Hypothesis 1.1a: *Transactions with higher (industry-adjusted) sales growth during the holding period of the PE sponsor exhibit higher equity returns.*

Hypothesis 1.1b: *Transactions with higher (industry-adjusted) operating margin improvements of the portfolio company during the holding period of the PE sponsor exhibit higher equity returns.*

Another lever for generating equity returns is an improvement in (ii) EBITDA valuation multiples (EV/EBITDA) between entry and exit. The EBITDA multiple is the most important valuation ratio in the PE industry. Assuming a constant EBITDA between entry and exit, a

[15] For example, Kaplan and Strömberg (2009) distinguish between three engineering mechanisms implemented by PE sponsors: governance (e.g. management incentives), financial (e.g. tax shields) and operational engineering (e.g. industry expertise).

positive change in multiple leads to an increased enterprise value and, assuming net debt as given, consequently to an increased residual equity value at exit, and finally to higher equity returns. Existing academic papers at least indicate that an EBITDA multiple increase between entry and exit seems to be a relevant value driver for equity returns. One of the few studies dealing with that issue is the recent work by Acharya et al. (2010), even if the role of EBITDA multiple expansion was not the key focus of the paper. The authors find that PE-backed firms improved the valuation multiples between entry and exit more than the respective group of public benchmarks not backed by PE sponsors. Guo et al. (2011) find for a sample of 192 large public-to-private deals that changes in industry EBITDA multiples over the holding period account for 18% of the returns to total pre-buyout capital and 12% to total post-buyout capital[16]. However, the question whether value creation through multiple expansion in PE-backed firms can mainly be explained by shifts in public markets or by firm-specific effects, still remains open.

Hypothesis 1.2: *Transactions with higher (industry-adjusted) EBITDA multiple expansion between entry and exit of the PE sponsor exhibit higher equity returns.*

A subtle mechanism to boost equity returns can be implemented by increasing the target company's (iii) debt ratio at entry. Ceteris paribus, increasing the financial risk (which also implies an increasing default risk) of a transaction through the use of more leverage has to be compensated by a risk premium, i.e. a higher expected rate of return (Modigliani and Miller, 1958). The typical compensation structure of PE general partners gives them an option-like stake in the fund which incentivizes them to increase its value with deal leverage (Axelson et al., 2010). Further, higher leverage ratios are associated with larger tax shields (see, e.g., Kaplan, 1989b) and the disciplining effect of debt according to Jensen's (1989) free cash flow hypothesis, both consequently increasing the available cash flows to the providers of capital (Guo et al., 2011). Overall, these effects related to leverage should boost equity returns.

Hypothesis 1.3: *More highly leveraged transactions exhibit higher equity returns.*

[16] Both, return to pre-buyout and post-buyout capital, include returns to debt and equity holders and cannot directly be compared to the "equity return perspective" in this paper.

Beyond these more buyout company-related financial value drivers, we argue that the stage of a PE fund's life cycle, at which a transaction is made, significantly influences deal-level equity returns. PE funds are usually "closed-end" funds (Kaplan and Strömberg, 2009) and have a predetermined lifetime of 10 to 12 years (see, e.g., Kaplan and Schoar, 2005, Gompers and Lerner, 1999). Typically, a PE sponsor tries to invest the committed capital within the first 5 years after the fund is launched, and has approximately another 5 years to sell the investments (Kaplan and Strömberg, 2009). In any case, a contractually fixed liquidation imposes restrictions on the fund managers' investment behavior.

At first glance, one might expect that the stage in a fund's life cycle, at which a deal is made, affects the risk-return profile of a transaction. First, PE sponsors might tend to conduct less risky deals, generating lower returns on average, the later in a funds' life cycle that a deal is made, i.e. more closely approaching the fund's liquidation date. This is because PE sponsors do not want to risk an already achieved positive overall fund return by conducting excessively risky deals and consequently prefer transactions with a lower risk-return profile. This is especially relevant as the probability for raising a follow-on fund is positively related to the performance of the current fund (Chung et al., 2010). Further, while raising another fund, PE sponsors' might want to avoid riskier deals, as bad publicity related to a problematic investment can be expected to negatively influence fund inflows. Second, PE sponsors might also be partly forced to pursue less attractive investments because they face increasing pressure to invest the non-invested capital in order to achieve targeted overall fund IRRs on total capital committed when the liquidation date of a fund is approaching. Further, the PE sponsor earns an annual management fee, which is a percentage of capital employed when investments are realized (Kaplan and Strömberg, 2009). Simultaneously, less time remains for the implementation of specific value enhancing strategies before the fund expires. A similar argument of reduced value-enhancing possibilities holds if a PE sponsor is currently in the fundraising process. PE sponsors are presumably limited in their portfolio managing and monitoring efforts when handling a fundraising process at the same time. Thus, it could be argued that in later stages of a fund cycle value-adding activities are more likely to be reduced. In summary, these arguments imply a negative relationship between the life cycle stage of the fund and the deal return.

Hypothesis 1.4: *Transactions conducted later in a PE fund's life cycle exhibit lower equity returns.*

In addition to testing the hypotheses above, we also control for other factors possibly related to equity returns. We describe these control variables in detail in section 4.1.1.

2.2 Buyout Pricing

2.2.1. Entry Pricing

The ratio of a firm's total enterprise value (EV) to EBITDA, i.e. the EBITDA multiple, is a proxy for deal pricing (see, e.g., Axelson et al., 2010, Demiroglu and James, 2010) as well as a proxy for the expected growth of a company (Opler and Titman, 1993). However, the rationale behind both interpretations is not mutually exclusive since companies with higher expected growth tend to be priced higher.

Deal leverage is thought to be a key explanatory variable in LBO pricing. Kaplan and Strömberg (2009) argue that PE sponsors may take advantage of systematic mispricing in debt and equity markets, which makes it reasonable to use more leverage to finance a transaction when the cost of debt is relatively low compared to the cost of equity. Axelson et al. (2010) provide empirical evidence for this hypothesis showing that LBO pricing at investment entry is negatively related to credit market conditions, i.e. deals tend to be priced higher if cheaper LBO debt is available, indicating that it is important to control for credit market conditions when analyzing entry EBITDA multiples. One of the key questions addressed by Axelson et al. (2010) is the influence of leverage on pricing. The authors find a significant and positive relationship between both and suggest two possible explanations: (1) PE sponsors take advantage of mispricing in debt markets, i.e. when the respective interest rate on debt does not appropriately reflect the underlying risk of a company, which is in line with Kaplan and Strömberg (2009). Consequently, PE sponsors might be able to pay higher prices when debt market conditions are loose. (2) General partners try to highly lever each deal, as their return profile is similar to a call option indicating that general partners use positive debt market conditions. The authors also find that multiples in public markets are significant in explaining multiples in PE deals.

Similarly, Demiroglu and James (2010) investigate leverage and pricing in LBOs using a data set of 180 public-to-private US buyouts. Consistent with Axelson et al. (2010) they find that buyout leverage is significantly and positively related to entry EBITDA multiples. However, it remains unclear to what extent these results can be transferred to entry types other than public-to-private deals considering the fact that Axelson et al. (2010) find that these transactions exhibit extraordinary high entry EBITDA multiples. Building upon this previous research we form the following two testable hypotheses.

Hypothesis 2.1: *More highly leveraged transactions exhibit higher entry prices.*

Hypothesis 2.2: *When industry-specific EBITDA multiples in public markets are higher, entry pricing for PE sponsored transactions increases as well.*

Apart from buyout target company characteristics it is important to look at PE sponsor- and fund-level variables when analyzing pricing in buyouts. For example, Bargeron et al. (2008) analyse the purchase price at entry of a transaction by comparing the acquisition premiums paid when the acquirer is a public firm versus those of a PE firm. The authors find that PE sponsors pay a 63% smaller premium compared to public acquirers implying that PE sponsors are able to buy more cheaply. Bargeron et al. (2008) conclude that one reason for this observation might be that PE firms acquire companies whose managers support the acquisition. Another explanation for this finding could be that PE sponsors are forced to buy more cheaply due to the fact that they are less likely to benefit from synergies compared to public acquirers. However, the authors also indicate that unobservable target characteristics might explain differences in premiums paid.

Further, Axelson et al. (2010) analyse the influence of PE sponsor- and fund-level characteristics on leverage and pricing and find relatively inconsistent results. They also indicate that further research in this area is necessary. Overall, research indicates that negotiation skills seem to be an important factor when it comes to pricing negotiations. In this context, it is reasonable to assume that more experienced PE sponsors have better negotiation skills and pay lower entry prices (for a given company).

Hypothesis 2.3a: *Transactions sponsored by more experienced and reputed PE sponsors exhibit lower entry prices.*

Banks might also be expected to accept higher leverage ratios for companies backed by more experienced and reputed PE sponsors as indicated by Demiroglu and James (2010), Ivashina and Kovner (2011) as well as Brinkhuis and De Maeseneire (2009). As stated, this would then indirectly lead to higher LBO prices paid. For example, Demiroglu and James (2010) show for a sample of public-to-private transactions that more reputed PE sponsors use more leverage to finance a transaction. Given that we want to examine the influence of leverage on pricing (see Hypothesis 2.1) and shed some light on the role of PE sponsors this is an interesting relationship. However, it remains open to what extent this result can be transferred to other transaction types than public-to-privates.

Hypothesis 2.3b: *More experienced and reputed PE sponsors use more leverage to finance a transaction.*

In addition to testing the hypotheses above, we also control for other factors possibly related to entry pricing. We describe these control variables in detail in section 5.2.1.

2.2.2. Exit Pricing

According to Acharya et al. (2010) operating improvements can be captured in two ways: The "typical" way is to look at EBITDA improvements (through revenue growth or EBITDA margin improvements) of the portfolio company *during* PE ownership. In addition, to capture expected future operating improvements *after,* the EBITDA multiple at exit of the PE sponsor is a good proxy for future EBITDA growth. Companies with a higher EBITDA multiple are expected to have more EBITDA growth in the future (assuming that market expectations are rational).

Intuitively, a portfolio company's operating performance (i.e. operating margin improvements or sales growth) during the holding period of the PE sponsor could be a good proxy for the future performance anticipated by investors. Consequently, portfolio companies with operating outperformance, e.g. above industry average, should receive higher exit

EBITDA multiples. According to these arguments, there is a positive relationship between operating performance during PE ownership and exit valuation.

In addition, particularly higher sales growth (as one driver of operating performance) could be rewarded by a higher exit valuation. With increasing size, companies overcome their liability of smallness, i.e. having a relatively small asset base and being more vulnerable to external shocks than larger enterprises (Aldrich and Auster, 1986). Hence, growth in size should reduce perceived business risk and could facilitate advancing to a higher multiple class when reaching higher sales figures. Again, the reduced business riskiness of larger companies as they have less volatile cash flows (Nikoskelainen and Wright, 2007) and are less exposed to information asymmetries (Chan et al., 1985) could be rewarded by a premium that buyers are willing to pay. Empirical studies in the PE context confirm these arguments. For example, Axelson et al. (2010) report a positive relationship between enterprise value and EBITDA multiple for LBOs. Furthermore, PE sponsors often conduct add-on acquisitions, buying smaller companies at relatively low multiples, and integrate the add-ons into one company which is then sold for a higher multiple appropriate for larger firms (buy-and-build strategy).

Hypothesis 2.4a: *Deals with higher (industry-adjusted) sales growth during the holding period of the PE sponsor exhibit higher exit EBITDA multiples.*

Hypothesis 2.4b: *Deals with higher industry-adjusted EBITDA margin growth during the holding period of the PE sponsor exhibit higher exit EBITDA multiples.*

Second, apart from changes related to a portfolio company's operating performance theory suggests that PE sponsor and fund characteristics are also relevant in explaining exit pricing. At the end of a fund's life cycle, PE sponsors might feel increasing pressure to realize the existing investments soon, consequently reducing their negotiation power. We therefore expect a negative relationship between the fund's life cycle stage at exit and exit EBITDA multiples, i.e. the more years have passed, the lower the exit EBITDA multiple for a given transaction.

Hypothesis 2.5a: *Deals exited later in a fund's lifecycle stage exhibit lower exit prices.*

This argument is especially relevant for less experienced and reputed PE sponsors with no proven track record of successful deals that could reduce information asymmetries because they can exhibit a meaningful exit track record. Consistently with the grandstanding hypothesis in the venture capital industry proposing that IPOs of companies backed by younger venture capital firms are more underpriced compared to those conducted by more established venture capital firms (Gompers, 1996), first time funds may have incentives to exit investments too early. In addition, higher reputed PE sponsors are less likely to sell heavily overpriced companies since they do not want to risk their reputation (see, e.g., Achleitner et al., 2011b). Altogether, bidders buying a company from a relatively unknown PE sponsor might demand a discount on the purchase price in order to account for the existing information asymmetries about the portfolio company's condition, especially when the portfolio company is sold while the PE sponsor is simultaneously raising a follow-on fund.

Hypothesis 2.5b: *Deals conducted by first time funds and exited later in a fund's lifecycle stage exhibit lower exit prices.*

In addition to testing the hypotheses above, we also control for other factors possibly related to exit pricing. We describe these control variables in detail in section 5.3.1.

3. Data Set

Our sample forms a subset of data bases compiled by two European funds-of-funds as part of their due diligence effort. It combines data on transaction level including PE sponsor level cash flow data of 1,980 realized and unrealized buyout transactions entered between 1986 and 2010 taking place in North America and Europe.[17] Table II-6 presents the most important sample characteristics and Table II-7 shows variable definitions for the most relevant variables in this paper.

For our total sample of 1,980 transactions we have all cash flows exchanged between PE sponsor and portfolio company which helps to calculate exact internal rates of return (IRR) for each deal (gross of fees and carried interest). This is also our measure for deal-level value creation. The IRR is the discount rate that equates the present value of the cash flow to zero. Despite the well-known drawbacks of applying the IRR, it is still the most common performance measure for PE returns (see, e.g., Kaplan and Schoar, 2005, Nikoskelainen and Wright, 2007). By directly using the cash flows between PE sponsors and target companies we can also take account of factors influencing the cash flow to equity holders during the holding period (e.g. dividends).

In addition, our data set includes the following variables for a subsample of the deals, both for the entry and exit date of the transaction: enterprise value (EV), net debt, equity value, EBITDA, and sales. However, we do not have exhaustive information on these variables for all 1,980 deals, but for the majority of the realized transactions. Table II-6 also shows that 27.2% (29.7%) of all (realized) transactions are from North America and 72.8% (70.3%) from Europe. The most important individual countries are the USA and UK which account for over 50% of the total sample.

[17] We excluded venture capital investments and investments located in other areas than Europe or North America.

Table II-6: Sample Characteristics

Panel A in Table II-6 presents sample characteristics for our total sample of European and North American buyout transactions. The total sample comprises realized and unrealized transactions. Panel B reports some additional statistics for the subsample of 1090 realized transactions.

Panel A - Total Sample				
Number of observations	1980			
Number of realized observations	1090			
Fund Manager Characteristics				
Number of different fund managers	98			
Average fund generation number	2.9			
Average age (in years) of fund manager at time of investment	12.9			
Median fund vintage year	1999			
	Number of Transactions			
Country Origin	Total	*in percent*	Realized	*in percent*
Canada	17	*0.9%*	10	*0.9%*
United States	522	*26.4%*	314	*28.8%*
Total North America	*539*	*27.2%*	*324*	*29.7%*
Austria	6	*0.3%*	3	*0.3%*
Belgium	12	*0.6%*	7	*0.6%*
Czech Republik	7	*0.4%*	3	*0.3%*
Denmark	37	*1.9%*	12	*1.1%*
Finland	31	*1.6%*	16	*1.5%*
France	270	*13.6%*	116	*10.6%*
Germany	146	*7.4%*	56	*5.1%*
Greece	2	*0.1%*	1	*0.1%*
Ireland	7	*0.4%*	4	*0.4%*
Italy	49	*2.5%*	17	*1.6%*
Netherlands	86	*4.3%*	36	*3.3%*
Norway	24	*1.2%*	7	*0.6%*
Poland	18	*0.9%*	10	*0.9%*
Portugal	5	*0.3%*	2	*0.2%*
Switzerland	34	*1.7%*	13	*1.2%*
Spain	44	*2.2%*	22	*2.0%*
Sweden	165	*8.3%*	108	*9.9%*
United Kingdom	498	*25.2%*	333	*30.6%*
Total Europe	*1441*	*72.8%*	*766*	*70.3%*
Total	*1980*	*100.0%*	*1090*	*100.0%*

Panel B - Realized Investments	
Number of realized investments	1090
with reported IRRs	1090
with reported entry types	822
with reported exit types	966
Investments and fully realized exits 1977-1989	32 investments, 4 exits
Investments and fully realized exits 1990-1994	152 investments, 26 exits
Investments and fully realized exits 1995-1999	454 investments, 190 exits
Investments and fully realized exits 2000-2004	398 investments, 361 exits
Investments and fully realized exits 2005-2007	54 investments, 509 exits

Table II-7: Variable Definitions

This table presents variable definitions for the relevant variables in this paper. The variables *Dummy Market Based Financial System*, *Creditor Protection* and *Anti-director Rights* are based on Shleifer's website at http://www.economics.harvard.edu/faculty/shleifer/dataset and Spamann (2009) cited in Cao et al. (2010).

Variable	Description
Equity IRR	Equity internal rate of return (IRR) is calculated from monthly cash flows between PE sponsor and the portfolio company gross of fees and carried interest. We use the last valuation reported by the PE fund as final cash flow for unrealized transactions. The variable is winsorized at the 1% level.
Deal Characteristics	
D/EBITDA	Portfolio company's net debt to EBITDA ratio at investment entry. The variable is winsorized at the 1% level.
D/E	Portfolio company's net debt to equity ratio at investment entry. The variable is winsorized at the 1% level.
EV/EBITDA	Portfolio company's enterprise value to EBITDA ratio at investment entry. The variable is winsorized at the 1% level.
Enterprise Value	Portfolio company's enterprise value at entry in USD million. The variable is winsorized at the 1% level.
Delta Sales	Portfolio company's change in sales between entry and exit of PE ownership, i.e. $\log(1+sales_{exit}) - \log(1+sales_{entry})$. The variable is winsorized at the 1% level.
Delta EBITDA/Sales (EBITDA Margin)	Portfolio company's change in EBITDA margin (=EBITDA/sales) between entry and exit of PE ownership, i.e. $\log(1+\text{EBITDA Margin}_{exit}) - \log(1+\text{EBITDA Margin}_{entry})$. The variable is winsorized at the 1% level.
Delta EV/EBITDA (EBITDA Multiple)	Portfolio company's enterprise value to EBITDA ratio, i.e. $\log(1+\text{EBITDA Multiple}_{exit}) - \log(1+\text{EBITDA Multiple}_{entry})$. The variable is winsorized at the 1% level.
Entry Type Dummies	We distinguish between corporate spin-offs, public-to-private transactions, secondary transactions and private-to-private deals. For deals with unreported/unknown entry type we form the category "unknown".
Exit Type Dummies	We distinguish between trade sales, initial public offerings (IPO), secondary transactions and bankruptcies/write-offs. For deals with unreported/unknown entry type we form the category "unknown".
Investment Entry and Exit Year Dummies	Time category dummies based on Strömberg (2008) to control for systematic time patterns in the buyout market. We distinguish the periods 1984-1989, 1990-1994, 1995-1999, 2000-2002, and 2003-2010.
Holding Period	Time between investment and divestment of a PE sponsor in a certain company.
Institutional and Market Factors	
Dummy Market Based Financial System	A dummy if a deal was conducted in a country with a market based financial system.
Creditor Protection	A variable indicating how sophisticated creditor protection is in a country. A higher value indicates "better" creditor protection.
Anti-director Rights	A variable indicating how strongly the legal system supports minority shareholders against managers or majority shareholders. A higher value indicates "better" minority shareholder protection.
MSCI Annual Return	Annualized return of the MSCI World Index over the holding period of the PE sponsor.
Yearly Credit Spread	Yield spread on corporate bonds (Moody's BAA bond index) on the risk free rate (10-year US government bonds).
PE Sponsor and Fund Variables	
Fund Cycle Stage at Entry (Exit)	Difference between the investment entry (exit) date of the observed deal and the vintage year of the investing fund as proxy for the stage of the fund's life cycle.
PE Fund Size	Fund size of the investing PE fund in USD million.
PE Fund Generation	Fund generation number of the investing PE fund based on the historical number of funds launched by a PE sponsor at investment entry.
PE Sponsor Age	PE sponsor's age at investment entry in years based on the foundation of the PE sponsor. The variable is winsorized at the 1% level.
Dummy First Time Fund	A dummy variable if the investing PE fund is a first time fund.
Industry Variables	
EV/EBITDA Industry	Median enterprise value to EBITDA ratio in a specific industry based on public companies with the same three-digit ICB code as reported by Thomson One Banker. The underlying indices are Stoxx Americas 600 and EURO Stoxx Total market Index. The variable is winsorized at the 1% level.
Delta EV/EBITDA Industry	Median change in EV/EBITDA in a specific industry based on public companies with the same three-digit ICB code as reported by Thomson One Banker, i.e. $\log(1+\text{industry median EV/EBITDA}_{exit}) - \log(1+\text{industry median EV/EBITDA}_{entry})$. The underlying indices are Stoxx Americas 600 and EURO Stoxx Total market Index. The variable is winsorized at the 1% level.
Delta Sales Industry	Median change in sales in a specific industry based on public companies with the same three-digit ICB code as reported by Thomson One Banker, i.e. $\log(1+\text{industry median sales}_{exit}) - \log(1+\text{industry median sales}_{entry})$. The underlying indices are Stoxx Americas 600 and EURO Stoxx Total market Index. The variable is winsorized at the 1% level.
Delta EBITDA Margin Industry	Median change in EBITDA margin (=EBITDA/sales) in a specific industry based on public companies with the same three-digit ICB code as reported by Thomson One Banker, i.e. $\log(1+\text{industry median EBITDA margin}_{exit}) - \log(\text{industry median EBITDA margin}_{entry})$. The underlying indices are Stoxx Americas 600 and EURO Stoxx Total market Index. The variable is winsorized at the 1% level.
Industry Dummies	Industry dummies based on one-digit ICB codes (http://www.icbenchmark.com).

Table II-8: Descriptive Statistics

Panel A presents summary statistics for our total sample of 1980 buyout transactions. (1) Equity IRR is calculated from monthly cash flows between the private equity (PE) sponsor and the portfolio company gross of fees and carried interest. For unrealized deals we use fair values reported by the PE fund as the final cash flow. (2) Cash multiple is the ratio of the cash inflow to cash outflow from the PE sponsor's perspective. (3) Holding period is the number of years a PE sponsor held a portfolio company. Exit year for unrealized deals is the last valuation date. (4)/(5) Fund cycle stage at entry (exit) is the difference between the investment (divestment) year and the PE fund's vintage year. The variables in Panel B report portfolio firm characteristics at entry and exit of the PE sponsor's holding period for all realized deals with available firm-level data. On the right-hand side we report the results of mean and median tests comparing the entry and exit values. *, ** and *** indicate p-values of 10 percent, 5 percent, and 1 percent significance level, respectively. Panel C presents entry and exit transaction types of our realized deals and a comparison to the LBO universe.

Panel A: Descriptive Statistics – Total Sample

	Realized Deals			Unrealized Deals			Difference Tests	
	Obs.	Mean	Median	Obs.	Mean	Median	Mean (t-statistic)	Median (Pearson Chi^2)
(1) Equity IRR	1090	0.31	0.26	890	0.29	0.10	-0.76	61.09***
(2) Cash Multiple	1090	3.03	2.53	890	1.93	1.26	-10.84***	197.41***
(3) Holding Period [in years]	1090	4.66	4.10	890	3.10	2.58	-13.90***	148.39***
(4) Fund Cycle Stage at Entry *(Entry Year - Fund Vintage Year)*	1090	2.25	2.00	815	2.15	2.00	-1.16	0.43
(5) Fund Cycle Stage at Exit *(Exit Year - Fund Vintage Year)*	1090	6.90	6.00	816	5.01	5.00	-13.65***	51.59***

*** p<0.01, ** p<0.05, * p<0.1

Panel B: Portfolio Company Characteristics – Realized Investments

	Entry			Exit				Difference Tests	
	Obs.	Mean	Median	Obs.	Mean	Median	Obs.[1]	Mean (t-statistic)	Median (z-statistic)
(1) Debt to Equity Ratio	876	2.00	1.45	739	0.61	0.40	722	15.64***	19.81***
(2) Debt to EBITDA Ratio	851	3.96	3.90	743	2.76	2.40	728	11.81***	14.89***
(3) EBITDA [USDm]	953	35.51	11.20	879	53.83	19.00	870	-10.73***	-18.00***
(4) Sales [USDm]	890	298.66	92.20	793	385.45	141.80	781	-10.11***	-18.85***
(5) EBITDA/Sales Margin	868	0.13	0.13	791	0.15	0.13	777	-1.24	-3.67***
(6) EV/EBITDA Multiple	851	7.22	6.70	743	8.90	8.30	728	-8.16***	-10.57***
(7) Enterprise Value [USDm]	876	290.64	94.15	759	526.52	170.00	742	-12.61***	-19.16***

*** p<0.01, ** p<0.05, * p<0.1

[1]Number of observations with data at entry and exit

Panel C: Entry and Exit Types – Realized Investments

Entry Type	Our Sample	LBO Universe* (1970-2007)	Exit Type	Our Sample	LBO Universe* (1985-2005)
Corporate Spin-off	361	4,497	Private	476	3055
	33.1%	*26.1%*		*43.7%*	*39.9%*
Public-to-private	43	999	IPO	152	1019
	3.9%	*5.8%*		*13.9%*	*13.3%*
Secondary	107	2,329	Secondary	239	2281
	9.8%	*13.5%*		*21.9%*	*29.8%*
Private-to-private	311	8,987	Bankruptcy	99	473
	28.5%	*52.2%*		*9.1%*	*6.2%*
Unreported/Unknown	268	391	Unreported/Unknown	124	830
	24.6%	*2.3%*		*11.4%*	*10.8%*
Total	1090	17203	Total	1090	7658
	100%	100%		100%	100%

*Source: Strömberg (2008)

With regard to potential selection bias issues, we remain fairly comfortable that our results are not affected by any meaningful performance and survivorship related bias for several reasons. To begin with, Panel A in Table II-8 shows for our total sample of 1,980 transactions that we have a median equity IRR (gross of fees and carry) of 26% (10%) and a median cash multiple of 2.5 (1.3) for realized (unrealized) deals. This is considerably lower than, for example, the median IRR of 36% and the median cash multiple of 2.8x for 110 larger European buyouts reported by Acharya et al. (2010) and comparable to the median IRR of 26% reported by Lopez-de-Silanes et al. (2010) for a large and representative sample of 5,839 realized buyout transactions.

In addition, 99 out of our 1,090 realized deals went bankrupt (i.e. did not generate any positive cash flow for the PE sponsor or are reported as bankrupt) which accounts for 9.1% of all realized transactions. This bankruptcy fraction is slightly lower than that of Lopez-de-Silanes et al. (2010), who report a fraction of 12.9%, and higher than the average of 6% reported by Strömberg (2008) for the period 1970-2007.

Further, PE funds-of-funds providing us with their data gathered this information independently of whether they subsequently committed to an investment or not. If our data base had contained only those PE sponsors invested in funds-of-funds, our analyses would suffer from a bias towards more successful deals assuming that funds-of-funds are superior

investors. In addition, any potentially remaining positive bias should not affect our analysis in any major way as we intend to focus on the relative importance of different value creation drivers and the underlying drivers explaining entry and exit EBITDA multiples rather than absolute figures.

We believe that our sample stands out for its diversity with respect to the investing PE sponsors. It includes transactions from 98 different PE sponsors as shown in Table II-6. The average age of PE sponsors at the time of investment is 12.9 years. In addition, approximately 30% of our deals were conducted by PE funds in the first fund generation, while 21% of the buyout investments were made by funds at least of the fifth generation. The average fund generation number is 2.9 years.

Panel B in Table II-8 also reports descriptive statistics for the subsample of realized deals for which more detailed data is available. Due to our focus on the analysis of EBITDA multiples, we removed deals with negative EBITDA figures at entry to exclude restructuring cases.

The means and medians for the remaining transactions are separately shown at the time of the buyout (entry) and the disinvestment of the PE sponsor (exit). For example, the leverage measures indicate that the portfolio companies significantly de-leverage during the holding period of the PE ownership. The median EBITDA valuation multiple at entry is 6.7x and increases over the holding period (median holding period is 4.1 years) to a median of 8.3x in this sample. Sales and enterprise value both show that the buyout companies, on average, grew considerably during the holding period. While the median enterprise had sales of €92.2 million and an enterprise value of €94.2 million at entry, it had sales of €141.8 million and an enterprise value of €170.0 million at exit.

Another advantage of our data set, which is especially important when it comes to the analysis of buyout pricing, is that our sample includes different entry and exit types. Panel C in Table II-8 shows entry and exit types of our realized transactions. At entry, our sample contains 361 (or 33.1%) corporate spin-offs, 43 (3.9%) public-to-private transactions, 107 (9.8%) secondary transactions and 311 (28.5%) private-to-private deals. In addition, for 268 (24.6%) transactions the entry type is unknown. Corporate spin-offs are divestments of larger

corporations that sell a unit (e.g. division, subsidiary, etc.). Public-to-private transactions are de-listings or going-privates. Secondary transactions are purchases from other PE sponsors. Finally, private-to-private deals are private deals not included in the above categories, e.g. successions. At exit, our sample contains 476 (or 43.7%) trade sales, 152 (13.9%) initial public offerings (IPO), 239 (21.9%) secondary transactions, and 99 (9.1%) bankruptcies, which sums up to 966 observations. In addition, for 124 (11.4%) deals the exit type is unknown. In a trade sale another corporation buys the company for strategic reasons. An IPO is the going-public of the company and the subsequent sale of the shares by the PE sponsor. Secondary exits represent the sale of a buyout company to another financial sponsor. Finally, bankruptcies are reported bankruptcies of the companies or if a total loss of the invested capital occurred for the PE sponsor. In addition, Panel C of Table II-8 also shows the relative frequencies of these exit types for the LBO universe using the results of the comprehensive study of Strömberg (2008). The comparison of our transactions with the LBO universe shows that our sample is a fairly representative subsample of the LBO universe. However, due to the inherent private nature of PE deals we had difficulty in finding out about the entry and exit type for approximately 25% and 11% respectively of our deals, which is relatively high compared to the 2.3% at entry, but in line with the 11% at exit reported in Kaplan and Strömberg (2009). At entry, only 29% of our deals are considered private-to-private deals compared to 52% in Strömberg (2008), indicating that the majority of our deals classified as "Unknown" might have been private-to-private transactions.

In addition to these deal level data we used Thomson Reuters Datastream and the research section of the Fed (Board of Governors of the Federal Reserve System[18]) to obtain different economic variables (e.g. stock market returns, industry EBITDA multiples etc.) and to expand the quality of our data set.

[18] http://www.federalreserve.gov/econresdata.

4. Private Equity Sponsors' Returns

4.1 Explanatory Variables

In order to account for a company's operational performance, EBITDA is the most prevalent parameter. First, EBITDA is the most common basis for company valuations (enterprise value) in PE deals. As a result, a higher EBITDA for valuation purposes leads to a higher enterprise value and, assuming a constant net debt level, to a higher equity value. Second, most of the factors positively influencing EBITDA growth, ceteris paribus, also affect the free cash flow which can be used to repay debt or to pay dividends during the holding period. In line with this argument, EBITDA is often also used as a cash flow proxy (Opler and Titman, 1993). Basically, EBITDA can be increased by sales growth or EBITDA margin improvements. Consequently, in order to operationalize **Hypotheses 1.1a and 1.1b** we include *Delta Sales,* i.e. the change in sales between entry and exit of PE ownership, and *Delta EBITDA/Sales*, i.e. the change in EBITDA margin between entry and exit, in our regressions. However, since we are actually interested in a portfolio company's operating margin compared to or above its industry peers, we also include industry median figures based on companies with the same three-digit ICB code. The underlying indices are the Stoxx Americas 600 and EURO Total Market Index as reported by Thomson One Banker. We name these variables *Delta Sales Industry* and *Delta EBITDA/Sales Industry*.

We use the difference between EV/EBITDA multiple at entry and exit to test **Hypothesis 1.2** (*Delta EV/EBITDA*). Again, we adjust the deal-specific multiple by the industry's median multiple based on public companies with the same three-digit ICB code (*Delta EV/EBITDA Industry*).

We include two measures for leverage to test **Hypothesis 1.3**: First, we use the net debt to equity ratio *(D/E)* at deal entry as the best proxy for the financial risk of a transaction (Modigliani and Miller, 1958). Second, we use the net debt to EBITDA *(D/EBITDA)* ratio at transaction entry, which is the most common and important leverage parameter in leveraged buyouts (see, e.g., Demiroglu and James, 2010).

In order to test **Hypothesis 1.4** we use the difference between the investment entry date of the observed deal and the vintage year of the investing fund as proxy for the stage of the fund's life cycle (*Fund Life Cycle Stage at Entry*). The reason is that PE funds usually have similar predetermined lifetimes of 10 to 12 years and we do not explicitly observe the fund liquidation date in our data base.

In addition to testing these hypotheses, we control for other factors that might affect equity returns. First, we include the logarithm of the *Enterprise Value* at entry to account for size effects, as it can influence the absolute performance and the relative importance of different value drivers. For example, Achleitner et al. (2010) show that larger deals create more value through EBITDA margin improvements, whereas sales growth plays a more important role in smaller deals.

Second, we include proxies for institutional factors that possibly drive equity returns. For example, Cumming and Walz (2010) as well as Cumming et al. (2011) find that a country's legal environment has a positive influence on buyout returns. Accordingly, based on Cao et al. (2010) we include several institutional environment variables in our regression[19]: (a) a dummy if a deal was conducted in a country with a market based financial system (*Dummy Market Based Financial System*), (b) a variable indicating how sophisticated creditor protection is in a country (*Creditor Protection*), and (c) a variable indicating how strongly the legal system supports minority shareholders against managers or majority shareholders (*Anti-director Rights*). Another variable often used is a dummy indicating if a deal was conducted in a country with English Common Law. However, we do not include this variable due to the high correlation (around 80%) with *Dummy Market Based Financial System* caused by the high importance of US and UK deals in our sample.[20]

Further, in order to control for market cycle effects on equity IRRs, we assign to every PE deal the annualized return of the MSCI World Index over the holding period of the transaction to account for the general market sentiment. Considering that we have a regionally

[19] For more detailed definitions for the following variables see Cao et al. (2010), especially Appendix I and II.

[20] We only have transactions from two countries (Switzerland and Sweden) with a market-based financial system, but not with legal origin from the UK (or vice versa).

diverse sample of European and North American transactions, the MSCI World Index may be the best measure to control for worldwide market conditions (*MSCI Annual Return*). Furthermore, there are some other standard factors we control for. We include industry dummies to control for industry specific effects and time category dummies to control for systematic time patterns in the buyout market. Here, we resort to the PE market cycle time categories introduced by Strömberg (2008). In this study the relevant categories distinguish the periods 1984-1989, 1990-1994, 1995-1999, 2000-2002, and 2003-2010.

4.2 Empirical Results

Table II-9 reports the results of the OLS regressions with the equity IRR as a dependent variable. In column (1) we report the effects of our control variables when the independent variables are ignored. The only variables with relevant statistically significant explanatory power are deal size and MSCI annual return. In contrast, the variable for anti-director rights turns statistically significant (5% level) in specifications (2) to (5), indicating that a strong legal protection for minority shareholders may restrict majority shareholders (mostly the PE sponsor) to some extent. More interestingly, column (2) shows the results of our basic regression including the company-related drivers of equity returns and our control variables. We find that both, EBITDA margin improvements and sales growth significantly and positively affect equity returns, at least at the 5% level, respectively. This is strong support for Hypotheses 1.1a and 1.1b. In economic terms[21], we find that a buyout company that grows its sales by 10% over the holding period, e.g. by €9.2 million at the sample median, yields an about 1.7 percentage points higher equity IRR (0.180*ln(1.1) = 0.017) than a buyout company with stable sales. Far stronger is an increase in EBITDA/Sales by 10%, e.g. by 0.01 times EBITDA/Sales at the sample median, which even results in a 25.6 percentage points increase in equity IRR.

The effects of these variables for operational changes can be partly attributed to the disciplining effect of debt (Jensen, 1989). However, as the net debt to EBITDA leverage variable still has a (weakly) significant (10% level) and positive impact on equity returns, we

[21] In the following two paragraphs we refer to specification (2) in Table II-9 when interpreting the results in economic terms.

argue that equity returns are also boosted by the effect of higher tax shields and increased financial risk, i.e. the 'classical' leverage effect, as well as the option-like compensation structure of PE general partners. However, a 10% increase in net debt to EBITDA leverage, e.g. by 0.39 times net debt to EBITDA at the sample median, results in an only 0.6 percentage points higher IRR. Interestingly, our results differ from those of Nikoskelainen and Wright (2007) who do not find a statistically relevant relationship between the ratio of debt to EBIT and market-adjusted equity returns.[22]

Furthermore, the delta in EBITDA multiples over the holding period in our regressions is also significantly and positively related to equity returns (1% level) confirming Hypothesis 1.2 and the results of Achleitner et al. (2010) and Acharya et al. (2010). A buyout company which has a 10% higher valuation, e.g. 0.7 times higher EV/EBITDA at the sample median, yields a 2.9 percentage points higher IRR than a buyout company with the same EBITDA multiple valuation at entry and exit.

In specifications (4) and (5) we substitute our measure of leverage by the debt to equity ratio at entry which is highly significant (1% level) and positively related to equity returns. For example, in specification (4) a 10% higher debt to equity ratio at entry, on average, results in a 1.1 percentage points higher IRR. This finding supports Hypothesis 1.3 and indicates that the compensation structure of PE funds provides incentives to lever up deals as much as possible. A similar, and not mutually exclusive, explanation would be that the increasing financial risk associated with higher debt to equity ratios is offset by higher equity returns on average, which describes the "classical" leverage effect. Given the weak significance of our net debt to EBITDA variable in specifications (1) and (2), we interpret this finding as confirming the hypothesis that the debt to equity ratio is a better proxy to account for the influence of leverage on equity returns.

[22] It should be noted that Nikoskelainen and Wright (2007) use a different equity return measure based on entry and exit equity values (not allowing for interim cash flows) and adjusted by market returns.

Table II-9: OLS Regression Results - Equity IRR

The table presents the results of ordinary least squares regressions on the determinants of equity IRR winsorized at the 99th percentile using a sample of realized private equity (PE) sponsored buyouts with available firm-level data completed between 1986 and 2006. Equity IRR is calculated from monthly cash flows between PE sponsor and the portfolio company gross of fees and carried interest. The variables are defined as in Table II-7. We double-cluster standard errors by time (quarterly per year) and industry (three-digit ICB codes). Generally, the numbers in the upper rows represent the regression coefficients. *, ** and *** indicate p-values of 10 percent, 5 percent, and 1 percent significance level, respectively. In the lower rows standard errors are reported.

		Equity IRR				
				OLS		
Independent Variables	Hypothesis	(1)	(2)	(3)	(4)	(5)
Delta Sales			0.180**	0.177**	0.207***	0.204***
	1.1a		(0.075)	(0.076)	(0.073)	(0.073)
Delta Sales Industry			-0.290***	-0.284***	-0.304***	-0.299***
			(0.077)	(0.077)	(0.082)	(0.082)
Delta EBITDA/Sales			2.688***	2.665***	2.776***	2.757***
	1.1b		(0.487)	(0.482)	(0.489)	(0.486)
Delta EBITDA/Sales Industry			-1.671	-1.728	-1.618	-1.670
			(1.344)	(1.356)	(1.287)	(1.297)
Delta EV/EBITDA			0.307***	0.302***	0.299***	0.294***
	1.2		(0.035)	(0.033)	(0.032)	(0.031)
Delta EV/EBITDA Industry			-0.147	-0.153	-0.126	-0.132
			(0.150)	(0.153)	(0.149)	(0.152)
Log(D/EBITDA)			0.062*	0.063*		
	1.3		(0.036)	(0.036)		
Log(D/E)					0.116***	0.116***
					(0.029)	(0.029)
Fund Cycle Stage at Entry	1.4			-0.023**		-0.021*
				(0.011)		(0.011)
Control variables						
Log(Enterprise Value)		0.032*	0.033	0.033	0.026	0.025
		(0.017)	(0.021)	(0.022)	(0.018)	(0.019)
Dummy Market Based Financial System		-0.032	0.007	0.006	0.000	-0.001
		(0.043)	(0.044)	(0.044)	(0.045)	(0.045)
Creditor Protection		-0.001	0.015	0.012	0.010	0.008
		(0.020)	(0.029)	(0.028)	(0.025)	(0.024)
Anti-director Rights		-0.014	-0.078**	-0.075**	-0.066**	-0.062**
		(0.027)	(0.036)	(0.034)	(0.031)	(0.029)
MSCI Annual Return		2.160***	1.387***	1.520***	1.311***	1.435***
		(0.402)	(0.422)	(0.418)	(0.400)	(0.400)
Industry Dummies		Yes	Yes	Yes	Yes	Yes
Entry Year Dummies		Yes	Yes	Yes	Yes	Yes
Constant		-0.022	0.249	0.259	0.327**	0.336**
		(0.128)	(0.158)	(0.160)	(0.137)	(0.141)
Observations		863	603	603	603	603
Adj. R-squared		0.09	0.27	0.27	0.30	0.30

*** p<0.01, ** p<0.05, * p<0.1

One could argue that our positive relationship between leverage and equity returns is endogenous since banks are willing to provide more debt to finance a transaction if they expect a very positive development with regard to the performance of the portfolio company during the holding period of the PE sponsor. This would imply that deals with higher expected performance are more highly leveraged and not the other way around. However, as we control for the portfolio company's operating performance over the holding period in the regressions, the positive relationship between leverage and equity returns is not endogenous. Nevertheless, we also test if our leverage measures are endogenous using the Durbin-Wu-Hausman test (Cameron and Trivedi, 2010). We use the yield spread on corporate bonds (Moody's BAA bond index) on the risk free rate (10-year US government bonds) (*Yearly Credit Spread*) as an instrument in the first stage to predict deal-level D/EBITDA and D/E ratios. The pairwise correlation between D/EBITDA (D/E) and credit spread is -0.13 (-0.10). The F statistics for this test are 0.8, 0.8, 1.1 and 1.1 for specifications (2), (3), (4) and (5), respectively. This implies that there are no signs of endogeneity for these specifications.

In specifications (3) and (5) in Table II-9 we add our proxy for the fund life cycle stage to the basic specification. We find a weakly significant (10% level) and negative relationship between this variable and equity returns indicating that, on average, investments made closer to the liquidation date of the investing fund generate lower returns. This supports Hypothesis 1.4. For each year that passes since the vintage year of the fund, the IRR shrinks by about 2.2 percentage points. Our findings suggest that PE sponsors tend to conduct less risky deals (in terms of business risk) the shorter a fund's remaining life time is in order not to risk the already achieved fund returns and/or not to be forced to accept less attractive investment opportunities for the entire committed capital. Further, less time remains to implement operational improvements during the holding period. In addition, PE sponsors might try to avoid negative publicity if they are in the process of launching a new fund, which is more likely to happen at a later stage of the previous fund's life cycle.

In order to check the robustness of these results we also conduct a two-step Heckman correction (Heckman, 1979) presented in Table II-10. The reason is that focusing on the subsample of realized investments in the OLS regressions could lead to a selection bias as PE sponsors tend to hold underperforming investments longer in their portfolio. PE sponsors try

to avoid selling or writing-off poorer performing investments as this might constrain fundraising activity (see, e.g., Cumming and Walz, 2010). Our sample selection correction involves two steps. First, we determine the probability of an exit using an identifier variable. Second, we conduct a linear regression in order to explain equity IRRs based on the first step. In both steps we use the same independent variables as in the regressions presented in Table II-9. In addition, we use an additional variable as an identifier in the first step, namely the logarithmized age of the investment. Previous studies have shown that the probability of an exit is a function of the age of an investment (Cochrane, 2005, Cumming and Walz, 2010).

Overall, the results of the second step of the Heckman corrected regressions are highly consistent with the results obtained by the OLS regressions Table II-9. The relationship between equity IRR and D/EBITDA has even gained in statistical and economic significance (10% level in OLS, 1% in Heckman corrected estimates). However, our variable measuring the fund cycle stage at investment entry, which was weakly (10%) significant in the OLS models, no longer has a statistically significant influence on equity IRR. We therefore interpret our weakly significant relationship between a fund's life cycle stage and IRRs in the OLS regressions cautiously.

Having analysed the influence of different value drivers on equity IRRs we now turn to the underlying factors behind pricing, i.e. entry and exit EBITDA multiples, and consequently also the effects behind multiple expansion.

Table II-10: Heckman Correction - Equity IRR

The table presents Heckman corrected results on the determinants of equity IRR winsorized at the 99th percentile using a sample of realized and unrealized private equity (PE) sponsored buyouts with available firm-level data completed between 1986 and 2008. The results of the Heckman correction in the first step are not reported, but include all variables from the second step as well as the (logarithmized) age of the investment (in days) for identification. The variables are the same as in Table II-9 and defined as in Table II-7. *, ** and *** indicate p-values of 10 percent, 5 percent, and 1 percent significance level, respectively. In the lower rows standard errors are reported.

		Equity IRR				
		Heckman 2nd step				
Independent Variables	Hypothesis	(1)	(2)	(3)	(4)	(5)
Delta Sales			0.176***	0.171***	0.198***	0.200***
	1.1a		(0.044)	(0.044)	(0.044)	(0.044)
Delta Sales Industry			-0.326***	-0.299***	-0.357***	-0.353***
			(0.076)	(0.080)	(0.083)	(0.082)
Delta EBITDA/Sales			2.628***	2.555***	2.715***	2.702***
	1.1b		(0.357)	(0.359)	(0.355)	(0.354)
Delta EBITDA/Sales Industry			-0.917	-1.445	-1.378	-1.426
			(0.898)	(0.981)	(0.979)	(0.977)
Delta EV/EBITDA			0.330***	0.320***	0.307***	0.303***
	1.2		(0.040)	(0.041)	(0.039)	(0.039)
Delta EV/EBITDA Industry			-0.062	-0.093	-0.076	-0.081
			(0.134)	(0.135)	(0.135)	(0.135)
Log(D/EBITDA)			0.118***	0.119***		
	1.3		(0.039)	(0.043)		
Log(D/E)					0.124***	0.123***
					(0.022)	(0.022)
Fund Cycle Stage at Entry	1.4			-0.018		-0.015
				(0.015)		(0.015)
Control variables						
Log(Enterprise Value)		0.023	0.024	0.024	0.030*	0.030*
		(0.015)	(0.016)	(0.017)	(0.016)	(0.016)
Dummy Market Based Financial System		0.081	0.055	0.048	0.099	0.098
		(0.070)	(0.053)	(0.054)	(0.061)	(0.061)
Creditor Protection		0.003	0.013	0.011	0.011	0.009
		(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Anti-director Rights		0.003	-0.065*	-0.063*	-0.044	-0.041
		(0.037)	(0.036)	(0.036)	(0.036)	(0.036)
MSCI Annual Return		2.087***	1.353***	1.523***	1.194***	1.290***
		(0.274)	(0.276)	(0.302)	(0.292)	(0.306)
Industry Dummies		Yes	Yes	Yes	Yes	Yes
Entry Year Dummies		Yes	Yes	Yes	Yes	Yes
Constant		-0.140	0.175	0.153	0.175	0.182
		(0.163)	(0.162)	(0.166)	(0.168)	(0.169)
Uncensored observations		863	603	603	603	603
Censored observations		384	231	231	231	231
Mills Lambda		2.33**	3.35***	2.24**	2.96***	2.95***
Chi-Squared		101.8***	257.2***	265.5***	277.7***	280.3***

*** p<0.01, ** p<0.05, * p<0.1

5. The Drivers of Pricing in Buyouts

5.1 Time Trends

In Figure II-4 we report the time series medians for entry and exit EBITDA multiples as well as the number of transactions for our subsample of 841 deals with data on EBITDA multiples and entered between 1990 and 2005. The black columns show the number of transactions (left axis) completed in each year. Each deal was assigned to the year in which the PE sponsor invested, i.e. at entry. Generally, the figure shows that the majority of buyouts in our data set were done in the period 1995 to 2005. The more recent years after 2004, accounting for about 40% of all private equity transactions in the LBO universe (Strömberg, 2008), are underrepresented in our sample, as we only include exited deals in Figure 1 due to our focus on multiple expansion and many of the more recent transactions are still in the PE sponsor's portfolios. In addition, the black line represents the median entry EBITDA multiple (right axis) for all deals completed in the respective year. For example, in 2005 the median entry EBITDA multiple paid by PE sponsors was 6.6x and this median multiple is based on the 41 transactions completed in that year. Overall, the figure provides very intuitive results indicating both the strong decline in prices between 2001 and 2003 due to the burst of the dot.com bubble, as well as the sharp increase in (entry) prices from 2003 on. Unfortunately, we are unable to adequately cover the recent private equity boom of 2006 and 2007 (Kaplan and Strömberg, 2008) which is thought to be associated with even higher multiples compared to the period 2003 to 2005.

Figure II-4: Pricing Trends and Multiple Expansion

The figure presents the median entry EV/EBITDA multiple (black line) that a PE sponsor paid to acquire a company in the respective year based on the subsample of 832 realized transactions entered between 1990 and 2005 and with data on entry EV/EBITDA multiples. The black column represents the number of acquisitions that PE sponsors conducted in the respective year. The grey line shows the median exit EV/EBITDA multiple associated with the realized deals entered in the respective entry year based on 742 transactions, i.e. the distance between the grey and black line indicates the difference between median exit and entry multiples for all deals completed in one year (multiple expansion).

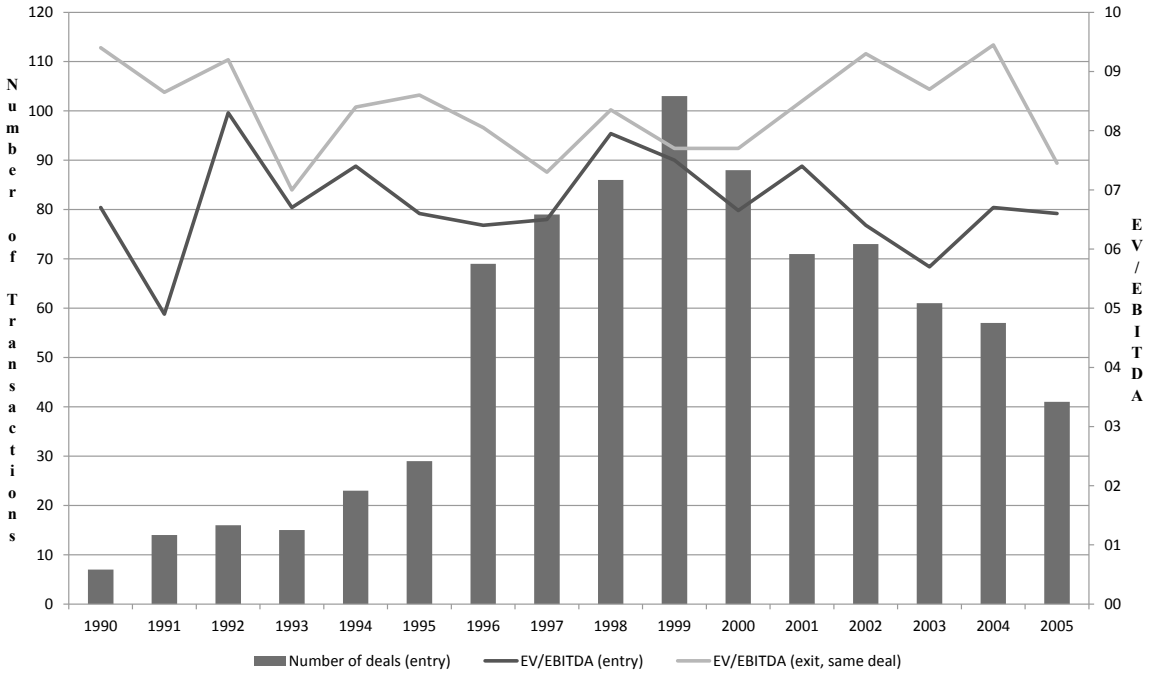
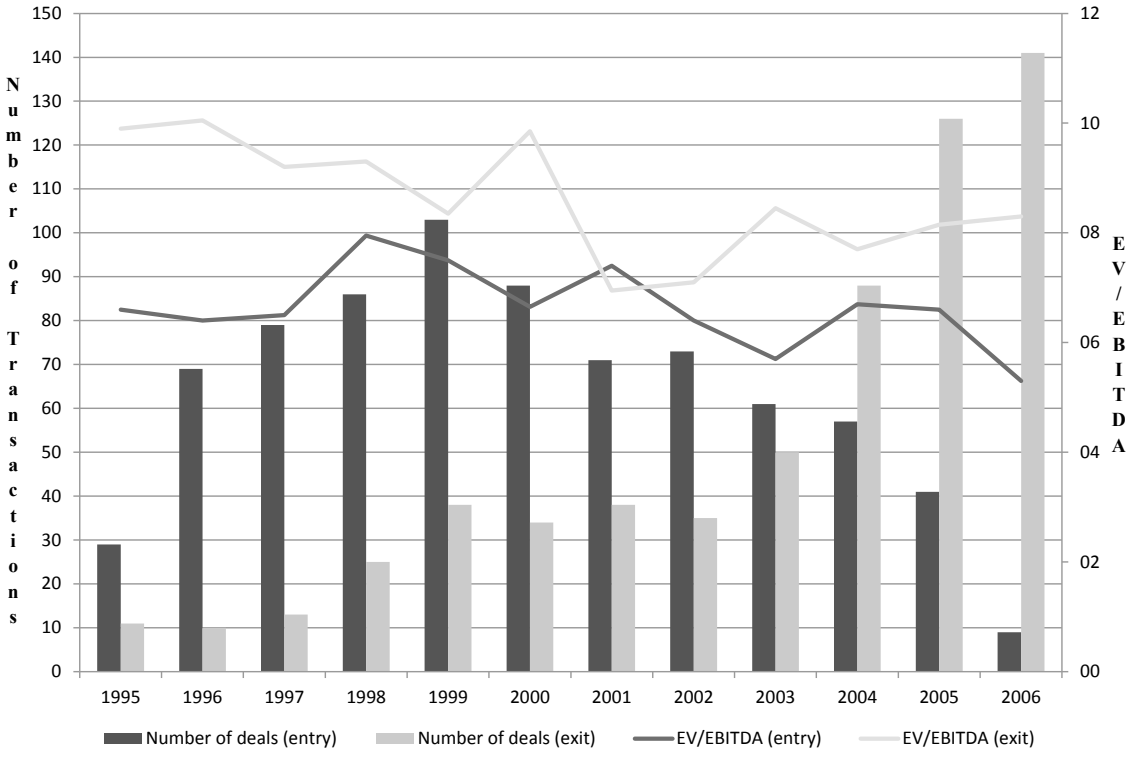


Figure II-5 provides further insights into the comparison of entry and exit EBITDA multiples and not only shows the number of transactions entered into (black column) but also those exited (grey column) in one year. However, the figure only presents details for the years 1995 to 2006 due to the fact that only those consecutive years are included in which at least 5 transactions were completed (entry) and realized (exit). For example, in 2005 41 deals were completed and 126 realized. Again, the black line represents the median entry EBITDA multiple (right axis) for all deals completed in the respective year. However, the main difference to Figure II-4 is the interpretation of the grey line representing the median exit EBITDA multiples for each year. Now, the median exit EBITDA multiple is the median multiple of all transactions realized in the respective year. For example, PE sponsors received a median EBITDA multiple of 8.2x for the sale of the 126 companies in 2005. Overall, the figure provides striking results: in almost every year (except 2001) divesting PE sponsors

were able to realize higher prices for the sale of portfolio companies than PE sponsors paid to acquire new portfolio firms in the same year. This finding implies that PE sponsors are simply good negotiators or the ex-portfolio firms sold are in better condition than the acquired companies. Alternatively, managers selling a company to a PE sponsor might prefer keeping their job to fighting for the best price for the previous shareholders (Kaplan and Strömberg, 2009). Especially in the case of a management buyout (MBO), participating managers have incentives to reduce the purchase price (Madden et al., 1990, Davidson and Cheng, 1994). Hence, PE sponsors would also benefit from relatively low entry multiples that are easier to improve at exit. Briston et al. (1992) provide empirical support for this hypothesis showing that pre-buyout shareholders experience negative excess returns after the announcement of an MBO for a sample of 65 deals conducted in the UK between 1984 and 1989. This indicates that the buyer group (including management) is able to achieve a favorable price. In summary, these findings suggest that value creation by multiple expansion is a manageable value driver rather than only a matter of luck.

Figure II-5: Comparison of Entry and Exit Pricing

The figure presents the median entry EV/EBITDA multiples (black line), i.e. the median multiple, that a PE sponsor paid to acquire a company, and the median exit EV/EBITDA multiples (grey line), i.e. the median multiple, that a PE sponsor received for selling a company, in one year based on the subsamples of 766 realized deals at entry and 609 realized deals at exit, respectively. The figure only includes transactions from those years in a row in which at least five EV/EBITDA multiples for both entry and exit dates could be observed, i.e. the period between 1995 and 2006. The black column represents the number of acquisitions that PE sponsors conducted in the respective year, whereas the grey column represents the number of divestments by PE sponsors in the respective year.



5.2 Entry EBITDA Multiple

5.2.1. Explanatory Variables

In order to test **Hypothesis 2.1**, we include the deal net debt to EBITDA *(D/EBITDA)* ratio as leverage proxy in our analysis. We prefer to use net debt to EBITDA, as it is the most important leverage parameter in leveraged buyouts (see, e.g., Demiroglu and James, 2010).

However, as mentioned by Axelson et al. (2010) and by Demiroglu and James (2010), there a two major problems when analyzing the relationship between deal leverage and EBITDA multiples: first, there is the endogeneity of leverage to multiples since the factors

might be jointly driven by unobserved forces. Second, there could be a measurement error problem as both, enterprise value and net debt, are calculated relative to the EBITDA. In order to overcome these problems, and in line with Axelson et al. (2010) and Demiroglu and James (2010), we run two-stage instrumental variable regressions. In the first stage we use credit spread as an instrument to predict deal leverage at entry to be included in the multiple regression of the second stage. Similar to Ljungqvist et al. (2007) we use the yield spread on corporate bonds (Moody's BAA bond index) on the risk free rate (10-year US government bonds) as credit spread (*Yearly Credit Spread*).

In order to test **Hypothesis 2.2** we calculate public market EBITDA multiples by using the median industry EBITDA multiple *(EV/EBITDA Industry)* based on three-digit ICB codes.

We include two proxies for the PE sponsors' experience and reputation to test **Hypotheses 2.3a**/**2.3b**. These proxies are (1) *PE fund generation*, i.e. the historical number of funds launched by a PE sponsor at investment entry (see, e.g., Schmidt et al., 2004), (2) *PE Sponsor Age* at investment entry (see, e.g., Kaplan and Schoar, 2005, Meuleman et al., 2009). We also include the *PE fund size*, i.e. the size of the investing PE fund in USD million, in some specifications as it can be seen as an alternative reputation proxy (Kaplan and Schoar, 2005). Furthermore, and more importantly, as described by Cumming and Dai (2011) some PE sponsors might try to achieve (inefficiently) large fund commitments as this is accompanied by higher management fees and more prestige.

In addition to testing these hypotheses, we control for other factors that might affect entry pricing. First, we control for the role of the buyout company's size (*Enterprise Value*). We also control for expected operational improvements during the holding period. However, since we have no ex-ante variable representing the expectations at investment entry, we include the ex-post realized operational changes (*Delta EBITDA*) assuming that ex-ante expectations materialized. In addition, we control for different country-specific institutional factors by including the following variables[23]: *Dummy Market Based Financial System, Creditor Protection* and *Anti-director Rights*. In order to ensure that our results are not

[23] See section 4.1.1 and Table II-7 for variable definitions.

blurred by the source from which a buyout company is bought, we also include entry type dummies in our regressions.

5.2.2. Empirical Results

The results of our regression analyses are shown in Table II-11. Before we proceed to the discussion of the results, we would like to highlight various model-specific aspects of our IV regressions. Firstly, we tested for regressor endogeneity using the Durbin-Wu-Hausman test (Cameron and Trivedi, 2010). The F statistics for this test are 4.7, 3.3, 5.8, 5.3, 3.9 and 6.6 for specifications (1) to (6) respectively. This means that there are strong signs of endogeneity and we, therefore, conclude that it is correct to use the IV instead of the simple OLS approach to regress deal pricing on deal leverage variables. Secondly, we turn to the question of instrument relevance in order to rule out that our specifications are affected by a weak instrument problem, which may lead to misleading results. The pairwise correlation between D/EBITDA at entry and credit spread is -0.13. We consider this to be sufficient as far as instrument relevance is concerned. To gain more comfort that we are not confronted with a weak instrument situation, we also look at the robust F statistics from the first stage, which are 8.4, 23.3, 24.5, 6.7, 17.4 and 14.6 for specifications (1) to (6) respectively. Since we consider specifications (2), (3), (5) and (6) to be most relevant – as they include entry type dummies – and given the rule of thumb of 10 suggested by Stock and Yogo (2005), we conclude that we do not face a weak instrument problem.

Our base specifications are models (1b) and (3b) which only differ in the PE sponsor experience proxy. We find deal leverage, predicted in stage one, to be significantly (1% level) and positively related to entry EBITDA multiples indicating that buyout pricing is influenced by the amount of leverage available for a transaction. This effect has a considerable economic effect as in our sample a deal with 10% more leverage yields a 3.5% higher entry EBITDA multiple (1.1^0.359 = 1.035). This finding supports Hypothesis 2.1 that buyout pricing is strongly affected by the amount of leverage used to finance a transaction. Given that more leverage is available when credit market conditions are good, this indicates that PE sponsors might take advantage of low interest rates which possibly do not appropriately reflect the increasing bankruptcy risk associated with higher leverage ratios. This implies that PE

sponsors use inefficiencies in the debt market during boom times to increase their expected return on equity which allows them to pay higher entry prices.

Our results also show that entry EBITDA multiples are significantly and positively related to industry multiples in public markets indicating that general market conditions as well as industry specific factors play an important role in buyout pricing (Hypothesis 2.2). A 10% higher industry multiple prevailing at transaction date, ceteris paribus, results in a 2.2% higher entry multiple (1.1^0.224 = 1.022).

Our second stage regressions show PE sponsors' experience to be significantly (1% and 5% level in second stage regressions 2b-6b and 10% level in regression 1b) and negatively related to entry EBITDA multiples, thereby supporting Hypothesis 2.3b. This is in line with the results reported by Cumming and Dai (2011) for venture capital transactions. In economic terms, for a given deal a one year older PE sponsor pays a 0.6%-0.7% lower entry multiple than its younger competitor. In line with the arguments provided by Axelson et al. (2010), our finding suggests that over the years PE sponsors accumulate relevant negotiation skills that allow them to pay lower prices for a given company. Furthermore, we also find weak evidence in specification (6b) that PE fund size is positively related to pricing which is in line with the inefficient fund size hypothesis mentioned.

Table II-11: IV Regression - Entry Multiple

The table presents the results of instrumental variable regressions on the determinants of logarithmized EV/EBITDA multiple at entry winsorized at the 99th percentile using a sample of realized and unrealized private equity (PE) sponsored buyouts completed between 1986 and 2008. We use credit spreads as instrument to predict deal-specific D/EBITDA at entry winsorized at the 99th percentile in the first stage regression. The variables are defined as in Table II-7. Standard errors are clustered by time (quarterly per year). Generally, the numbers in the upper rows represent the regression coefficients. *, ** and *** indicate p-values of 10 percent, 5 percent, and 1 percent significance level, respectively. In the lower rows standard errors are reported in parentheses.

	Log(D/EBITDA) at Entry First Stage IV Regression							Log(EV/EBITDA) at Entry Second Stage IV Regression					
VARIABLES	(1a)	(2a)	(3a)	(4a)	(5a)	(6a)	Hypothesis	(1b)	(2b)	(3b)	(4b)	(5b)	(6b)
Log(D/EBITDA)							2.1	0.359***	0.304***	0.419***	0.396***	0.328***	0.483***
								(0.123)	(0.087)	(0.130)	(0.143)	(0.091)	(0.154)
Log(EV/EBITDA) Industry	-0.340**	-0.326***	-0.321***	-0.302**	-0.292**	-0.291**	2.2	0.224***	0.200***	0.210***	0.227***	0.202***	0.218***
	(0.137)	(0.121)	(0.122)	(0.137)	(0.124)	(0.125)		(0.072)	(0.055)	(0.074)	(0.077)	(0.057)	(0.082)
PE Fund Generation	0.077***	0.080***	0.090***				2.3a	-0.021*	-0.018**	-0.032**			
	(0.020)	(0.018)	(0.019)					(0.012)	(0.009)	(0.014)			
PE Sponsor Age				0.013**	0.011**	0.012**	2.3b				-0.007**	-0.006**	-0.008***
				(0.006)	(0.005)	(0.005)					(0.003)	(0.002)	(0.003)
Log(PE Fund Size)			-0.159***			-0.164***				0.045			0.060*
			(0.029)			(0.029)				(0.030)			(0.035)
Control variables													
Log(Enterprise Value)	0.193***	0.140***	0.193***	0.213***	0.166***	0.225***		0.024	0.050***	0.011	0.015	0.043**	-0.012
	(0.023)	(0.022)	(0.025)	(0.021)	(0.021)	(0.024)		(0.026)	(0.017)	(0.033)	(0.033)	(0.019)	(0.042)
Delta EBITDA	-0.016	-0.014	-0.003	-0.010	-0.008	-0.008		0.146***	0.144***	0.143***	0.141***	0.139***	0.134***
	(0.052)	(0.046)	(0.044)	(0.051)	(0.046)	(0.045)		(0.024)	(0.020)	(0.022)	(0.024)	(0.021)	(0.024)
Dummy Market Based Financial System	0.387***	0.173***	0.205***	0.396***	0.183***	0.209***		-0.138**	-0.061*	-0.095**	-0.160**	-0.071**	-0.113***
	(0.070)	(0.062)	(0.064)	(0.071)	(0.062)	(0.065)		(0.064)	(0.033)	(0.039)	(0.073)	(0.034)	(0.044)
Creditor Protection	0.024	-0.045	-0.002	0.030	-0.029	0.020		0.000	0.022	0.012	0.001	0.029*	0.008
	(0.031)	(0.028)	(0.027)	(0.031)	(0.029)	(0.029)		(0.015)	(0.013)	(0.015)	(0.016)	(0.013)	(0.017)
Anti-director rights	0.066	0.089**	0.044	0.034	0.041	-0.007		0.012	0.007	0.009	0.018	0.017	0.027
	(0.051)	(0.042)	(0.042)	(0.050)	(0.043)	(0.044)		(0.024)	(0.019)	(0.021)	(0.023)	(0.018)	(0.020)
Instrument													
Yearly Credit Spread	-0.230***	-0.287***	-0.240***	-0.208***	-0.264***	-0.204***							
	(0.067)	(0.056)	(0.056)	(0.067)	(0.056)	(0.057)							
Entry Type Dummies	No	Yes	Yes	No	Yes	Yes		No	Yes	Yes	No	Yes	Yes
Constant	0.584	1.435***	2.016***	0.509	1.436***	2.050***		1.029***	0.856***	0.678***	1.050***	0.826***	0.542*
	(0.365)	(0.333)	(0.350)	(0.364)	(0.338)	(0.356)		(0.163)	(0.132)	(0.239)	(0.169)	(0.132)	(0.295)
Observations	1,097	1,097	933	1,104	1,104	1,005		1,097	1,097	933	1,104	1,104	1,005
Adj. R-squared	0.14	0.35	0.44	0.13	0.33	0.41		n/m	n/m	n/m	n/m	n/m	n/m
Root MSE	1.03	0.89	0.85	1.04	0.91	0.87		0.44	0.38	0.43	0.46	0.39	0.45

*** p<0.01, ** p<0.05, * p<0.1

In addition, we find also strong empirical support for Hypothesis 2.3b stating that more experienced and reputed PE sponsors use more leverage to finance a transaction. This is also in line with the results reported by Demiroglu and James (2010), Ivashina and Kovner (2011) and Achleitner et al. (2011). Our proxies for PE sponsor reputation and experience are statistically significant (PE fund generation at 1% level and PE sponsor age at 5% level) and positively related to deal leverage in our first stage regressions. For instance, a one year older PE sponsor uses approximately 1.2% more D/EBITDA compared to its younger competitor for a given transaction. Altogether our findings extend existing knowledge about the role of PE sponsor experience and LBO pricing. While increased availability of leverage for a given transaction indirectly increases entry prices paid by experienced PE sponsors, this effect is somewhat mitigated by skills that allow them to negotiate lower prices for a transaction with a given leverage level. Following this argumentation, our findings provide further support for the argument in PE literature that some sponsors have skills that make them continuously outperform their competitors (Kaplan and Schoar, 2005). Interestingly, we also find a negative relationship between fund size and leverage *when* simultaneously controlling for PE sponsor reputation and investment size. Since banks (co-)determine the amount of debt used in a transaction, this could be interpreted as further evidence for diseconomies of scale in PE fund size (see, e.g., Cumming and Dai, 2011, Lopez-de-Silanes et al., 2010).

Similar to Axelson et al. (2010), Demiroglu and James (2010) and Achleitner et al. (2011) we also find a significant and negative relationship between credit market conditions and leverage at the first stage (1% level). The results of the first stage also show that deals conducted in market based financial systems are more highly leveraged (1% level). This could be due to a more pronounced risk appetite in these countries (e.g. the USA and UK) and the more sophisticated possibilities of banks to forward credit risk. Further, we find evidence that deals done in a market based financial system exhibit lower entry pricing.

We find that deal size is positively related to deal leverage and entry pricing. Further, our proxy for ex ante expectations about operational improvement is positively related to entry pricing, indicating that PE sponsors are willing to pay higher entry prices for companies they expect to perform superiorly in the future.

5.3 Exit EBITDA Multiple

5.3.1. Explanatory Variables

In order to operationalize **Hypotheses 2.4a and 2.4b** we include *Delta Sales*, i.e. the change in sales between entry and exit of PE ownership, and *Delta EBITDA/Sales*, i.e. the change in EBITDA margin between entry and exit, in our regressions. Again, we adjust the deal-specific operating measures by industry median figures based on companies with the same three-digit ICB code in some specifications (*Delta Sales Industry* and *Delta EBITDA/Sales Industry)*.

Resorting to the argument already given for EBITDA multiples at entry, we use the difference between the exit date of the observed deal and the vintage year of the investing fund as proxy for the fund's life cycle stage (*Fund Cycle Stage at Exit*) in order to test **Hypothesis 2.5a**. Please note that this is nevertheless another variable as previously used in the entry multiple regressions as we use the difference between the exit date (not the entry date) and the vintage year. In addition, we also include an interaction term between this life cycle variable and a dummy variable if the investing fund is a first time fund (*Fund Cycle*Dummy First Time Fund)* to test **Hypothesis *2.5b***.

In addition to testing these hypotheses, we control for other factors that might affect exit pricing. Firstly, due to the fact that PE sponsors try to avoid selling portfolio companies in weak economic environments and immediately take advantage of profitable exit opportunities (e.g. in a good economic environment) we have to control for the *Holding Period* of a transaction. Deals with shorter holding periods are expected to have higher exit EBITDA multiples.

Adopting the same rationale applied for entry EBITDA multiples we also include the following variables[24]: *Dummy Market Based Financial System, Creditor Protection* and *Anti-director Rights*. In addition, we include exit industry EBITDA multiples in the public market to account for general market conditions (*EV/EBITDA Industry*) and we control for credit

[24] See section 4.1.1 and Table II-7 for variable definitions.

market conditions at exit (*Yearly Credit Spread*). Further, we also include time and exit type dummies.

5.3.2. Empirical Results

Table II-12 reports the regression results using the exit EBITDA multiple as a dependent variable. In all specifications we find that sales growth is significantly and positively related to exit EBITDA multiples, confirming Hypothesis 2.4a. The statistical significance is at 1% levels in our OLS and Heckman corrected regressions. In economic terms, a 10% increase in sales over the holding period results in approximately a 1% higher exit EBITDA multiple (1.1^0.119 = 1.01). We conclude that a seller pays a premium for sustainable and constant past growth, indicating a company's favorable competitive position. Similarly, higher sales figures could be associated with more stable cash flows.

We find no statistical evidence for our Hypothesis 2.4b, that margin improvements have a positive influence on exit EBITDA multiples. These results indicate that past margin improvements are not associated with a higher anticipated potential for future margin improvements. On the contrary, the negative (but statistically insignificant) sign of the coefficients rather indicate that past margin improvements are associated with less potential for future efficiency improvements.

In specifications (3) to (5) we also include our proxy for the fund life cycle stage at exit and dropped the variable holding period due to the strong correlation between both variables. We find no statistically significant influence of fund life cycle stage on exit EBITDA multiples indicating the lower negotiation power of PE sponsors and the higher acceptance of lower exit prices from the PE sponsor's side, respectively (Hypothesis 2.5a). However, interestingly, our results indicate that this holds for less experienced and less reputed PE sponsors (Hypothesis 2.5b). The interaction term we construct for this purpose is statistically significant (5% level) and negatively related to exit EBITDA multiples.

We consider our findings for the buyout arena to be somewhat related to the grandstanding hypothesis in an early-stage venture capital context. Less experienced and reputed PE sponsors face stronger information asymmetries about the quality of a company to

be sold, resulting in discounts on the purchase price. In addition, these PE sponsors might accept lower exit prices when approaching the end of a fund's lifecycle in order to raise a follow-on fund. It is reasonable to assume that the success of fundraising activities is more likely when most of the portfolio companies of the previous fund have been sold.[25]

Similar to section 4.1.2 we check the robustness of our results by conducting a two-step Heckman correction in specifications (6) and (8). Again, we use the logarithmized age of the investment in days as an identifier in the first step. Overall, the results of the Heckman corrected regressions confirm the findings from the OLS regressions.

[25] However, if we substitute the first time fund dummy by our other experience variables (PE sponsor age and fund generation) the interaction term turns insignificant. This indicates that the fundraising argument is especially relevant for PE sponsors trying to raise their second fund.

Table II-12: OLS Regression and Heckman Correction - Exit Multiple

The table presents the results of ordinary least squares and the Heckman corrected regressions on the determinants of logarithmized EV/EBITDA multiple at exit winsorized at the 99th percentile using a sample of 626 realized and 277 unrealized PE sponsored buyouts completed between 1986 and 2006 (2008 for Heckman corrected estimates). The results of the Heckman correction in the first step are not reported, but include all variables from the second step (excluding exit type and year dummies) as well as the (logarithmized) age of the investment (in days) for identification. The variables are defined as in Table II-7. We double-cluster standard errors by time (quarterly per year) and industry (three-digit ICB codes) in the OLS regressions and by time in the Heckman corrected regressions. Generally, the numbers in the upper rows represent the regression coefficients. *, ** and *** indicate p-values of 10 percent, 5 percent, and 1 percent significance level, respectively. In the lower rows the standard errors are reported in parentheses.

		Log(EV/EBITDA) at Exit							
		OLS	OLS	OLS	OLS	OLS	Heckman 2nd step	Heckman 2nd step	Heckman 2nd step
Independent Variables	Hypothesis	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Delta Sales		0.119***	0.119***	0.116***	0.113***	0.120***	0.118***	0.112***	0.117***
	2.4a	(0.040)	(0.040)	(0.040)	(0.042)	(0.043)	(0.037)	(0.037)	(0.037)
Delta Sales Industry			-0.022	-0.033	-0.060	-0.029	-0.032	-0.060	-0.029
			(0.071)	(0.072)	(0.070)	(0.065)	(0.072)	(0.072)	(0.072)
Delta EBITDA/Sales		-0.235	-0.239	-0.235	-0.250	-0.231	-0.239	-0.248	-0.230
	2.4b	(0.196)	(0.200)	(0.202)	(0.214)	(0.208)	(0.253)	(0.251)	(0.249)
Delta EBITDA/Sales Industry			-0.137	-0.080	-0.137	-0.459	-0.027	-0.174	-0.496
			(0.707)	(0.750)	(0.747)	(0.636)	(0.725)	(0.719)	(0.698)
Fund Cycle Stage at Exit	2.5a			-0.011	0.007	0.005	0.009	0.008	0.006
				(0.009)	(0.011)	(0.012)	(0.092)	(0.011)	(0.011)
Dummy First Time Fund					0.120	0.068		0.123	0.071
					(0.085)	(0.091)		(0.103)	(0.105)
Fund Cycle*Dummy First Time Fund	2.5b				-0.033**	-0.029**		-0.033**	-0.030**
					(0.014)	(0.015)		(0.015)	(0.015)
Control variables									
Holding Period		-0.014	-0.013						
		(0.009)	(0.008)						
Log(EV/EBITDA) Industry		0.513***	0.507***	0.502***	0.485***	0.487***	0.495***	0.490***	0.493***
		(0.082)	(0.083)	(0.083)	(0.081)	(0.082)	(0.092)	(0.091)	(0.090)
Yearly Credit Spread		-0.014	-0.016	-0.019	-0.016		-0.018	-0.016	
		(0.031)	(0.037)	(0.038)	(0.038)		(0.039)	(0.039)	
Dummy Market Based Financial System		0.127***	0.127***	0.125***	0.119***	0.118***	0.110*	0.130**	0.131**
		(0.037)	(0.038)	(0.038)	(0.038)	(0.042)	(0.065)	(0.064)	(0.063)
Creditor Protection		0.014	0.014	0.014	0.013	-0.008	0.014	0.013	0.008
		(0.017)	(0.017)	(0.018)	(0.018)	(0.016)	(0.020)	(0.020)	(0.020)
Anti-director Rights		-0.002	-0.002	-0.002	0.002	0.008	-0.004	0.003	0.009
		(0.036)	(0.037)	(0.038)	(0.038)	(0.037)	(0.031)	(0.031)	(0.031)
Exit Type Dummies		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exit Year Dummies		No	No	No	No	Yes	No	No	Yes
Constant		0.955***	0.972***	1.010***	0.959***	1.047***	1.060***	0.922***	1.001***
		(0.194)	(0.207)	(0.221)	(0.240)	(0.245)	(0.299)	(0.301)	(0.281)
Observations		626	626	626	626	626			
Uncensored observations							626	626	626
Censored observations							277	277	277
Adj. R-squared		0.15	0.15	0.15	0.17	0.18			
Mills Lambda							-0.32	0.23	0.27
Chi-Squared							100.4***	114.9***	126.8***

*** p<0.01, ** p<0.05, * p<0.1

6. Conclusion

Using a proprietary data set of 1,090 realized and 890 unrealized European and North American buyouts completed between 1986 and 2010, this paper analyses value creation and buyout pricing from the perspective of PE sponsors. In doing so, this study investigates the influence of buyout target related factors (i.e. operational improvements, leverage and multiple expansion) and the fund life cycle stage on equity IRRs. In addition, the factors driving entry and exit pricing are analysed. To the best of our knowledge, this is one of the first studies to be based on a comprehensive sample, including a large diversity in terms of geography, deal type and size. Further, it is among the first to analyse the impact of the PE fund life cycle stage in which an investment is made on equity returns and buyout pricing.

With regard to PE sponsors' returns, we find that in addition to operational improvements and leverage, EBITDA multiple expansion has a strong influence on equity IRR. Apparently, managing and timing the valuation of the buyout company is an important acquired skill of successful PE firms as our findings indicate, and not simply a matter of luck. While previous literature on value creation emphasizes the role of operational improvements, our study indicates that buyout pricing at entry and exit is another essential factor for PE sponsors to generate high equity returns.

In terms of LBO pricing at entry in line with Axelson et al. (2010), we find a significant positive impact of industry-specific multiple levels in public markets on deal multiples. Consistent with previous research, we find that leverage significantly affects buyout pricing at entry. The intuition behind this finding is that the leverage, which can be imposed, increases the enterprise value which can be paid for a given buyout company. In addition, the first-stage equations of our instrumental variable regressions show a significant and positive effect of PE sponsor experience on leverage. We argue that more experienced PE sponsors are able to acquire more debt for a given buyout company, allowing them to pay higher prices for targets in which they want to invest. At the same time, they have skills, such as negotiation skills, that allow them to pay less for a transaction with a given level of leverage.

This study is also one of the first to analyse exit multiples in buyouts. With regard to past performance, we find that sales growth over the holding period has a positive impact on prices attained. We argue that PE sponsors push their portfolio companies into higher multiple classes by increasing their size. On the other hand, EBITDA margin improvements over the holding period have no significant influence on LBO pricing at exit. Similar to buyout pricing at entry, timing seems to be an important skill, since our analysis shows that higher prices are realized when valuations of public benchmarks in the same sector are also high.

We also provide evidence that with approaching expiration of the fund's lifetime, EBITDA multiples realized for a given deal decrease when the investing fund is a first time fund. In line with the argument above, we think that less experienced and reputed fund managers have more pressure to realize an investment if the fund's liquidation date is nearing as they have strong incentives to successfully raise a follow-on fund. As potential buyers will be aware of this situation, the PE sponsor's negotiation power is weakened, resulting in lower multiples obtained. This fact combined with the finding that deals conducted later in a fund's life cycle generate lower returns, is of enormous practical importance: obviously it is one key task of young PE sponsors to identify attractive investment opportunities as soon as possible after a fund is launched. Consequently, the deal flow and network of young PE sponsors are invaluable assets and essential to generate sustainable high returns.

Overall, this study provides evidence that multiple expansion is a manageable skill that can be influenced by a PE sponsor and is not only driven by luck. This "multiple expansion skill" refers to three different aspects: first, factors directly related to the PE sponsor as well as to the investing fund have a strong influence on multiple expansion. Second, given that buyout multiples are strongly influenced by multiples in the public markets and consequently by general economic conditions, the timing of entry and exit decisions as well as the anticipation of boom and bust periods is an important factor in generating multiple expansion. Third, PE sponsors can achieve higher exit multiples by fostering sales growth during the holding period. Consequently, a clear focus on revenue growth instead of EBITDA margin improvements are a signal of sustainable operational improvements rewarded by a potential buyer.

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II.III Essay 3 - Leverage and the Performance of Buyouts: (How) Does the Use of Debt Impact Equity Returns?

Abstract

In this paper we investigate the effects of debt usage on (risk-adjusted) equity returns in private equity-backed buyout transactions. We use a proprietary data set of more than 700 realized European and North American buyouts acquired between 1990 and 2006 to empirically assess theoretical predictions. Our results show a positive relationship between debt levels and equity returns indicating the return-boosting effects related to leverage. However, our results also provide evidence that it is possible to 'over-leverage' a company, i.e. at very high levels of leverage (debt to total capital of approximately 90%) the increased company default risk outweighs the positive effects related to leverage resulting in decreasing equity returns. On the other side, we find no significant relationship between leverage and *risk-adjusted* equity returns which implies that the return increase through higher debt ratios comes along with increasing risk. In addition, we show that private equity sponsors successfully conduct debt-equity-arbitrage in times of favorable debt market conditions. This implies that these investors successfully time debt markets

Keywords: private equity, buyout, performance, leverage, debt-equity-arbitrage

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1. Introduction

According to a report by the rating agency Moody's published in the end of 2009, large private equity (PE)-backed companies are at higher risk compared to similar companies not owned by a PE sponsor. The report shows that about 20% of leveraged buyout (LBO) deals initiated prior to 2008 are distressed which is considerably higher than the 14% for comparable non PE-backed companies.[26] [27] This is in line with the prevalent assumption which says that PE-backed companies are more likely to default or be in need of restructuring due to the high debt burden imposed in buyouts. Generally, leverage levels in buyout capital structures are indeed higher than in public firms (Axelson et al., 2010). These considerable amounts of debt utilized to finance LBOs created public criticism. Indeed, the financial crisis at the end of the 2000s has (once again) shown that the threats related to high leverage ratios are especially relevant in times of economic and financial turmoil. For example, according to the New York Times several companies backed by well-reputed PE sponsors experienced serious problems in terms of default or distress in the recent financial crisis.[28]

On the other hand, however, the use of leverage is an essential part of the value creation framework applied by PE sponsors. Generally, previous research has identified three basic mechanisms of such value creation in LBOs: Governance, operational and financial engineering (Kaplan and Strömberg, 2009). Governance engineering refers to organizational changes (e.g. active monitoring and board control) and incentive schemes implemented by PE sponsors in portfolio companies. Operational engineering refers to industry and operating expertise of PE sponsors that can add value to portfolio companies. Financial engineering refers to the use of debt in financing a buyout and the related effects on company performance (e.g. the disciplining effect of debt and tax benefits). While the implementation of governance and operational engineering strategies is in line with a rather benevolent view of PE firms as facilitators of company success, the assessment of the role of financial engineering is more controversial.

[26] http://www.nytimes.com/2009/11/05/business/05buyout.html.

[27] In this paper we use the term private equity as a synonym for (leveraged) buyout investments, excluding venture capital.

[28] http://www.nytimes.com/2009/11/05/business/05buyout.html.

Theoretically, the Modigliani-Miller theorem suggests a positive relationship between leverage and equity return as higher financial risk should be compensated with higher (expected) returns (Modigliani and Miller, 1958). In addition, Jensen (1989) argues in his seminal work that the use of debt in LBOs has a disciplining effect and consequently reduces the agency conflict between shareholders and managers of the company. This concept links financial engineering with corporate governance arguments and predicts that buyouts are the superior organizational form compared to public firms. Accordingly, a positive effect from leverage on company performance (and equity returns) can be expected. Further, as debt is privileged over equity in most economies due to the tax deductibility of interest payments, additional tax shields through higher leverage ratios should also increase a company's value. Apart from these "classical" aspects related to leverage, more recently another view has become more prominent. PE sponsors might take advantage of mispricing between debt and equity markets to generate high returns (Axelson et al., 2010).

However, despite these positive effects the use of leverage also has a downside as higher debt ratios are generally accompanied by increasing bankruptcy risk with regard to the buyout target. Assuming that the default risk increases with higher debt ratios (possibly even over-proportionally) direct and indirect costs of default might become exceedingly high. This could lead to a concave (an inverse u-shaped) function of leverage and company performance as well as equity returns, which is also related to the classical trade-off theory of capital structure indicating a non-linear relationship between debt and firm value.

While leverage obviously has advantages and disadvantages, the typical structure of PE funds provides particular incentives for PE sponsors to impose highly leveraged capital structures on their portfolio companies. PE funds are structured as limited partnerships in which the PE sponsor serves as manager or general partner (GP), but only commits a small share of the funds to be invested in buyout companies (Kaplan and Strömberg, 2009). For managing the PE fund, limited partners (LPs) pay a management fee to the GP that is independent of fund performance. However, while initial fund returns are distributed to LPs, if they exceed a certain threshold (normally 8%) the GP receives 20% of the additional fund returns. This mechanism to incentivize the GP is called carried interest (Metrick and Yasuda, 2010). It has been shown that this situation induces PE sponsors to take excessive risks by choosing high levels of leverage and to conduct investments with a negative net present value

(Axelson et al. 2009, 2010) as the PE sponsor's payoff profile is similar to a call option on the firm value with the amount of debt as the strike price. This is known as "gambling for resurrection" and refers to a potential risk transfer from shareholders to the providers of debt (Rudolph, 2008). In the case of default, PE sponsors do lose the relatively small amount of equity they provided to the PE fund themselves but still retain management fees. In turn, PE sponsors strongly participate in the returns from successful investments through the carried interest. Hence, GPs have incentives to take risks that they themselves only bear to a small extent but which potentially yield high returns.

However, according to Axelson et al. (2009) this overinvestment problem can be mitigated by the usage of deal-by-deal external leverage in financing buyout transactions, as banks will be hesitant to provide debt for unprofitable deals that GPs might otherwise undertake. In addition, banks as providers of debt for the transaction might serve as effective monitors and help in resolving this agency conflict. In reality, however, these mechanisms may be insufficient to resolve the agency conflict between GPs and LPs. First, information asymmetries about the buyout target render it difficult for banks as external partners to evaluate the expected profitability of an investment (Achleitner et al., 2011b). Second, the compensation scheme of bank employees is often largely based on revenues (i.e. amount of debt packages issued), which might result in high levels of risk appetite (comparable to those of GPs) in order to ensure a fast contract signing (for a discussion, see, e.g., Phelan, 2009, John et al., 2000). Since LBO exposures of banks are generally not large relative to their capital bases a relatively high risk appetite of banks towards LBO debt seems plausible (ECB, 2007). Third, banks often syndicate most of the debt to the capital markets, which ultimately frees them from the responsibility for and risk of the debt issuances (Rudolph, 2008).

The main objective of this paper is to provide compelling, large-scale empirical evidence of the effect of debt on equity returns in LBO investments. In our view, the question whether high debt to total capital ratios in LBOs, often between 60% and 90%, are return and value maximizing has not yet been answered persuasively.[29] We group our analysis around three themes in order to contribute to the existing literature. First, we try to answer if there is a

[29] In contrast, firms not backed by a PE sponsor exhibit considerably lower leverage ratios. For example, Guo et al. (2010) report a typical debt to total capital ratios of buyout targets of 23.7% before the buyout. This ratio increases to almost 70% after the investment entry of a PE sponsor.

significant relationship between leverage and deal-level return, and if yes, which is the correct functional specification. It is reasonable to assume that the use of additional leverage has positive results on equity returns for low levels of debt, e.g. through tax shields and the disciplining effect of debt. However, intuitively it may be possible to "over-leverage" companies, leading to disproportionately increased default risk. In this context, we are able to use an appropriate measure of risk-adjusted deal-level equity returns. This makes it possible to investigate whether the positive relationship found by other researchers comes at the cost of disproportionate increase in risk. Second, we want to investigate the role of debt-equity arbitrage in generating equity returns. Third, building upon the previous questions we investigate the impact of highly leveraged capital structures on company performance.

A closer look at existing empirical research on the relationship between leverage and equity returns surprisingly does not yield a clear picture. While some studies confirm the intuitive positive relationship (e.g. Guo et al. 2009, Achleitner et al. 2010, 2011), others allege that leverage does not play a major role in explaining equity returns (Nikoskelainen and Wright 2007) or even find a negative impact on (fund-level) returns (Axelson et al. 2010). In this context, it should be noted that the problem of reverse causality is of high importance when analyzing the relationship between leverage and performance (and may possibly explain differing empirical results to some extent). In other words, (expected) firm performance could also affect the capital structure chosen (Berger and Bonaccorsi di Patti, 2006).[30] We address this concern by controlling for a firm's operating performance and by conducting two-stage instrumental variable regressions.

Our study is most closely related to the recent large-scale and international study by Axelson et al. (2010) who find a negative relationship between deal-level leverage and fund returns. The authors interpret this finding as follows (Axelson et al., 2010, pp. 30f): *"To summarize these results, the evidence that fund-level returns tend to be negatively related to the transaction-level leverage suggests that private equity sponsors may be acting more in their own (carried!) interest than their investors' when they impose highly leveraged capital structures on their portfolio companies."*

[30] For example, Berger and Bonaccorsi di Patti (2006) distinguish between two forms of reverse causality. First, the efficiency-risk hypothesis implies that *"more efficient firms tend to choose relatively low equity ratios"*. The franchise-value hypothesis says that "*more efficient firms tend to choose relatively high equity ratios to protect future income*".

Their evidence suggests that PE sponsors' incentives have a strong impact on the use of leverage. In addition, their findings suggest a non-linear relationship, i.e. that there is no effect of leverage on fund returns at low levels of leverage, but a negative one at high levels. These findings challenge most of the existing body of evidence and call for further research on this matter. In addition, Axelson et al. (2010) find no evidence for debt-equity arbitrage. However, as they only observe fund-level returns, the reliability of their conclusions on deal-level relationships could be somewhat limited. Our sample includes deal-level performance data that allows re-visiting their analysis and provides more reliable evidence on the relationship between leverage and return in general, and debt-equity arbitrage in particular.

Another study related to ours was conducted by Nikoskelainen and Wright (2007). For a sample of 321 buyouts in the UK they find that governance mechanisms are not the key drivers of value creation in LBOs. In contrast to most other studies, their leverage measures, debt to EBITDA and debt to equity, have no substantial influence on equity returns. Instead, return is driven rather by the size of the transaction and acquisition activity during the holding period. However, their conclusions are drawn from a relatively small sample of UK deals only. We extend their study by using an international sample and applying different equity return measures. Nikoskelainen and Wright (2007) calculate equity returns by comparing equity values at entry and exit, thereby neglecting the interim cash flows (e.g. dividends) during the PE sponsor's holding period. This calculation method could lead to biased equity returns as interim cash flows can be quite considerable.[31] Further, we analyse more aspects related to leverage than the disciplining effect of debt only and also examine the role of a portfolio company's operating performance in this regard.

Guo et al. (2009) assess whether US buyouts between 1990 and 2006 have created value and what were the drivers. They distinguish three levers of value creation, which are gains in operating performance, increases in industry valuation multiples and realized tax benefits through higher leverage. They find that increases in tax benefits account for a little less than one third of the returns. While providing an important piece of research, Guo et al. (2009) only investigate the tax benefit argument and do not tackle other issues related to leverage,

[31]http://www.bloomberg.com/news/2010-04-15/dividend-deals-accelerate-as-blackstone-seeks-apria-payout-credit-markets.html.

e.g. like the debt-equity-arbitrage argument. Furthermore, their sample is limited to buyouts in the US and their findings do not necessarily hold for the global PE universe.

Achleitner et al. (2010) adopt a perspective somewhat comparable to Guo et al. (2009) (with a stronger focus on practitioner's view) to assess value creation drivers in European buyouts. Similarly, they find that about two-thirds of value created can be attributed to operational and market effects and the remaining third arises from leverage. While this article contributes to the literature by proposing a comprehensive framework for measuring value creation in buyouts, the reliability of its empirical results is somewhat limited by their bivariate research approach.

Finally, Achleitner et al. (2011a) touch the issue of leverage and equity IRR as well. They find statistical support for a positive linear relationship between the net debt to equity (net debt to EBITDA) ratio and deal-level equity performance. However, the paper's focus is on value creation drivers of PE investments with a particular emphasis on deal pricing at entry and exit within the value creation context. Therefore the relationship between leverage and performance is only one aspect among others and not investigated in more detail. In particular, the authors do not test for non-linear functional forms or for a potential endogeneity of leverage. Further, they do not investigate if PE sponsors time debt markets.

Apart from the buyout-related stream of literature, there is a large body of literature dealing with capital structure and firm performance. Interestingly, empirical results are to a large extent inconsistent (for an overview, see, e.g., Frank and Goyal, 2009). Nevertheless, recent research shows for a sample of public US firms that there are six core drivers of leverage, namely industry median leverage, tangibility of assets, firm profits, firm size, market-to-book assets ratio and expected inflation (Frank and Goyal, 2009). However, as shown by Axelson et al. (2010) buyout leverage is driven by factors other than public firm leverage. Therefore, these results are not easily transferable to buyout transactions.

In our empirical analysis, we find strong evidence for both a linear and a concave relationship between leverage and equity returns. Even if this indicates that PE sponsors may 'over-lever' a company at high levels of leverage (debt to total capital of approximately 90%), our findings suggest that it is reasonable for PE sponsors to impose high debt burdens on buyout targets at investment entry as it generates higher equity returns. When it comes to the

underlying drivers for this positive relationship, we find – in contrast to Axelson et al. (2010) - that debt-equity-arbitrage in times of favorable debt market conditions is a relevant value driver for PE sponsors. In other words, PE sponsors make use of imperfections between equity and debt markets by borrowing under-priced debt in order to purchase equity stakes.

On the other hand, we do not find a significant relationship between leverage and *risk-adjusted* equity returns. This implies that a higher return due to increasing leverage comes along with a considerable increase in risk which is in line with the classical risk-return relationship in financial theory.

With regard to the relationship between leverage and company performance, we find (only weak) evidence that the D/E ratio has a negative influence on sales growth of the PE-backed company during the holding period of the PE sponsor. This could be due to the fact that highly leveraged PE-backed companies have restricted resources to focus on growth strategies since they have to meet high interest and redemption payments. Further, we find a positive relationship between the D/EBITDA ratio and EBITDA margin improvements indicating that companies with higher leverage ratios (have to) focus on efficiency improvements.

The rest of the paper is structured as follows: In Section 2 we provide the main conceptual arguments on the influence of leverage on equity returns and company performance, respectively in buyouts. In Section 3 we provide more information on the process of gathering our sample and its representativeness. In Section 4 we report the results of our empirical efforts to shed some light on the link between leverage and equity returns in buyouts and the underlying drivers behind it. In Section 5 we analyse the relationship between leverage and the operational performance of buyout targets. This helps to better understand the underlying sources driving the relationship between leverage and equity returns. Section 6 summarizes and concludes.

2. Theoretical Predictions

Generally, the relationship between leverage and performance is especially relevant in LBO transactions. To put it simply, the PE sponsor's fund acquires a target company with substantial amounts of debt. After negotiating with banks about the amount of debt they are willing to provide for the transaction, the remaining purchase price is covered with equity from the PE sponsor's fund. In addition, the new management of the buyout target typically also contributes a small share to the new equity. The high levels of debt give these transactions their name, i.e. leveraged buyouts. In previous studies, different aspects of how leverage manifests itself on company performance and equity returns have been enumerated.

To begin with, the *leverage effect* based on Modigliani and Miller (1958) describes the basic principle in finance that the (expected) return on equity of a company can be increased by substituting equity through debt as long as the cost of additional debt is lower than the overall cost of debt and equity. In other words, leverage and equity returns are positively related.[32] However, in perfect capital markets a higher return due to the leverage effect is always accompanied by a proportional increase in (financial) risk. Consequently, risk-adjusted equity returns should not be affected. Achleitner et al. (2010) calculate that one-third of equity returns in European buyouts can be attributed to the leverage effect.

A second mechanism related to a higher leverage ratio is an increased firm value through *tax shields*. In most economies, debt is privileged over equity as interest payments are tax deductible and reduce the taxable income of the company. Kaplan (1989) shows that this mechanism is applied in the PE context as tax benefits can strongly explain premiums paid by PE sponsors to pre-buyout shareholders. This indicates that pre-buyout shareholders (at least partially) absorb the value increase due to tax shields. However, more recently Guo et al. (2011) provide evidence that post-buyout shareholders at least partially benefit from the value

[32] The classical formula describing the leverage effect is: $r_E^L = r_E^U + (r_E^U - r_{FK}) * \frac{FK}{EK}$, with r_E^L as the equity return of a levered company, r_E^U as the equity return of an unlevered company, r_{FK} as the risk free rate and $\frac{FK}{EK}$ as the debt to equity ratio. The right part on the right side of this formula represents the additional equity return due to an increased financial risk, i.e. the leverage effect.

increase through higher tax shields. They report a proportion of return to post-buyout capital due to total tax benefits of 44.5%.[33]

Thirdly, previous LBO literature often emphasizes the *disciplining effect of debt* in buyout companies (Jensen, 1989). This concept rests on the assumption that company managers have an incentive to use free cash flows to secure autonomy against capital markets, and to increase company size as well as corporate reputation instead of investing in profitable development and maintenance of the business or distributing free cash flows to the shareholders. The use of debt can serve as a corporate governance mechanism to resolve this agency problem and increase firm value as leverage increases operating efficiency. Increased debt as a fixed contractual obligation which has to be served periodically reduces the possibility for managers to conduct unprofitable investments (empire building) or to consume private benefits. The managers' incentive to operate efficiently is very strong as the inability to serve debt results in company default. Given the arguments above, the disciplining effect of debt should not only improve company performance but also equity returns. Empirically, mixed support for Jensen's free cash flow theory has been reported (for an overview, see, e.g., Nikoskelainen and Wright, 2007).

On the other hand, debt is a fixed contractual obligation which needs to be served periodically to avoid company default. Hence, increasing leverage, ceteris paribus, ultimately increases *company default risk*. The empirical literature on default rates in LBO transactions provides mixed support for the hypothesis that PE-backed companies more often go bankrupt. For example, Strömberg (2008) finds that 6% of buyout transactions end in bankruptcy or financial restructuring. Even if this number implies a higher failure rate compared to listed US firms, it is below the average default rate of US corporate bond issuers (Strömberg, 2008). In addition, Wilson et al. (2010) show that PE-backed buyouts are less likely to fail than identical non PE-backed buyouts. On the other hand, however, as mentioned above recent figures by Moody's indicate that about 20% of large LBO deals initiated prior to 2008 are

[33]Referring to the discussion between value creation vs. value transfer, a cash flow increase through higher tax shields can be seen as value transfer from the government to the buyout target and PE fund, respectively.

distressed which is considerably higher than the 14% for comparable non PE-backed companies.[34]

Given the arguments above a positive relationship between leverage and equity return seems reasonable, especially for lower levels of leverage when company default risk is not disproportionately high. However, one could also argue that a concave rather than a linear positive relationship between leverage and equity returns should be observed. A higher leverage ratio increases the probability that an equity investor makes a very low or even negative return since the probability of company default increases. In addition, the marginal gain through each additional unit of leverage is decreasing, e.g. when the maximum tax shield has been capitalized and the disciplining effect of debt is fully implemented. Consequently, we think that this should lead to a point at which the risk of additional leverage outweighs gains in return and leads to a decrease in performance. The result would be that from a certain point on we should observe a negative relationship between both variables, indicating a concave (inverse u-shape) relationship between leverage ratio and equity returns. Overall, it remains an empirical question which functional specification is better able to describe the relationship between leverage and equity returns.

Beyond these effects related to the buyout company and its equity investors, the role of leverage as a function of debt market conditions has recently received considerable attention (see, e.g., Axelson et al., 2010, Demiroglu and James, 2010, Ivashina and Kovner, 2010). The argument is that PE sponsors are able to *arbitrage debt markets versus equity markets* as they receive more debt at favourable conditions. By borrowing relatively cheap debt and purchasing equity stakes in companies, PE sponsors might be able to capitalize on the imperfections in these two markets. In other words, if more debt is available and costs of debt are not priced adequately, PE sponsors use more under-priced debt, since the costs of higher default probabilities are not reflected in the interest rates. At first glance it might seem implausible that banks would lend under-priced debt. However, considering possibilities of banks to forward credit risks to third parties, this hypothesis could hold (Rudolph, 2008). With regard to empirical studies there has been very little research analyzing debt-equity-arbitrage in PE transactions. Recently, using fund-level returns Axelson et al. (2010) find no

[34] http://www.nytimes.com/2009/11/05/business/05buyout.html.

evidence for PE sponsors conducting debt-equity-arbitrage. However, it remains open whether these results are transferable to deal-level returns.

3. Data Set

3.1 Data Sources

We obtain the base of our proprietary sample from two European PE funds-of-funds. When PE sponsors contact potential investors (e.g. funds-of-funds) to raise a new fund, they have to provide extensive information for the investors' due diligence efforts. Among other things, investors ask for detailed information on historical transactions. Both funds-of-funds granted us access to their anonymized data bases which they compile for internal purposes. They contain detailed deal-level information on various characteristics of the buyout company, e.g. financials at entry and exit of the PE sponsors. In addition, for each deal monthly gross cash flows between portfolio company and PE sponsor are reported. From the investors' data bases we were allowed to retrieve necessary data for the initial sample used in this study. It is important to note that these data sets are assembled during the due diligence process, i.e. *before* the funds-of-funds' investment decision. This means the transactions in our sample go beyond those that the funds-of-funds have invested in. As we focus on buyout transactions, we exclude investments in early stages of companies (seed, start-up or expansion stages) and regions outside of North America and Europe. This leaves us with 1,916 buyout deals in our database of which 1153 are unrealized or only partially realized. These buyouts were exited in the years between 1990 and 2006 and conducted by 115 different PE sponsors. The average (median) number of deals per PE sponsor is 23 (13).

In some more detail, apart from general company and deal characteristics (e.g. investment entry and exit year, industry affiliation, buyout targets location, etc.), our data set includes the following variables, both for the entry (closing) and exit date (sale by the PE sponsor) of the transaction: enterprise value (EV), net debt, equity value, EBITDA, and sales. In the following we only present detailed descriptive statistics for our subsample of realized investments.

3.2 Sample Characteristics and Representativeness

We consider our sample on which we base our analyses to be fairly representative for the PE universe in terms of regions, PE market cycles, types of transactions, deal performance, and leverage.

To begin with, our sample contains buyout transactions from Europe as well as North America. These two markets represent about 93% of the PE universe over the time period covered with our sample (Kaplan and Strömberg, 2009). Panel A in Table II-13 benchmarks the total combined enterprise values of our sample in these regions with those of these PE markets over time as reported in Kaplan and Strömberg (2009). The four relevant time categories (1990-1994, 1995-1999, 2000-2004, 2005-2006) are taken from that study. A deal is assigned to one of these time categories based on the year the transaction was carried out. The numbers show that our final sample covers a considerable part of the PE universe. The coverage is particularly high between 1995 and 2004. We observe a higher share, in terms of combined enterprise value, for the European PE market than for North America. Obviously, our sample does not contain many recent deals entered in the years between 2005 and 2006. Although the respective benchmark category provided by Kaplan and Strömberg (2009) also covers deals closed in the first six months of 2007 (while our most recent deals were made in 2006), the low coverage numbers of about 1% indicate limited representativeness within our findings for more recent deals. The reason is that Kaplan and Strömberg (2009) present realized and unrealized LBOs, while we focus on realized investments.

Further, Panel B in Table II-13 exhibits the frequencies of exit types in our sample and compares these numbers to the corresponding data in Kaplan and Strömberg (2009) over time. The PE market cycles defined by Kaplan and Strömberg (2009) for assessing LBO types are slightly different from those for combined enterprise values. Here, the authors distinguish the periods as 1990-1994, 1995-1999, 2000-2002, and 2003-2006. Strömberg (2008) identifies the periods between 1990-1994 and 2000-2002 as bust periods for the PE market, and those between 1995-1999 and 2003-2006 as boom periods.

The bottom line of Panel B shows that the distribution of transactions over these PE market cycles in our sample is representative for that of the entire PE universe. The relative number of deals within the most recent time category 2003-2006 (20.1%) is here even higher

than that for the entire PE universe (16.9%) – although this time category 2003-2005 only covers three years instead of four. In terms of exit types, the table shows that a considerable amount of deals (44.2%) were exited as a trade sale, which is the sale to another corporation with a strategic motive. This number is comparable to the 40.2% trade sales reported in the benchmark study. Our numbers on initial public offerings (IPO) are similarly comparable (12.2% in our study compared to 12.3% in the benchmark study). However, secondary transactions as a means of exit, i.e. the purchase of the buyout company by another financial sponsor, are somewhat under-represented in our study at only 26.0% in our sample compared to 31.0%. Very likely, many of these deals have not been explicitly identified as such in our sample and therefore have ended up being included in the category of unknown exit types.

Probably most interesting in terms of sample representativeness is that 6.0% of the deals in our data set (44 out of 736) went bankrupt. We categorize a buyout transaction as a bankruptcy or write-off if it is either reported to be bankrupt in the original funds-of-funds data base or is reported as having been exited but not having generated any positive cash flow for the PE sponsor. This percentage is exactly the same as in the large-scale benchmark sample in Kaplan and Strömberg (2009). The representative number of write-offs in our sample already hints at a reduced positive selection bias. This is supported by looking at performance variables.

Panel A of Table II-14 shows for our total sample of realized and unrealized deals that we have a mean and median equity internal rate of return (IRR) gross of fees and carry of 31% and 21%, respectively. For the subsample of realized transactions we report a mean and median equity IRR of 40% and 33% respectively. We also show deal-level Sharpe Ratios and Cash Multiples in Table II-14 (for definitions of these measures see Section 4). The median Cash Multiple in our sample is 2.6x and the median Sharpe Ratio is 0.4. These numbers seem quite comparable to the few studies which provide deal-level data on returns. Groh and Gottschalg (2011) report mean and median equity IRRs of 50% and 36% respectively for 133 US buyouts. Acharya et al. (2010) report a median IRR of 36% and a median Cash Multiple of 2.8x for 110 larger European buyouts. Based on a large and representative sample of 5,106 realized buyout transactions Lopez-de-Silanes et al. (2010) report a median IRR of 26% and a median multiple of 2.1x. So far, there are no deal-level risk-adjusted performance measures provided in previous PE studies that we could benchmark to our Sharpe Ratios.

Similar to performance, leverage levels in our sample seem to be quite representative for the PE markets in the US and Europe, at least when compared to available data from other scholarly work. Panel B and Panel C of Table II-14 show more details on leverage at deal closing over time in our sample. The median D/E (D/EBITDA) ratio at investment entry in our sample is 1.6x (4.1x), the mean is at 2.0x (4.3x). In comparison, Axelson et al. (2010) provide large-scale data on leverage for European and US LBOs. In the time span from 1998 until 2006 that they cover in their study the median D/E ratio is 2.2x and the median D/EBITDA ratio is 5.2x. Similarly, Brinkhuis and De Maeseneire (2009) report for 123 European buyouts completed between 2000 and 2007 a median debt to EBITDA ratio of 5.3 and a debt to equity ratio of 2.4x. Considering that numbers reported in Axelson et al. (2010) as well as in Brinkhuis et al. (2009) are based on total debt and ours on net debt, the values seem to be consistent.

Further, the evolution of leverage levels in our sample is largely similar to the time trends in Axelson et al. (2010) after the year 1995 (the time frame for which their study has a meaningful number of observations). Leverage levels significantly dropped at the beginning of the new century, but increased again during the middle of the first decade. This development can be observed in both samples. The only considerable difference is that, in contrast to Axelson et al. (2010), we do not observe an increase in D/EBITDA levels after 2002. We think that this difference arises from the distinct time categories chosen. In particular the fact that the most recent category of Axelson et al. (2010) contains a significant number of deals from the years 2007 and 2008 with extremely high levels of D/EBITDA (see their Figure 1, Panel A), which we do not cover, should explain this discrepancy. Since we also find similar levels and patterns of D/E values over time reported for the US by Demiroglu and James (2010) and for D/E and D/EBITDA leverage in Europe reported by Achleitner et al. (2011b),[35] we are confident that the leverage numbers underlying our analyses are reasonably representative for the PE universe.

In summary, although our final sample is somewhat biased towards European deals and buyouts carried out in the late 1990s, it draws a more representative picture than most previous studies on buyout transactions.

[35] Please note that the sample used in Achleitner et al. (2011b) is different from the one underlying this study and only contains German deals which, nonetheless, seem representative for European capital structures.

Table II-13: Sample Representativeness

This table benchmarks our final sample of 763 realized European and North American private equity (PE)-sponsored buyouts completed between 1990 and 2006 to the large-scale data on the LBO universe provided by Kaplan and Strömberg (2009). In Panel A we report combined total enterprise values of all transactions by region (Europe and North America) that we cover with our sample. Enterprise value is the sum of equity and net debt used to purchase the buyout company in US-Dollars. Further, we distinguish four PE market cycle periods during the relevant time period between 1990 and 2006. Please note that our most recent deals were closed in 2006 while the benchmark sample also covers deals from the first half of 2007. The percentages in the rows on the left-hand side ("*% of LBO universe*") result from dividing the combined enterprise value in our sample by the corresponding total combined enterprise value reported in Kaplan and Strömberg (2009). Panel B benchmarks the distribution of exit types in our sample with the same sample from Kaplan and Strömberg (2009). However, in their study the authors report different time periods for exit types. While the categories of 1990-1994 and 1995-1999 are the same in Panel A and Panel B, for exit types they differentiate the periods from 2000 until 2002 and from 2003 until 2006. We changed the time categorization in our sample accordingly. Bankruptcy is a liquidation of the buyout company (i.e. a reported bankruptcy or a total loss for the PE sponsor). Secondary refers to a deal between two PE firms. A trade sale is the sale to a strategic acquirer. An initial public offering (IPO) refers to a going-public and the subsequent sale of the shares by the PE sponsor. Finally, we group all transactions for which a different exit type was reported, or was simply unknown, into a miscellaneous group. Panel B reports the frequency of each exit type. The percentages below represent the share of each exit type in the respective time category and are calculated by dividing the number of exits for each type by the total number of observations (in the respective time period). The percentages below the total numbers refer to the relative importance of each time period in terms of number of transactions and are calculated by dividing the number of exits in each category by the total number of exits.

Panel A: Representativeness - Combined Enterprise Value (in US-Dollars) over Regions and Time

	Our Sample					LBO Universe (Kaplan and Strömberg 2009)				
Regions	1990-1994	1995-1999	2000-2004	2005-2006	Total	1990-1994	1995-1999	2000-2004	2005-30.06.2007	Total
Europe	2,172	45,945	81,994	13,880	143,991	38,640	199,387	516,984	703,463	1,458,473
(% of LBO universe)	5.6%	23.0%	15.9%	2.0%	9.9%	26.5%	37.5%	52.7%	48.9%	47.1%
North America	4,903	45,071	45,927	1,393	97,294	107,002	332,311	464,231	734,728	1,638,272
(% of LBO universe)	4.6%	13.6%	9.9%	0.2%	5.9%	73.5%	62.5%	47.3%	51.1%	52.9%
Total	7,208	91,016	127,921	15,273	241,418	145,642	531,698	981,215	1,438,190	3,096,745
(% of LBO universe)	4.9%	17.1%	13.0%	1.1%	7.8%					
(% of global LBO universe)						98.0%	96.0%	93.0%	92.0%	93.3%
Global						148,614	553,852	1,055,070	1,563,250	3,320,786

Panel B: Representativeness - Distribution of Exit Types over Time

	Our Sample					LBO Universe (Kaplan and Strömberg 2009)				
No. of Exits	1990-1994	1995-1999	2000-2002	2003-2006	Total	1990-1994	1995-1999	2000-2002	2003-2005	Total
Bankruptcy	0	31	6	9	46	52	249	97	40	438
(% of time category)	0.0%	8.5%	3.4%	5.9%	6.0%	5.1%	7.9%	5.8%	3.4%	6.2%
Secondary	10	73	55	60	198	212	909	616	450	2187
(% of time category)	13.9%	20.1%	31.4%	39.2%	26.0%	20.7%	28.7%	36.9%	37.9%	31.0%
Trade Sale	27	167	92	51	337	402	1308	647	479	2836
(% of time category)	37.5%	46.0%	52.6%	33.3%	44.2%	39.2%	41.3%	38.8%	40.3%	40.2%
IPO	20	52	9	12	93	232	360	142	133	867
(% of time category)	27.8%	14.3%	5.1%	7.8%	12.2%	22.6%	11.4%	8.5%	11.2%	12.3%
Other/Unknown	15	40	13	21	89	127	340	166	86	(719.0)
(% of time category)	20.8%	11.0%	7.4%	13.7%	11.7%	12.4%	10.7%	10.0%	7.2%	10.2%
Total	72	363	175	153	763	1025	3166	1668	1188	7047
(% of total)	9.4%	47.6%	22.9%	20.1%	100.0%	14.5%	44.9%	23.7%	16.9%	100.0%

Table II-14: Descriptive Sample Statistics

Panel A of this table presents summary statistics for our sample of private equity (PE)-sponsored buyout transactions for which we have detailed information. We report deal-level means, medians, standard deviations and minimum as well as maximum values in our sample. We winsorize some of the variables in order to account for outliers. We identify outliers by running a boxplot analysis and treat an observation as an outlier if it is more than 1.5 box lengths below or above the box (i.e. the 25th and 75th percentile). Equity IRR is calculated from monthly cash flows between the PE sponsor and the portfolio company gross of fees and carried interest in percent. We winsorize this variable at the 95th percentile. Cash Multiple is obtained by dividing the total cash inflows that the PE sponsor receives from a buyout transaction by the total of cash outflows related to the transaction. We obtain Sharpe Ratios by using the mathematical model in Braun et al. (2011). This variable is winsorized at the 99th percentile. Enterprise Value, Sales and EBITDA are the amounts in millions of US-Dollars. We report the values for these variables at two points in time. At entry refers to the time when the buyout company is acquired by the PE sponsor. At exit refers to the time when the PE sponsor sells the buyout company. For both points in time we also show our two leverage variables, i.e. the ratios of net debt to equity and net debt to EBITDA. We winsorize the net debt to EBITDA at entry variable at the 3rd and 97th percentile and both leverage variables at exit variable at the 5th and 95th percentile. Finally, Holding Period is the time span in years between entry and exit. Panel B shows the evolution of leverage over investment entry years and Panel C over the relevant PE market cycles between 1990 and 2006 that we cover in this study. Based on the year in which the transaction was closed, each buyout in our sample was assigned to one of the four time categories 1990-1994, 1995-1999, 2000-2002, or 2003-2006. These categories were introduced by Strömberg (2008) and mark different PE market cycles. We report means, medians and standard deviations for both leverage measures.

Panel A: Descriptive Statistics

		n	Mean	Median	Std. Dev.	Min.	Max
	Realized and unrealized transactions						
(1)	Equity IRR [% p.a.]	1916	31.0	21.0	47.1	-1.0	147.8
(2)	Cash Multiple	1916	2.4	1.8	2.4	0.0	24.4
	Realized transactions						
(3)	Equity IRR [% p.a.]	763	40.1	33.2	59.9	-1.0	147.8
(4)	Cash Multiple	763	3.1	2.6	2.7	0.0	24.4
(5)	Sharpe Ratio	431	0.6	0.4	1.0	-2.1	5.3
(6)	Enterprise Value at Entry [$m]	763	319.6	101.2	703.9	0.9	8,800.0
(7)	Enterprise Value at Exit [$m]	701	581.4	175.6	1,191.4	0.0	14,086.7
(8)	Sales at Entry [$m]	703	333.0	101.5	1,097.0	0.2	24,475.0
(9)	Sales at Exit [$m]	695	433.3	141.8	1,169.2	0.0	21,338.0
(10)	EBITDA at Entry [$m]	763	46.5	14.3	130.0	0.0	2,667.0
(11)	EBITDA at Exit [$m]	727	64.9	21.8	137.8	-153.1	1,716.0
(12)	Net Debt/Equity at Entry	763	2.1	1.6	2.1	0.1	17.5
(13)	Net Debt/Equity at Exit	587	0.6	0.4	0.7	0.0	2.6
(14)	Net Debt/EBITDA at Entry	763	4.3	4.1	2.0	0.1	9.5
(15)	Net Debt/EBITDA at Exit	714	2.9	2.5	2.2	0.0	8.5
(16)	Holding Period	763	4.7	4.1	2.6	0.1	13.8

Panel B: Deal Leverage at Entry over Years

	No. of Deals	D/E			No. of Deals	D/EBITDA		
		Mean	Median	St. Dev.		Mean	Median	St. Dev.
1990	5	1.99	1.41	1.55	5	5.08	5.18	1.89
1991	14	1.39	1.00	1.13	14	3.12	2.70	2.46
1992	12	1.53	1.11	1.43	12	3.47	3.34	2.28
1993	16	2.25	1.79	1.62	16	4.69	4.81	2.71
1994	25	2.53	1.94	1.79	25	5.22	5.48	2.49
1995	36	2.15	1.44	1.93	36	4.20	3.94	2.38
1996	66	2.09	1.60	1.71	66	4.21	3.91	1.93
1997	86	2.11	1.47	1.58	86	4.02	3.75	1.84
1998	77	2.11	1.88	1.34	77	5.07	4.83	1.99
1999	98	1.84	1.57	1.23	98	4.70	4.39	2.00
2000	63	1.65	1.46	1.17	63	4.01	3.90	1.90
2001	46	1.77	1.73	1.02	46	4.41	4.52	1.94
2002	66	1.92	1.68	1.28	66	3.98	3.76	1.67
2003	60	1.76	1.59	1.18	60	3.72	3.54	1.33
2004	55	2.10	1.64	1.51	55	4.32	3.99	1.99
2005	36	1.70	1.49	1.32	36	3.92	4.05	1.66
2006	2	1.84	1.84	0.03	2	4.04	4.04	0.82
Total	*763*	*1.95*	*1.61*	*1.41*	*763*	*4.29*	*4.10*	*1.98*

Panel C: Deal Leverage at Entry over Time Categories

	No. of Deals	D/E			No. of Deals	D/EBITDA		
		Mean	Median	St. Dev.		Mean	Median	St. Dev.
1990-1994	72	2.04	1.49	1.59	72	4.39	4.34	2.55
1995-1999	363	2.04	1.63	1.50	363	4.48	4.33	2.02
2000-2002	175	1.79	1.61	1.18	175	4.10	3.97	1.82
2003-2006	153	1.87	1.59	1.33	153	3.99	3.82	1.67
Total	*763*	1.95	1.61	1.41	*763*	*4.29*	*4.10*	*1.98*
Kruskal Wallis p-value			0.75				0.06*	

4. Leverage and Return to Equity

4.1 Variables and Methodology

4.1.1. Dependent Variables

We measure deal-level performance from the perspective of PE sponsors using the internal rate of return (IRR) for each deal, gross of fees and carried interest. The IRR is the annual discount rate that equates the present value of the cash flows to zero and is a non-risk-adjusted measure for evaluating the success of an investment. The calculation is based on all cash flows accruing between the PE sponsor and the respective portfolio company.

$$0 = -I + \sum_{t=1}^{T} \frac{CF_t}{(1 + IRR)^t}$$

By directly using these cash flows we can take account of factors influencing the cash flow to equity holders during the holding period (e.g. dividends) and we do not have to rely on the assumption that no dividends are paid during the holding period. Despite the well-known drawbacks of applying the IRR, it is still the most common performance measure for PE returns (see, e.g., Kaplan and Schoar, 2005, Nikoskelainen and Wright, 2007).

In order to check the robustness of our results, we also use two further performance measures, namely Cash Multiples and Sharpe Ratios. The Cash Multiple is also a non-risk-adjusted return measure and is calculated by dividing the total cash inflows from the perspective of a PE sponsor by the total cash outflows.

$$Cash\ Multiple = \sum_{t=1}^{T} \frac{CF_{t,positive}}{CF_{t,negative}}$$

As a risk-adjusted equity return measure we use deal-level *Sharpe Ratios*. The Sharpe Ratio is a well-known risk-adjusted performance measure which measures the relationship between the excess return over the risk free rate and the standard deviation of the returns generated (Sharpe, 1966). The Sharpe Ratio is defined as

$$Sharpe\ Ratio\ (SR) = \frac{r_i - r_f}{\sigma_i}$$

with r_i as the return of investment i, r_f as the risk free rate[36] during the holding period and σ_i as the standard deviation of the return in investment i. In our case each investment represents one PE transaction.

Whereas the calculation of deal-level IRRs and Multiples is an easy task since we have the relevant cash flows in our data set, the calculation of deal-level Sharpe Ratios is much more difficult. The major challenge is to obtain deal-specific standard deviations of equity values (required for the denominator of the Sharpe Ratio formula). Market valuations of enterprise and equity values can hardly be observed or appropriately calculated over the holding period of the PE sponsor due to the illiquidity and opaqueness of the PE business. Therefore, we use an approach to price equity and debt of buyouts on the transaction level and consequently to mathematically model PE investment risk based on the Black-Cox default model as described in Braun et al. (2011). The model is based on the articles by Black and Scholes (1973) and Merton (1974) as well as the extension by Ho and Singer (1984) that allows for two redemption payments during the holding period of the PE sponsor. Braun et al. (2011) build upon these works and allow for continuous default and redemption payments. We apply this model to our dataset and calculate deal-specific standard deviations and, as a result, deal-level Sharpe Ratios.[37]

The Sharpe Ratio is an adequate performance measure if the underlying returns are normally distributed. This assumption is questionable in the context of PE returns. However, Eling and Schumacher (2007) demonstrate with hedge funds that the use of different risk-adjusted performance measures (with changing assumptions with regard to the underlying

[36] We use 5-year US government bonds as risk-free rate.

[37] We were only able to calculate Sharpe Ratios for 418 PE transactions as the calculation method puts a set of restrictions on the underlying PE deals (e.g. the amount of debt at exit must not exceed the amount of debt at entry).

return distribution) does not change the ranking between different hedge funds. This holds if significant deviations of hedge fund returns from a normal distribution exist. In our opinion, these arguments are applicable to the PE business as PE transactions also have an asymmetric return profile (Jäger, 2004, Cochrane, 2005, Lossen, 2006).

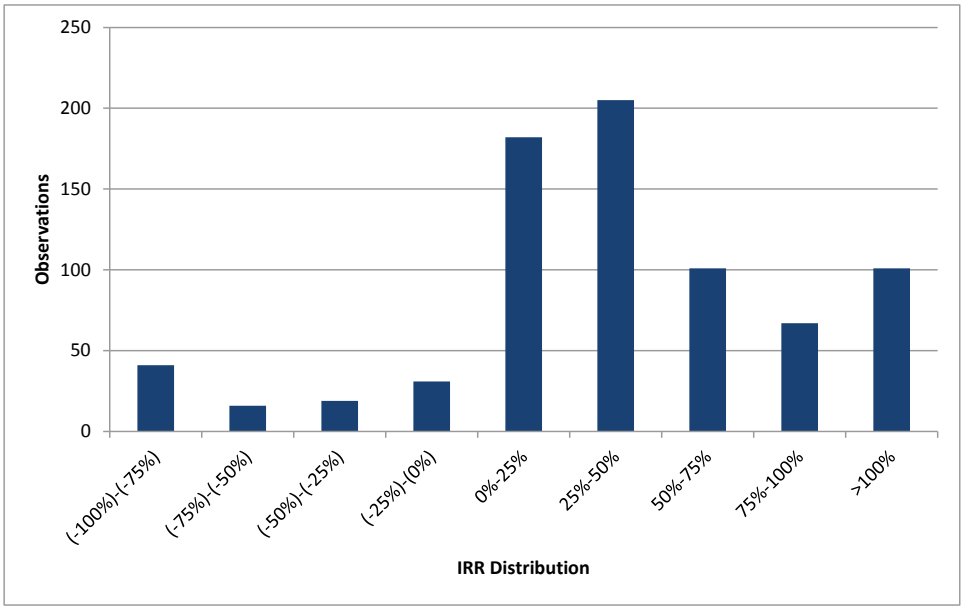
Further, by definition, the standard deviation does not differentiate between positive and negative deviations from a mean return since it only measures the level of fluctuation. This could be especially relevant in the asset class PE, where positive outliers generate returns of several hundred (or even thousand) percent in order to offset the high probability of write-offs (Ick, 2005). Consequently, standard deviations tend to overstate investment risk. However, this problem should be rather more relevant for venture capital investments compared to buyout investments in well-established companies with relatively stable cash flows. In addition, as it is the purpose of this paper to compare PE transactions among each other and not to compare the return of PE transactions to those of public benchmarks, this problem should be of minor relevance.

Panel A and B in Figure II-6 present risk and return characteristics of our sample.

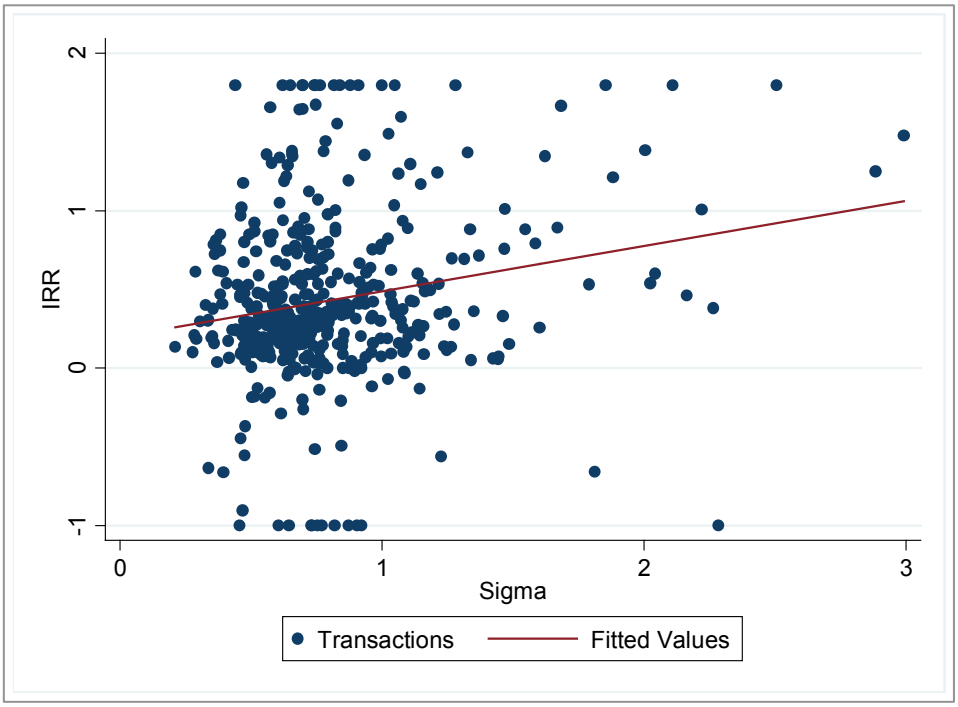
Figure II-6: Return Distribution

This figure presents risk and return characteristics of our sample. Panel A shows the internal rate of return (IRR) distribution and Panel B shows a risk-return diagram for our individual PE transactions (risk = standard deviation (sigma) of equity returns calculated according to Braun et al. (2011); return = equity IRR).

Panel A: IRR Distribution



Panel B: Risk-Return-Diagram



4.1.2. Independent Variables

In order to analyse our theoretical arguments, we use two leverage measures in our analysis. First, we apply the net debt to equity ratio (D/E) at investment entry. Second, we use the net debt to EBITDA ratio (D/EBITDA) at investment entry, which is also sometimes seen as the most important leverage parameter in LBOs as it mirrors the debt redemption capacity of a buyout target (see, e.g., Demiroglu and James, 2010). Notably, there are some important differences between D/E and D/EBITDA. For example, the D/E ratio is more appropriate for representing the leverage effect as this ratio is part of the related "leverage formula". On the other hand, we think that the best measure for the disciplining effect of debt is the D/EBITDA ratio. As EBITDA is a proxy for free cash flow, an increasing D/EBITDA ratio implies a stronger incentive for management to operate efficiently as the amount of debt to be served with a given EBITDA becomes higher with increasing D/EBITDA.

Two remarks relating to the fact that we use the company's capital structure and EBITDA at investment entry of the PE sponsor as independent variables in our regressions to derive our leverage variables: (1) Since a PE transaction implies a total recapitalization of the company, the existing capital structure of the buyout company is of minor relevance. Consequently, the capital structure at investment entry is to a large extent influenced by the PE sponsor.[38] (2) Axelson et al. (2010) do not find support for the hypothesis that the chosen leverage level at investment entry does not mirror what PE sponsors think is the optimal long-term capital structure of the buyout firm. This is in line with recent research by Cohn et al. (2011) who argue that PE sponsors use debt in buyout transactions to implement one-time changes in the target firm's capital structure.

We include a number of control variables in our regression analyses. We control for effects related to company size by including the (logarithmized) value of a buyout target's enterprise value at investment entry (*Enterprise Value*). It is important to note that by accounting for size we control if larger (or smaller) deals exhibit a better performance, not if larger companies have higher leverage ratios. As shown by Braun et al. (2011) PE sponsors

[38] The development of the capital structure over the holding period of a PE sponsor is also strongly influenced by economic and debt market conditions, at least to a larger extent compared to the investment entry date.

backing larger companies do not offset the higher lending capacity of larger firms (due to reduced cash flow volatility) by deploying higher leverage ratios proportionally.

In addition, we include the variable *Fund Generation*, i.e. the investing PE fund's sequence number. By doing so, we control if any potentially significant relationship between deal-level leverage and return is independent from the fact that a less or more experienced PE sponsor invests.

We also control for (expected) operational improvements during the holding period, i.e. EBITDA growth between entry and exit. We compute *Delta EBITDA* by first dividing EBITDA at investment exit by EBITDA at entry and then logarithmize these values. Conceptually, this helps to separate effects which boost equity returns indirectly by improving a company's operational performance (e.g. through the disciplining effect of debt) from the mechanisms directly increasing equity returns (e.g. leverage effect). By doing so, we are also able to mitigate the potential endogeneity problem that a larger proportion of debt is used when the buyout target has higher expected operational improvements. Since we have no ex-ante variable representing the expectations at investment entry, we include the ex-post realized operational changes assuming that ex-ante expectations materialized. In addition, we want to filter the value increase through multiple expansion, i.e. the difference between the EBITDA multiple paid by the PE sponsor at investment entry and the exit multiple.

We also include the return of the MSCI World Index over the transaction's holding period (*MSCI Annual Return*) to control for macroeconomic factors. As an alternative measure we use buyout fund benchmark returns (*PE Benchmark Fund IRR*) obtained through Thomson One Banker. In addition, we include the U.S. high-yield rate for the corresponding month according to the Merrill Lynch High-Yield index (obtained through Datastream) minus LIBOR to control for debt market conditions (*LBO spreads*).

Furthermore, there are some other standard factors we control for: (a) In order to control for significant systematic differences between European and North American deals a dummy variable is used which adopts a value of 1 if the PE transaction took place in Europe and a value of 0 if the deal took place in North America. (b) We include industry dummies (excluding the financial services industry) to control for industry specific returns and (c) time dummies to control for systematic time patterns in the buyout market. (d) We include exit

type dummies in order to control for variance in deal performance driven by the type of purchaser. For instance, in a trade sale a strategic buyer might be willing to pay a premium for a given buyout company based on perceived synergy potential.

Table II-15-A provides an overview on the variable descriptions and Table II-15-B shows a correlation matrix for the most important variables used in the regression analyses.

Table II-15: Variable Description and Correlation Matrix for Regression Variables

Table II-15-A presents variable definitions for the relevant variables in this paper. Table II-15-B presents a correlation matrix for the independent variables used in the regression analyses.

Table II-15-A

Variable	Description
Equity IRR	Equity internal rate of return (IRR) is calculated from monthly cash flows between PE sponsor and the portfolio company gross of fees and carried interest. We use the last valuation reported by the PE fund as final cash flow for unrealized transactions.
Cash Multiple	Cash Multiple is calculated by dividing all positive cash flows (cash inflows from the PE sponsor's perspective) by all cash outflows from the PE sponsor's perspective.
Sharpe Ratio	Sharpe ratio is calculated by dividing the excess return over the risk free rate by the standard deviation of the returns generated.
Deal Characteristics	
D/EBITDA	Portfolio company's net debt to EBITDA ratio at investment entry.
D/E	Portfolio company's net debt to equity ratio at investment entry.
EV/EBITDA (EBITDA Multiple)	Portfolio company's enterprise value to EBITDA ratio at investment entry.
Enterprise Value	Portfolio company's enterprise value at entry in USD million.
Sales	Portfolio company's sales at entry in USD million.
EBITDA	Portfolio company's EBITDA at entry in USD million.
Delta EBITDA	Portfolio company's change in EBITDA between entry and exit of PE ownership, i.e. $\log(EBITDA_{exit}) - \log(EBITDA_{entry})$.
Delta Sales	Portfolio company's change in sales between entry and exit of PE ownership, i.e. $\log(sales_{exit}) - \log(sales_{entry})$.
EBITDA/Sales Entry (EBITDA Margin)	Portfolio company's change in EBITDA margin (=EBITDA/sales) between entry and exit of PE ownership, i.e. $\log(EBITDA\ Margin_{exit}) - \log(EBITDA\ Margin_{entry})$.
Delta EV/EBITDA (Delta EBITDA Multiple)	Portfolio company's enterprise value to EBITDA ratio, i.e. $\log(EBITDA\ Multiple_{exit}) - \log(EBITDA\ Multiple_{entry})$.
Exit Type Fixed Effects	We distinguish between trade sales, initial public offerings (IPO), secondary transactions and bankruptcies/write-offs. For deals with unreported/unknown entry type we form the category "unknown".
Time Fixed Effects	Time category dummies based on Strömberg (2008) to control for systematic time patterns in the buyout market. We distinguish the periods 1984-1989, 1990-1994, 1995-1999, 2000-2002, and 2003-2010.
Holding Period	Time between investment and divestment of a PE sponsor in a certain company.
Market Variables	
MSCI Annual Return	Annualized return of the MSCI World Index over the holding period of the PE sponsor.
LBO spreads	U.S. high-yield rate for the corresponding month according to the Merrill Lynch High-Yield index minus LIBOR.
PE Benchmark IRR	Buyout fund benchmark returns classified by vintage years (obtained through Thomson One Banker).
Region Fixed Effects	Dummy indicating if a deal was conducted in Europe (1) or in North America (0).
PE Sponsor and Fund Variables	
PE Fund Generation	Fund generation number of the investing PE fund based on the historical number of funds launched by a PE sponsor at investment entry.
PE Sponsor Fixed Effects	PE sponsor dummies allocating a unique figure for every PE sponsor.
Industry Variables	
Industry Fixed Effects	Industry dummies based on one-digit ICB codes (http://www.icbenchmark.com).

Table II.15-A

Total Sample		Log D/E (1)	Log D/EBITDA (2)	Log Delta EBITDA (3)	Log Delta Multiple (4)	Log EBITDA Entry (5)	EBITDA Margin Entry (6)	Log Sales Entry (7)	Log Enterprise Value Entry (8)	Holding Period (9)	Fund Generation (10)	Fund Benchmark IRR (11)	MSCI Annual Return (12)	LBO Spreads (13)
Log D/E	(1)	1												
Log D/EBITDA	(2)	0.6247*	1											
Log Delta EBITDA	(3)	-0.0067	0.1867*	1										
Log Delta Multiple	(4)	-0.1692*	-0.4640*	-0.2368*	1									
Log EBITDA Entry	(5)	0.2600*	0.1476*	-0.0802*	0.0167	1								
EBITDA Margin Entry	(6)	0.0371	0.0424	-0.3020*	0.005	0.0087	1							
Log Sales Entry	(7)	0.2410*	0.2110*	0.0912*	-0.0979*	0.7690*	-0.2105*	1						
Log Enterprise Value Entry	(8)	0.2370*	0.3745*	0.0067	-0.1241*	0.9340*	0.0155	0.7693*	1					
Holding Period	(9)	0.0543	0.0138	0.0989*	-0.0466	-0.0836*	0.0386	-0.0114	-0.0832*	1				
Fund Generation	(10)	0.0760*	0.1459*	-0.0048	0.0447	0.2275*	-0.015	0.1447*	0.2631*	-0.0292	1			
Fund Benchmark IRR	(11)	0.0512	0.0239	0.0650*	-0.0053	-0.1422*	-0.059	-0.0745*	-0.1213*	0.2853*	-0.0375	1		
MSCI Annual Return	(12)	-0.0225	-0.0129	0.0815*	0.0204	-0.0416	-0.0303	-0.0751*	-0.0384	-0.2334*	-0.1544*	0.2529*	1	
LBO Spreads	(13)	-0.0552	-0.0898*	0.0453	0.1349*	0.1075*	-0.0319	0.0939*	0.0698*	-0.2070*	0.1145*	-0.4400*	-0.0659*	1

*p<0.1

4.2 Empirical Results

4.2.1. Bivariate Results

Table II-16 shows bivariate statistics on the relationship between leverage and equity returns. We assign the buyout companies into quartiles based on each of the two measures of leverage. As a result, we obtain four groups ranging from the group of companies with the lowest leverage ratios to those with the highest. Then, we calculate average performance statistics for each of these quartiles. Panel A shows statistics on IRR, Cash Multiple and Sharpe Ratio for the quartiles built based on the buyout company D/E ratio as a measure of leverage. Obviously, equity returns increase with the D/E level irrespective of the equity return measure used. For example, the median IRR in the quartile containing buyouts with the lowest debt to equity ratio is 30% and increases over the two middle groups, with IRRs of 31% and 35%, to the highest median IRR of 41% in the highest debt to equity quartile. The same pattern can be observed for mean IRR values and is robust to using Cash Multiple as the measure of equity returns. However, in terms of median values the lowest Cash Multiple return is yielded by deals in the second quartile.

With regard to the risk-adjusted return, on average, a deal in the lowest debt to equity group yields a Sharpe Ratio of 0.29 while a buyout in the highest quartile achieves a Sharpe Ratio of 0.42. The Kruskal-Wallis tests for IRR, Cash Multiple and Sharpe Ratio, reported at the bottom of Panel A, statistically confirm the inequality of equity returns among these D/E groups. Overall, our data exhibits a robust pattern of a positive relationship between leverage, measured as D/E, and equity returns.

Table II-16: Equity Returns and Leverage Quartiles

We split our final sample of 763 private equity (PE)-sponsored buyouts into four subgroups according to their level of leverage. Accordingly, the leverage levels within these quartiles range from low to high level. For each of these subgroups we report mean, median, and standard deviation of the three equity return measures used in this study. We winsorize some of the variables in order to account for outliers. We identify outliers by running a boxplot analysis and treat an observation as an outlier if it is more than 1.5 box lengths below or above the box (i.e. the 25th and 75th percentile). Equity IRR is calculated from monthly cash flows between PE sponsor and the portfolio company gross of fees and carried interest in percent. We winsorize this variable at the 95th percentile. Cash Multiple is obtained by dividing the total cash inflows that the PE sponsor receives from a buyout transaction by the total cash outflows related to the transaction. We obtain Sharpe Ratios by using the mathematical model in Braun et al. (2010). We winsorize this variable at the 99th percentile. Panel A presents the results based on splitting the sample into quartiles based on debt to equity. Accordingly, Panel B exhibits equity returns within subgroups based on debt to EBITDA. At the bottom of both panels we report the results of Kruskal-Wallis tests on the equality of equity returns across leverage quartiles. *, **, and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Panel A: Debt to Equity

	No. of Deals	IRR (%)			No. of Deals	Cash Multiple			No. of Deals	Sharpe Ratio		
		Mean	Median	St. Dev.		Mean	Median	St. Dev.		Mean	Median	St. Dev.
Quartile 1 (lowest)	192	35%	30%	57%	192	2.78	2.51	2.30	93	0.45	0.29	0.97
Quartile 2	190	37%	31%	55%	190	2.87	2.31	2.26	108	0.54	0.37	1.12
Quartile 3	191	40%	35%	62%	191	2.96	2.56	2.27	117	0.72	0.43	1.17
Quartile 4 (highest)	190	48%	41%	64%	190	3.96	3.17	3.71	113	0.66	0.42	1.07
Total	*763*	*40%*	*33%*	*60%*	*763*	*3.14*	*2.56*	*2.74*	*431*	*0.60*	*0.39*	*1.09*
Kruskal Wallis p-value			0.06*				0.00***				0.00***	

Panel B: Debt to EBITDA

	No. of Deals	IRR (%)			No. of Deals	Cash Multiple			No. of Deals	Sharpe Ratio		
		Mean	Median	St. Dev.		Mean	Median	St. Dev.		Mean	Median	St. Dev.
Quartile 1 (lowest)	191	47%	34%	62%	191	3.10	2.70	2.47	110	0.79	0.37	1.46
Quartile 2	191	36%	34%	62%	191	2.76	2.42	2.33	113	0.42	0.36	0.71
Quartile 3	191	38%	33%	57%	191	3.44	2.87	3.14	109	0.66	0.40	1.14
Quartile 4 (highest)	190	40%	33%	58%	190	3.26	2.49	2.93	99	0.54	0.40	0.88
Total	*763*	*40%*	*33%*	*60%*	*763*	*3.14*	*2.56*	*2.74*	*431*	*0.60*	*0.39*	*1.09*
Kruskal Wallis p-value			0.73				0.18				0.64	

In contrast, we do not observe such an obvious relationship if we measure leverage as debt to EBITDA. In Panel B of Table II-16 we report average equity returns for quartiles of deal D/EBITDA ratios analogous to Panel A. To begin with, Kruskal-Wallis tests indicate that equality of equity returns among the D/EBITDA quartiles cannot be statistically rejected. Based on median values there is barely any difference between IRRs and Sharpe Ratios among the four quartiles of D/EBITDA leverage. For example, the median IRR for all leverage groups is between 33% and 34%. Similarly, the average values for Cash Multiple do not suggest a plausible pattern for the relationship between D/EBITDA leverage and equity returns.

Altogether, the bivariate patterns show that the differentiation between these two leverage measures matters. It seems as if there is an obvious positive relationship between D/E and equity returns. On the other hand, the data on D/EBITDA do not provide such an intuitive picture.

However, multivariate tests which allow controlling for critical effects on the relationship between leverage and equity returns, such as time, industry or transaction specific effects, are needed in order to be able to provide meaningful interpretations of the results.

4.2.2. Multivariate Results

In our first set of regression analyses we use deal-level IRR as a dependent variable and D/E as the measure of leverage (see Table II–17). Since the relationship between our leverage measures and IRR is not unambiguous we test for both a log-linear (specifications 1 and 2) as well as for a quadratic (specifications 3 and 4) relationship. We use the Adjusted R2 to test which model fits best as the Adjusted R2 is useful when choosing between different non-nested sets of independent variables in different functional forms (Wooldridge, 2009). Our results in Table II-17 show statistically significant relationships in specifications (1) to (4). With regard to the better functional specification we find no preferences for one model as the Adjusted R2 is almost the same for both specifications. The logarithmized D/E in specifications (1) and (2) are both statistically significant at the 1% level. A 10% increase in D/E on average results in a 0.5 percentage points higher IRR ($0.056*\ln(1.1) = 0.005$). Controlling for operational improvements over the holding period in specification (2), this effect increases to 0.8 percentage points.

Regarding the quadratic functional form, we also find the D/E (positive sign) and the squared D/E ratio (negative sign) in specifications (3) and (4) to be statistically significant at the 1% level. Obviously, a higher D/E ratio leads to a higher IRR – up to a certain point. From that point on an additional increase in leverage leads to a decrease in IRR as the marginal gain through each additional unit of leverage is decreasing while the default risk increases further on. The turning point of our functions in specification (3) is at a D/E ratio of 9.3 (0.074/(2*0.004)) or a debt to total capital ratio of approximately 90%. For example, an increase in D/E from 1.5 to 2.0 leads to a 3.2 percentage points increase in IRR. On the other hand, an increase in D/E from 9.5 to 10.0 leads to a 0.2 percentage points decrease in IRR. However, only 12 out of 763 realized transactions exhibit D/E ratios higher than 9.3.

These results indicate that it is reasonable from a PE sponsor's perspective to use more leverage (up to a D/E ratio of 9.3). In other words: a debt to total capital ratio of about 90% maximizes equity returns. However, given that such capital structures are relatively uncommon, this turning point has more theoretical than practical relevance. This also explains why the logarithmized D/E ratios in specifications (1) and (2) are statistically significant too, indicating a log-linear positive relationship between D/E ratio and IRR.

In order to check the robustness of these results, in particular concerning the appropriate functional form to capture the relationship between D/E and equity returns, in specification (5) we also include dummies to differentiate D/E quartiles analogous to the logic we applied in our bivariate analysis. We chose the highest D/E quartile as reference category. The results support our findings and show that deals with low D/E levels have significantly lower equity returns. A deal in the lowest D/E quartile has on average a 13.2 percentage points lower equity return compared to our reference group of the most highly leveraged companies. A buyout in D/E quartile 2 yields a 10.2 percentage point lower IRR. However, we observe no statistically significant difference between the two groups of higher leveraged companies, i.e. D/E quartile 3 and D/E quartile 4. Again, these numbers indicate that the positive marginal effect becomes smaller and smaller and ultimately disappears at high D/E levels.

In our second set of regressions shown in Table II-18 we chose the same specifications as in the first step but use D/EBITDA instead of D/E as the measure of leverage. We observe similar patterns, even though results are less significant or even insignificant. In economic terms, specification (2) suggests that a 10% increase in D/EBITDA on average leads to a 0.6

percentage points higher deal-level IRR. Again, the turning point at which an increase in leverage yields lower equity returns (according to our quadratic equations (3) and (4)) is extremely high at a D/EBITDA ratio of about 32.5 and was reached only two times in our sample.

Summarizing the results of Table II-17 and Table II-18 we find strong evidence for a positive effect of leverage on equity return. However, given the turning point of the function our findings indicate that it is possible to "over-leverage" a company. Since the turning point occurs at very high leverage levels, it is understandable why we find evidence for both a log-linear positive as well as a concave relationship between leverage and equity returns.

It is difficult to say exactly which positive effect associated with debt is responsible for higher equity returns. One explanation for our findings would be that increasing financial risk associated with a higher D/E ratio is offset by higher equity returns on average (leverage effect). Given the basic connection between risk and return in financial theory, this is an intuitive result. This finding also supports the assumption that it is reasonable for GPs to lever each deal up as much as possible (but they should use at least 10% equity to finance a transaction). We believe that the D/E ratio is a better proxy to account for the financial risk of a transaction and to indicate the option-like compensation structure of a PE general partner due to the fact that the size of the equity investment by the PE sponsor is included. Another explanation for higher equity returns is an improved utilization of tax shields.

On the other hand, since we control for EBITDA growth during the holding period (which is highly relevant in explaining equity returns), we already account for an improved operational performance through the disciplining effect of debt. Assuming the disciplining effect of debt should be absorbed by the Delta EBITDA variable, we attribute the remaining positive effect of leverage on returns on the leverage effect and tax shields. However, comparing specifications (1), excluding Delta EBITDA, and (2), including Delta EBITDA, in Table II-18, we would expect our D/EBITDA variable in specification (1) to be more significant (statistically and economically) if this holds true. In specification (2) it should be absorbed by the Delta EBITDA variable. However, since we observe the opposite we conclude that the disciplining effect of debt is not a relevant return driver which is in line with Nikoskelainen and Wright (2007).

Table II-17: Regression Results – Net Debt to Equity Ratio

This table presents the results of ordinary least square regressions with double-clustered standard errors by time (quarterly per year) and industry (three-digit ICB code) on the determinants of deal-level internal rate of return (IRR). We winsorize some of the variables in order to account for outliers. We identify outliers by running a boxplot analysis and treat an observation as an outlier if it is more than 1.5 box lengths below or above the box (i.e. the 25th and 75th percentile). The variables are defined as in Table II-15. Generally, the numbers in the upper rows represent the regression coefficients. *, ** and *** indicate p-values of 10 percent, 5 percent, and 1 percent significance level, respectively. In the lower rows standard errors are reported.

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Equity IRR	Equity IRR	Equity IRR	Equity IRR	Equity IRR
Log D/E	0.056***	0.082***			
	(0.019)	(0.020)			
D/E			0.074***	0.072***	
			(0.017)	(0.018)	
(D/E)^2			-0.004***	-0.004***	
			(0.001)	(0.001)	
D/E Quartile 1					-0.132**
					(0.051)
D/E Quartile 2					-0.102***
					(0.039)
D/E Quartile 3					-0.055
					(0.045)
Control Variables					
Fund Generation	0.000	0.008	0.004	0.009	-0.004
	(0.010)	(0.014)	(0.010)	(0.013)	(0.021)
Holding Period	-0.052***	-0.072***	-0.068***	-0.073***	-0.068***
	(0.009)	(0.008)	(0.007)	(0.008)	(0.010)
Delta EBITDA		0.184***	0.187***	0.183***	0.192***
		(0.037)	(0.033)	(0.036)	(0.039)
Delta EV/EBITDA		0.273***	0.274***	0.267***	0.259***
		(0.039)	(0.042)	(0.040)	(0.040)
Log Enterprise Value	-0.002	0.010	0.009	0.010	0.016
	(0.017)	(0.015)	(0.014)	(0.015)	(0.017)
MSCI Annual Return	0.846***		0.507**		0.893***
	(0.258)		(0.213)		(0.246)
PE Benchmark Fund IRR		0.285		0.291	
		(0.418)		(0.395)	
LBO Spreads	0.684		-1.109		-0.086
	(0.720)		(0.740)		(0.902)
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes
Exit Type Fixed Effects	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	No	Yes	No	Yes	No
PE Sponsor Fixed Effects	No	No	No	No	Yes
Constant	0.465***	0.400***	0.428***	0.304**	0.297*
	(0.177)	(0.141)	(0.153)	(0.136)	(0.168)
Observations	754	661	661	661	661
R-squared	0.44	0.46	0.44	0.46	0.52
Adj. R-squared	0.43	0.42	0.41	0.42	0.45

*** p<0.01, ** p<0.05, * p<0.1

Table II-18: Regression Results – Net Debt to EBITDA Ratio

This table presents the results of ordinary least square regressions with double-clustered standard errors by time (quarterly per year) and industry (three-digit ICB code) on the determinants of deal-level internal rate of return (IRR). We winsorize some of the variables in order to account for outliers. We identify outliers by running a boxplot analysis and treat an observation as an outlier if it is more than 1.5 box lengths below or above the box (i.e. the 25th and 75th percentile). The variables are defined as in Table II-15. Generally, the numbers in the upper rows represent the regression coefficients. *, ** and *** indicate p-values of 10 percent, 5 percent, and 1 percent significance level, respectively. In the lower rows standard errors are reported.

VARIABLES	(1) Equity IRR	(2) Equity IRR	(3) Equity IRR	(4) Equity IRR	(5) Equity IRR
Log D/EBITDA	0.003	0.063***			
	(0.020)	(0.022)			
D/EBITDA			0.013**	0.014*	
			(0.007)	-0.007	
(D/EBITDA)^2			-0.0002**	-0.0002*	
			(0.0001)	(0.0001)	
D/EBITDA Quartile 1					0.059
					(0.040)
D/EBITDA Quartile 2					-0.014
					(0.045)
D/EBITDA Quartile 3					-0.014
					(0.046)
Control Variables					
Fund Generation	0.000	0.008	0.004	0.008	-0.001
	(0.010)	(0.014)	(0.012)	(0.014)	(0.022)
Holding Period	-0.052***	-0.071***	-0.066***	-0.071***	-0.067***
	(0.009)	(0.009)	(0.008)	(0.009)	(0.010)
Delta EBITDA		0.172***	0.179***	0.175***	0.190***
		(0.036)	(0.034)	(0.037)	(0.042)
Delta EV/EBITDA		0.282***	0.274***	0.266***	0.232***
		(0.044)	(0.045)	(0.042)	(0.037)
Log Enterprise Value	0.005	0.011	0.013	0.014	0.026*
	(0.018)	(0.015)	(0.014)	(0.016)	(0.015)
MSCI Annual Return	0.840***		0.517**		0.918***
	(0.273)		(0.236)		(0.249)
PE Benchmark Fund IRR		0.327		0.311	
		(0.439)		(0.444)	
LBO Spreads	0.538		-1.257		0.007
	(0.737)		(0.768)		(0.880)
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes
Exit Type Fixed Effects	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	No	Yes	No	Yes	No
PE Sponsor Fixed Effects	No	No	No	No	Yes
Constant	0.451**	0.321**	0.493***	0.340**	0.070
	(0.185)	(0.150)	(0.172)	(0.153)	(0.150)
Observations	754	661	661	661	661
R-squared	0.44	0.44	0.42	0.44	0.52
Adj. R-squared	0.42	0.41	0.40	0.41	0.45

*** p<0.01, ** p<0.05, * p<0.1

4.2.3. Evidence on Debt-Equity Arbitrage as a Return Driver

In order to investigate whether PE sponsors generate equity returns by conducting debt-equity arbitrage, i.e. timing debt markets, we split our leverage measures into the components explained by debt market conditions and residual leverage applying the approach proposed by Axelson et al. (2010). We estimate a regression of the logarithmized D/E (and D/EBITDA) on high-yield spreads and use the fitted values from this regression to calculate predicted leverage. In other words: we estimate the amount of leverage (predicted leverage) which is determined by debt market conditions, i.e. LBO spreads. Residual leverage is then the difference between actual and predicted leverage. If PE sponsors arbitrage debt markets against equity markets when debt is relatively cheap, the predicted component of leverage, directly related to favorable debt market conditions, should have a positive impact on equity returns. This would imply that PE sponsors are successful in timing debt markets.

Table II-19 reports the results of these regression sets. We exclude time dummies in these regressions as we already account for temporal effects by using time specific high-yield spreads at investment entry for each transaction.

Indeed, in all specifications we find a significant (5% and 10% level) positive relationship between our predicted leverage measures and equity IRR. This is evidence for the hypothesis that PE sponsors arbitrage debt markets against equity markets when debt is relatively cheap. This might also imply that interest rates charged by banks during PE boom periods do not adequately reflect the inherent default risks of the portfolio companies. Considering the improved possibilities of banks to forward credit risks to third parties in the last couple of years, this result seems plausible. In addition, our results also show that residual leverage has a significant (1% to 10% level) and positive influence on equity IRRs. This can be explained by other effects related to leverage (e.g. leverage effect and tax shields) and is in line with the results presented in Section 4.2.2.

Table II-19: Debt-Equity-Arbitrage

This table presents the results of ordinary least square regressions with double-clustered standard errors by time (quarterly per year) and industry (three-digit ICB code). The dependent variable is deal-level equity IRR. We winsorize some of the variables in order to account for outliers. We identify outliers by running a boxplot analysis and treat an observation as an outlier if it is more than 1.5 box lengths below or above the box (i.e. the 25th and 75th percentile). We split our leverage measures into the component explained by debt market conditions and residual leverage. We estimate a regression of log D/E (and D/EBITDA) on high-yield spreads and use the fitted values from this regression to calculate logarithmized predicted leverage (we use STATA's 'predict' command). Residual leverage is then the difference between actual and predicted leverage. The other variables are defined as in Table II-15. Generally, the numbers in the upper rows represent the regression coefficients. *, ** and *** indicate p-values of 10 percent, 5 percent, and 1 percent significance level, respectively. In the lower rows standard errors are reported in parentheses.

	(1)	(2)	(3)	(4)
VARIABLES	Equity IRR	Equity IRR	Equity IRR	Equity IRR
Log D/E predicted	0.774**		0.675*	
	(0.379)		(0.378)	
Log D/E residual	0.085***		0.085***	
	(0.021)		(0.020)	
Log D/EBITDA predicted		0.662**		0.580*
		(0.319)		(0.323)
Log D/EBITDA residual		0.062*		0.060*
		(0.029)		(0.019)
Control variables				
Fund Generation	-0.000	-0.000	0.003	0.003
	(0.010)	(0.016)	(0.011)	(0.012)
Holding Period	-0.071***	-0.070***	-0.067***	-0.066***
	(0.007)	(0.007)	(0.007)	(0.008)
Delta EBITDA	0.195***	0.183***	0.189***	0.177***
	(0.032)	(0.032)	(0.033)	(0.033)
Delta EV/EBITDA	0.284***	0.294***	0.279***	0.288***
	(0.041)	(0.047)	(0.041)	(0.046)
Log Enterprise Value	0.008	0.010	0.009	0.010
	(0.014)	(0.014)	(0.014)	(0.014)
MSCI Annual Return			0.507**	0.501*
			(0.225)	(0.235)
Region Fixed Effects	Yes	Yes	Yes	Yes
Exit Type Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	No	No	No	No
Constant	0.263	-0.328	0.235	-0.286
	(0.170)	(0.406)	(0.176)	(0.402)
Observations	661	661	661	661
R-squared	0.43	0.42	0.43	0.42
Adj. R-squared	0.41	0.40	0.41	0.40

*** p<0.01, ** p<0.05, * p<0.1

4.2.4. Endogeneity Issues

One could argue that our positive relationship between leverage and equity returns is endogenous since banks are willing to provide more debt to finance a transaction if they expect a very positive development with regard to the performance of the portfolio company during the holding period of the PE sponsor. This would imply that deals with higher expected performance are more highly leveraged and not the other way around. We can provide two arguments against this view. First, we control for the portfolio company's operating performance over the holding period in our regressions. Assuming this ex-post operating performance is a good proxy for ex-ante expectations at investment entry, this type of endogeneity should not be a problem. Second, we conduct a two-stage instrumental variables regression (IV regression) to check the robustness of our results by comparing the IV models to the OLS models above. In the first stage we use the yield spread on corporate bonds (U.S. high-yield rate for the corresponding month according to the Merrill Lynch High-Yield index) on LIBOR and company size as instruments to predict deal leverage (D/E and D/EBITDA) at entry to be included in the equity return regression of the second stage. It has been shown that LBO spreads, which can be seen as proxy for debt market conditions, have a significant influence on the leverage levels in buyout transactions (Axelson et al., 2010). Favorable debt market conditions make it possible for PE sponsors to implement a more highly leveraged capital structure. Further, company size is expected to have a positive influence on firm leverage as larger companies have a higher lending capacity as they are less risky (Nikoskelainen and Wright, 2007) and less exposed to asymmetrical information (Chan et al., 1985). In addition, as shown in Table II-17 and Table II-18 LBO spreads and company size have no significant influence on equity returns which is a requirement for instruments. In order to correctly apply a two-stage regression model, we also include all explanatory variables from the second stage in the first stage (Baum, 2006). We use the same explanatory variables as shown in section 4.2.2 (except deal size and LBO spreads which are the instruments now). To begin with, we test if leverage is endogenous using the Durbin-Wu-Hausman test (Cameron and Trivedi, 2010). The F statistics for this test are 3.0, 1.0, 6.2 and 0.9 for specifications (1) to (4) respectively. This implies that there are only (weak) signs of endogeneity for specifications (1) and (3), i.e. when we do not control for a company's operating performance during the holding period. Therefore, the application of OLS models seems appropriate as we focus on the model with operating improvement variables. Further,

we want to rule out any possibility that our specifications are affected by a weak instrument problem. Looking at the robust F statistic from the first stage of 37.1, 11.5, 80.8 and 37.0, which are all above or around the rule of thumb of 10 mentioned by Cameron and Trivedi (2010), we are confident that we do not face a weak instrument problem. In addition, we test if specifications (2) and (4) are overidentified. Our results show that the overidentifying restriction is valid.

Looking at the results of the first stage in Table II-20, company size is statistically significant and positively related to both leverage measures. In addition, in times of good credit market conditions (i.e. when we observe lower LBO spreads) more leverage is used. This is in line with suggested relationships between our instruments and leverage measures.

Even if we think the explanatory power of the OLS models is higher when we include a firm's operating performance, the results of the IV regressions in Table II-20 confirm the positive effect of leverage on equity returns. All leverage coefficients at our second stage regressions are statistically significant at the 5% or 10% level. This also applies to the economic significance of leverage for equity returns. For instance, specification (1b) suggests that a 10% increase in D/E leverage results in a 2.5 percentage points increase in equity returns (0.262*ln(1.1)=0.025). Specification (3b) indicates that a 10% higher D/EBITDA leverage yields a 2.2 percentage point higher equity IRR. However, given the IV regression diagnostics discussed above, we believe that an economic interpretation of specification (2) in Table II-17 and Table II-18 (OLS regression), respectively, is more meaningful.

Table II-20: Instrumental Variable Regression Results – Equity IRR

This table presents the results of instrumental variable (IV) regressions with heteroskedasticity-consistent standard errors on deal-level equity IRR. We winsorize some of the variables in order to account for outliers. We identify outliers by running a boxplot analysis and treat an observation as an outlier if it is more than 1.5 box lengths below or above the box (i.e. the 25th and 75th percentile). In the first stage we use LBO spreads and company size as instruments to predict deal leverage (log D/E and log D/EBITDA) at entry to be included in the equity IRR regression of the second stage. In order to correctly apply a two-stage regression model, we also include all explanatory variables from the second stage in the first stage. The variables are defined as in Table II-15. Generally, the numbers in the upper rows represent the regression coefficients. *, ** and *** indicate p-values of 10 percent, 5 percent, and 1 percent significance level, respectively. In the lower rows standard errors are reported in parentheses.

	First Stage IV Regression				Second Stage IV Regression			
	Log(D/E)	Log(D/E)	Log(D/EBITDA)	Log/D/EBITDA)	IRR	IRR	IRR	IRR
VARIABLES	(1a)	(2a)	(3a)	(4a)	(1b)	(2b)	(3b)	(4b)
Log D/E					0.262**	0.193*		
					(0.119)	(0.112)		
Log D/EBITDA							0.232**	0.163*
							(0.107)	(0.097)
Control variables								
Fund Generation	0.005	0.010	0.020	0.018	-0.013	0.007	-0.016	0.006
	(0.019)	(0.022)	(0.014)	(0.013)	(0.015)	(0.011)	(0.016)	(0.011)
Holding Period	0.017	0.000	0.010	-0.005	-0.026***	-0.074***	-0.024**	0.073***
	(0.014)	(0.019)	(0.009)	(0.011)	(0.009)	(0.009)	(0.009)	(0.009)
Delta EBITDA		-0.070		0.091**		0.195***		0.167***
		(0.055)		(0.036)		(0.034)		(0.030)
Delta EV/EBITDA		-0.256***		-0.491***		0.306***		0.336***
		(0.093)		(0.059)		(0.056)		(0.070)
MSCI Annual Return	-0.007	-0.688	0.089	0.536	1.131***	-0.303	1.109***	-0.528
	(0.403)	(0.681)	(0.273)	(0.389)	(0.345)	(0.361)	(0.351)	(0.371)
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exit Type Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
Time Fixed Effects	No	Yes	No	Yes	No	Yes	No	Yes
Instruments								
LBO Spreads		-7.909**		-4.884*				
		(3.956)		(2.504)				
Log Enterprise Value	0.129***	0.114***	0.146***	0.132***				
	(0.021)	(0.025)	(0.016)	(0.015)				
Constant	-0.38	0.151	0.535***	1.074***	-0.007	0.454***	-0.230	0.271
	(0.304)	(0.400)	(0.208)	(0.341)	(0.182)	(0.130)	(0.207)	(0.172)
Observations	754	661	754	661	754	661	754	661
Adj. R-squared	0.10	0.13	0.15	0.40	n/m	n/m	n/m	n/m
Root MSE	0.82	0.80	0.59	0.48	0.60	0.40	0.60	0.40
IV Regression Diagnostic								
Durbin-Wu-Hausman test (F-statistic)	3.01*	0.97	6.23**	0.90				
Joint test for instrument significance (F-statistic)	37.14***	11.47***	80.75***	36.98***				
Overidentification Test (Chi-squared)	n/a	0.26	n/a	0.71				

*** p<0.01, ** p<0.05, * p<0.1

4.2.5. Robustness Checks

In order to further test the robustness of our results, we substitute the equity IRR by alternative performance measures. In specifications (1) to (4) in Table II-21 we use logarithmized Cash Multiples as alternative return measures. Analogous to previous analyses, for both measures of leverage, D/E and D/EBITDA, we test for a log-linear and a quadratic relationship respectively.

These regressions show that our results are robust to using Cash Multiple as an alternative (non-risk-adjusted) return measure. The coefficients for D/E in specifications (1) and (2) are as statistically significant (1% level) as those in the equity IRR regressions and exhibit the same prefix (see Section 4.2.2). The coefficients indicating the effect of D/EBITDA on Cash Multiples are even statistically stronger (1% level) than those for equity IRRs.

In addition, in specifications (5) to (8) we use deal-level Sharpe Ratios as the dependent variable, i.e. a risk-adjusted performance measure. Again, we test for log-linear and quadratic relationships for both leverage measures. In contrast to equity IRR and Cash Multiples, we only find a weakly statistically significant (10% level) positive coefficient for log D/E. While the prefixes for the quadratic specification (2) are the same as for the alternative performance measures, the corresponding coefficients are not statistically significant. For D/EBITDA, we do not find statistically reliable patterns in specifications (7) and (8). Since we use a risk-adjusted performance measure here, the leverage effect would not be able to explain a potentially positive relationship between the D/E ratio and the Sharpe Ratio. In theory, leverage increases both risk and (expected) return proportionally. Obviously, the remaining positive effects related to leverage obviously do not outweigh the increased financial risk by boosting risk-adjusted equity returns.

Table II-21: Robustness Test – Alternative Performance Measures

This table presents the results of ordinary least square regressions with double-clustered standard errors by time (quarterly per year) and industry (three-digit ICB code) on the determinants of our alternative performance measures, i.e. deal-level Cash Multiple and Sharpe Ratio. We winsorize some of the variables in order to account for outliers. We identify outliers by running a boxplot analysis and treat an observation as an outlier if it is more than 1.5 box lengths below or above the box (i.e. the 25th and 75th percentile). The variables are defined as in Table II-15. Generally, the numbers in the upper rows represent the regression coefficients. *, ** and *** indicate p-values of 10 percent, 5 percent, and 1 percent significance level, respectively. In the lower rows standard errors are reported in parentheses.

VARIABLES	(1) Log (Cash Multiple)	(2) Log (Cash Multiple)	(3) Log (Cash Multiple)	(4) Log (Cash Multiple)	(5) Sharpe Ratio	(6) Sharpe Ratio	(7) Sharpe Ratio	(8) Sharpe Ratio
Log D/E	0.102***				0.076*			
	(0.020)				(0.040)			
D/E		0.087***				0.057		
		(0.014)				(0.043)		
(D/E)^2		-0.004***				-0.004		
		(0.001)				(0.003)		
Log D/EBITDA			0.116***				-0.018	
			(0.020)				(0.101)	
D/EBITDA				0.036***				-0.028
				(0.008)				(0.048)
(D/EBITDA^2)				-0.000***				0.001
				(0.000)				(0.002)
Fund Generation	0.008	0.008	0.007	0.006	0.000	0.003	0.003	0.004
	(0.011)	(0.011)	(0.011)	(0.011)	(0.024)	(0.023)	(0.026)	(0.025)
Holding Period	0.017*	0.015*	0.018**	0.018**	-0.109***	-0.110***	-0.111***	-0.111***
	(0.009)	(0.008)	(0.009)	(0.009)	(0.022)	(0.022)	(0.022)	(0.022)
Benchmark IRR	-0.124	-0.129	-0.055	-0.014	1.643	1.694	1.616	1.614
	(0.541)	(0.502)	(0.557)	(0.545)	(1.361)	(1.379)	(1.372)	(1.399)
Delta EBITDA	0.280***	0.279***	0.262***	0.259***	0.437***	0.432***	0.434***	0.443***
	(0.068)	(0.068)	(0.065)	(0.065)	(0.075)	(0.074)	(0.075)	(0.078)
Delta EV/EBITDA	0.340***	0.334***	0.370***	0.362***	0.484***	0.471***	0.467***	0.444***
	(0.041)	(0.037)	(0.040)	(0.039)	(0.112)	(0.114)	(0.108)	(0.108)
Log Enterprise Value	0.018	0.018	0.014	0.013	0.037	0.038	0.049	0.057
	(0.012)	(0.012)	(0.012)	(0.013)	(0.037)	(0.037)	(0.040)	(0.041)
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exit Type Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.764***	0.647***	0.633***	0.634***	0.768**	0.668**	0.706**	0.743**
	(0.180)	(0.180)	(0.195)	(0.193)	(0.306)	(0.321)	(0.336)	(0.350)
Observations	661	661	661	661	419	419	419	419
R-squared	0.48	0.48	0.47	0.47	0.40	0.40	0.40	0.40
Adj. R-squared	0.45	0.45	0.43	0.43	0.35	0.35	0.34	0.34

*** p<0.01, ** p<0.05, * p<0.1

In our second set of robustness checks, we also include 556 unrealized transactions, i.e. companies the PE sponsor has purchased but not sold yet, in our empirical analysis. When an investment performs poorly, PE sponsors are inclined to keep them longer in their portfolio, as selling for an unsatisfactory price (or even writing the investment off) deteriorates fund performance and, therefore, hampers future fundraising efforts (Cumming and Walz, 2010). Hence, a sample of realized investments only might suffer from a selection bias which neglects underperforming investments. For unrealized transactions we use the last valuation reported by the PE fund as final cash flow to calculate equity IRRs.

On the sample of 661 realized and 556 unrealized transactions (with sufficient deal-level information) we run log-linear, quadratic and ordinal models of D/E and D/EBITDA leverage and equity IRR respectively. The results are shown in Table II-22.

Specifications (1) to (3) exhibit our results for D/E as the leverage measure and show that they are robust to the inclusion of unrealized transactions. The statistical and economic significance is quite similar to the results for realized deals only.

However, the regression results of equity IRR on D/EBITDA leverage for unrealized and realized transactions in specifications (4) to (6) in Table II-22 differ from those for realized deals only (see Table II-18). While we find a positive relationship between D/EBITDA and equity IRR up to extremely high leverage levels for realized transactions, we do not find any statistically or economically relevant influence of D/EBITDA leverage on equity IRR in the log-linear and quadratic specifications. In turn, in specification (6), in which we distinguish four ordinal D/EBITDA categories, we even find a statistically significant (1% and 5%, respectively) and positive relationship for the second and third D/EBITDA quartile compared to the fourth quartile, our reference category. This could be due to the fact that it takes more time in transactions with highly leveraged capital structures until it is possible to pay out cash flows to equity investors due to higher interest and redemption payments. Since the subsample of unrealized transactions has a shorter holding period than the realized deals, the relationship between leverage and equity returns could be distorted when including unrealized transactions.

Table II-22: Robustness Test – Realized and Unrealized Transactions

This table presents the results of ordinary least square regressions with double-clustered standard errors by time (quarterly per year) and industry (three-digit ICB code) on the determinants deal-level equity IRR. We include realized (661) and unrealized (556) transactions. We winsorize some of the variables in order to account for outliers. We identify outliers by running a boxplot analysis and treat an observation as an outlier if it is more than 1.5 box lengths below or above the box (i.e. the 25th and 75th percentile). The variables are defined as in Table II-15. Generally, the numbers in the upper rows represent the regression coefficients. *, ** and *** indicate p-values of 10 percent, 5 percent, and 1 percent significance level, respectively. In the lower rows standard errors are reported in parentheses.

	(1)	(2)	(3)		(4)	(5)	(6)
VARIABLES	Equity IRR	Equity IRR	Equity IRR		Equity IRR	Equity IRR	Equity IRR
Log D/E	0.067***			Log D/EBITDA	0.012		
	(0.014)				(0.011)		
D/E		0.055***		D/EBITDA		0.001	
		(0.013)				(0.005)	
(D/E)^2		-0.002***		(D/EBITDA)^2		0.000	
		(0.001)				(0.000)	
D/E Quartile 1			-0.160***	D/EBITDA Quartile 1			0.012
			(0.037)				(0.038)
D/E Quartile 2			-0.119***	D/EBITDA Quartile 2			0.103***
			(0.028)				(0.037)
D/E Quartile 3			-0.108***	D/EBITDA Quartile 3			0.086**
			(0.031)				(0.039)
Control Variables							
Fund generation	0.009	0.009	0.010		0.009	0.010	0.010
	(0.008)	(0.008)	(0.008)		(0.008)	(0.008)	(0.008)
Holding Period	-0.038***	-0.039***	-0.039***		-0.039***	-0.039***	-0.040***
	(0.008)	(0.008)	(0.008)		(0.008)	(0.008)	(0.009)
Delta EBITDA	0.211***	0.210***	0.209***		0.211***	0.213***	0.216***
	(0.031)	(0.031)	(0.031)		(0.032)	(0.031)	(0.031)
Delta EV/EBITDA	0.224***	0.221***	0.221***		0.223***	0.217***	0.220***
	(0.056)	(0.056)	(0.056)		(0.056)	(0.057)	(0.055)
Log Enterprise Value	0.004	0.004	0.004		0.008	0.009	0.014
	(0.010)	(0.010)	(0.010)		(0.009)	(0.009)	(0.009)
PE Benchmark Fund IRR	-0.051	-0.038	-0.016		-0.033	-0.08	0.012
	(0.273)	(0.254)	(0.256)		(0.291)	(0.303)	(0.299)
Region Fixed Effects	Yes	Yes	Yes		Yes	Yes	Yes
Exit Type Fixed Effects	Yes	Yes	Yes		Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes		Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes		Yes	Yes	Yes
PE Sponsor Fixed Effects	No	No	No		No	No	No
Constant	0.363***	0.301**	0.495***		0.376***	0.389***	0.291**
	(0.119)	(0.118)	(0.121)		(0.137)	(0.140)	(0.132)
Observations	1217	1217	1217		1217	1217	1217
R-squared	0.39	0.39	0.39		0.38	0.38	0.39
Adj. R-squared	0.394	0.394	0.394		0.38	0.379	0.387

*** p<0.01, ** p<0.05, * p<0.1

In addition, as we have to rely on hypothetical equity IRRs when calculating returns for unrealized PE deals, we interpret this finding with caution. In this context, it is also reasonable to assume that PE sponsors do not want to disappoint their limited partners: they would rather report lower values to their investors and surprise them positively than the other way around - therefore, we think that IRRs based on net asset values are on average lower than IRRs based on realized cash flows (see, e.g., Cumming and Walz, 2010).

5. Leverage and Company Performance

In Section 4 we have shown that it is reasonable for PE sponsors to use high leverage ratios at investment entry to maximize non-risk-adjusted equity returns. However, the influence of high leverage ratios on company performance and consequently on other stakeholders (e.g. employees and banks) still remains open. For example, Axelson et al. (2010), who find that leverage has a negative impact on fund-level returns[39], argue that this result does not necessarily imply that *"...a highly levered capital structure imposes extra costs on the portfolio firm itself, as some critics of LBOs have argued."* In fact, the authors conclude that the result of these highly leveraged capital structures is rather that PE funds pay excessive entry prices for target companies – to the detriment of LPs as the negative impact on fund-level returns shows. We want to build upon these findings and further investigate whether highly leveraged capital structures have a negative influence on company performance. This also helps to better understand the sources driving the relationship between leverage and equity returns as the latter can be achieved through two different ways related to operational performance: first, a growth strategy would result in increasing sales over the holding period. Second, operational improvements could lead to superior sales margins, i.e. higher profit per unit of money earned.

We use two different proxies to measure company performance as a dependent variable: first, the logarithmized change in sales between investment entry and exit of the PE sponsor, i.e. $\log(sales_{Exit}/sales_{Entry})$. Second, the logarithmized change in EBITDA/sales ratio (EBITDA margin) between entry and exit of the PE sponsor, i.e. $\log(\text{EBITDA Margin}_{Exit}/\text{EBITDA}$

[39] Their result is not directly comparable to ours as we analyse the impact of leverage on deal-level returns, i.e. gross of fees.

$Margin_{Entry)}$. Again, we use D/E and D/EBITDA as leverage measures. Table II-23 reports the results of this set of regression analyses.

In specification (1) we find that the D/E ratio at entry has a weakly significant (10% level) and negative influence on sales growth. A 10% increase in D/E results in a 0.6% decrease in Delta Sales. One possible explanation for this finding is that companies with high leverage ratios must use a large proportion of their cash flows for interest payments and debt reduction. Consequently, the possibility of focusing on growth strategies (organic and inorganic) is reduced. Unfortunately, we have no data on the development of a company's capital expenditures in our data set in order to deepen this analysis.[40]

In specifications (3) and (4) we find a significant (10% and 1% level, respectively) and positive relationship between leverage and EBITDA margin improvements. A 10% increase in D/EBITDA at entry results in a 2.4% higher EBITDA margin improvement over the holding period. We argue that companies with high D/EBITDA ratios have to focus on cost reductions and efficiency improvements respectively (instead of sales growth) in order to handle the high debt burden. In this context, the disciplining effect of debt seems to induce the management to behave in this way.

However, one could argue that the leverage ratio agreed upon by debt providers and the PE sponsor at investment entry is a function of expected EBITDA margin improvements.[41] Therefore, we cannot completely exclude the argument that banks are willing to accept higher leverage ratios for companies with higher expected EBITDA margin improvements. In this context, it is reasonable to assume that our (ex-post) Delta EBITDA Margin variable is highly correlated with ex-ante expected margin improvements.

To test if our leverage variables are endogenous, we conduct two-stage IV regressions. In the first stage we, again, use LBO spreads to predict deal leverage (D/E and D/EBITDA) at entry to be included in the regression of the second stage. We use the same independent variables except for time dummies as we use monthly credit spreads. The F statistics for the

[40] Since we have anonymized transaction data it is not possible to collect additional data (e.g. capital expenditures).

[41] In this context, Achleitner et al. (2011b) find evidence that financial covenants based on D/EBITDA are less restrictive for firms with higher expected sales growth.

Durbin-Wu-Hausman tests are 8.87 and 12.49 for specifications (5) to (6), respectively. This implies that there are strong signs of endogeneity for both specifications. In these cases it is correct to use IV instead of the simple OLS approach. If we resort to the results of the second stage of the IV regression, we find no evidence that our leverage measures have a positive influence on EBITDA margin improvements.

Finally, when we look at the relationship between the holding period of a deal and our dependent variables, we find a significantly (1% level) positive relationship between the holding period and sales growth (each additional year results in an approx. 4.0% higher sales increase). This is an intuitive result as it is easier to achieve higher sales growth over a longer time period (e.g. through buy-and-build strategies). On the other hand, we find a negative (although not statistically significant) relationship between the holding period and EBITDA margin improvements. This could indicate that PE sponsors (and the installed management respectively) do not need much time to implement (standard) efficiency improvement measures. This is in line with Acharya et al. (2010) who argue that PE sponsors are most actively involved with a portfolio company within the first 100 days after investment entry.

Table II-23. Regression Results – Operating Performance

This Table presents the results of ordinary least square regressions with double-clustered standard errors by time (quarterly per year) and industry (three-digit ICB code) in specifications (1) to (4). In specifications (5) and (6) we present the results of the second stage of instrumental variable (IV) regressions with clustered standard errors by time (quarterly per year). In the first stage of the IV regression we use LBO spreads as instrument to predict deal leverage (log D/E and D/EBITDA) at entry to be included in the second stage. In order to correctly apply a two-stage regression model, we also include all explanatory variables from the second stage in the first stage. The dependent variables are: (a) The logarithmized ratio between sales at exit and entry of the PE-sponsored company, i.e. $\log(sales_{Exit} / sales_{Entry})$. (b) The logarithmized ratio between the EBITDA/Sales ratio (EBITDA Margin) at exit and entry of the PE-sponsored company, i.e. $\log(\text{EBITDA Margin}_{Exit} / \text{EBITDA Margin}_{Entry})$. We winsorize some of the variables in order to account for outliers. We identify outliers by running a boxplot analysis and treat an observation as an outlier if it is more than 1.5 box lengths below or above the box (i.e. the 25th and 75th percentile). The variables are defined as in Table II-15. Generally, the numbers in the upper rows represent the regression coefficients. *, ** and *** indicate p-values of 10 percent, 5 percent, and 1 percent significance level, respectively. In the lower rows standard errors are reported in parentheses.

	(1)	(2)	(3)	(4)	(5)	(6)
	Sales Delta	Sales Delta	EBITDA Margin Delta	EBITDA Margin Delta	EBITDA Margin Delta	EBITDA Margin Delta
VARIABLES	OLS	OLS	OLS	OLS	IV 2sls	IV 2sls
Log D/E	-0.064*		0.053*		-0.724*	
	(0.037)		(0.027)		(0.413)	
Log D/EBITDA		-0.005		0.251***		-0.808*
		(0.039)		(0.065)		(0.429)
Fund Generation	-0.001	-0.002	-0.001	-0.008	0.007	0.024
	(0.012)	(0.012)	(0.016)	(0.016)	(0.020)	(0.021)
Holding Period	0.039***	0.040***	-0.007	-0.006	-0.002	-0.002
	(0.007)	(0.007)	(0.010)	(0.011)	(0.015)	(-0.014)
EBITDA/Sales Entry	0.295*	0.227	-0.945***	-0.947***	-0.078	-0.687
	(0.174)	(0.157)	(0.296)	(0.234)	(-0.593)	(0.462)
Log Sales Entry	-0.052***	-0.062***	0.063***	0.051***	0.178***	0.136***
	(0.015)	(0.014)	(0.014)	(0.013)	(0.069)	(0.045)
MSCI Annual Return	0.044	0.098	1.360***	1.168***	1.079*	1.237**
	(0.273)	(0.305)	(0.418)	(0.407)	(0.556)	(0.550)
Region Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	No	No
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	649	649	642	642	642	642
R-squared	0.16	0.14	0.14	0.19		
Adj. R-squared	0.11	0.10	0.10	0.15		
Root MSE					0.86	0.84
IV Regression Diagnostic						
Durbin-Wu-Hausman test (F-statistic)					8.87***	12.49***
Joint test for instrument significance (F-statistic)					6.63**	8.91***

*** p<0.01, ** p<0.05, * p<0.1

6. Conclusion

Recently, debt financing in leveraged buyouts has become a prominent focus area for PE research. However, reliable empirical evidence concerning the relationship between leverage and return on transaction level is still scarce. Using a proprietary data set of more than 1,200 European and North American buyouts completed between 1990 and 2006 (of which more than 700 are realized), this paper provides empirical analyses on the influence of leverage on performance in buyouts. The main goal is to better understand the effect of leverage returns and, in particular, if there is something like an "optimal leverage ratio". In this context, we search for evidence whether PE sponsors conduct debt-equity-arbitrage in times of favorable debt market conditions. In addition, we also analyse the influence of leverage on a company's operational performance.

We run bivariate and multivariate analyses of the relationship between different leverage and performance measures. We find a robust concave relationship between D/E and equity returns. Theoretically, at lower levels of leverage the positive effects of debt on returns outweigh the increasing default risk. On the other hand, our results also indicate that it is possible to 'over-leverage' a company resulting in lower equity returns. However, our results suggest that the risk of 'over-leverage' only becomes relevant for a debt to total capital ratio of approximately 90% which, in reality, is very uncommon. This also implies that a debt to total capital ratio of 90% maximizes equity returns. Overall, these findings underline the incentive for PE sponsors to leverage each deal up as much as possible.

With regard to the question *how* the effects related to leverage influence equity returns, we find that PE sponsors successfully conduct debt-equity-arbitrage in times of favorable credit market conditions. By borrowing under-priced debt and purchasing equity stakes in companies, PE sponsors are obviously able to capitalize on the imperfections between debt and equity markets.

Building upon these results we also investigate the influence of leverage on company performance (instead of equity returns). We find only weak evidence that the D/E ratio at investment entry has a significant and negative influence on sales growth. We argue that highly leveraged firms have limited financial resources to implement growth strategies that pay off in the longer run. Unfortunately, we have no data on the development of a company's

capital expenditures in order to deepen this analysis. Further, we find no robust evidence that leverage has a significant influence on a company's EBITDA margin improvements during the holding period of the PE sponsor. Overall, we only find weak evidence that highly leveraged capital structures have a negative influence on company performance.

In summary, our findings indicate that it is reasonable from a PE sponsor's perspective to impose highly leveraged capital structures on their portfolio companies, especially in times of favourable debt market conditions when they can conduct debt-equity-arbitrage. However, this might not only be to the detriment of their LPs as shown by Axelson et al. (2010), but also harmful to the buyout target's operational performance, at least with respect to sales growth. With regard to the relationship between GPs and LPs, our results based on non-risk-adjusted returns do not hint at an agency problem between these two parties. Increasing leverage, at least up to extremely high levels, leads to higher equity returns. Hence, at first sight GPs and LPs jointly profit from higher debt levels. However, our robustness checks show that leverage does not have a positive influence on risk-adjusted equity returns. In assessing this agency problem risk-adjusted performance measures offer a key advantage: they account for the fact that a potential high-risk transaction, which is attractive from the GP's perspective, could be to the detriment of LPs. This is the case when the increased possible return due to the higher risk is not enough to justify the increase in risk which implies an inefficient investment from a risk-return perspective. Consequently, we argue that LPs should pay particular attention to risk-adjusted performance as they provide the major share of the equity capital (and hence bear the major exposure to the corresponding equity risk) involved in financing a transaction.

Notwithstanding, there is still research to be done on various topics of debt financing in LBOs. While our research clearly suggests the importance of leverage for deal performance, other studies have shown that debt packages negotiated between PE sponsors and banks to finance LBOs are, particularly in the US, quite heterogeneous. A hypothesis worth being addressed in future research might be that a relative increase in the availability of loans from institutional investors, such as hedge funds, changes the risk appetite of PE sponsors and how this is related to deal performance. This should be particularly interesting on a risk-adjusted basis, i.e. for PE fund investors to understand the mechanisms driving the agency conflict between LPs and GPs.

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II.IV Essay 4 - The Risk Appetite of Private Equity Sponsors

The Risk Appetite of Private Equity Sponsors

Abstract

Using a unique proprietary data set of 460 realized buyouts completed between 1990 and 2005, we examine the risk appetite of private equity (PE) sponsors in different states of the PE market and analyse key determinants of deal-level equity risk. We develop a new approach to mathematically model PE investment equity risk based on the Black-Cox default model. We find higher equity volatilities during boom periods. Further, deals conducted by more reputed PE sponsors have lower equity volatilities as they are unwilling to imperil their reputation by taking excessive risks. In addition, we find that PE sponsors' risk appetite is negatively related to the ownership stake in the buyout target company.

Keywords: private equity, risk appetite, equity volatility, asset volatility, reputation

JEL Classification Code: G24, G30, G32, G34

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1. Introduction

This study has two major goals. Firstly, we want to introduce a mathematical model that allows for computing transaction-level risk in private equity (PE) buyout investments. Secondly, we want to empirically investigate the patterns of PE sponsors' risk appetite over time and identify key determinants of deal-level risks chosen.

In recent years, empirical research on PE investments has focused to a large extent on returns and its drivers on fund (see, e.g., Kaplan and Schoar, 2005) and investment level (see, e.g., Nikoskelainen and Wright, 2007, Acharya et al., 2010, Achleitner et al., 2010, Guo et al., 2011). Consequently, with regard to understanding PE as an asset class and the drivers of deal returns, considerable progress has been made. Stylized facts include:

1. PE funds do not significantly outperform public benchmarks; some results even indicate that PE is an underperforming asset class (Kaplan and Schoar, 2005, Phalippou and Zollo, 2005).

2. However, funds managed by more experienced PE sponsors persistently generate excess returns and outperform public and private benchmarks, thus explaining why PE is still an attractive asset class for some investors despite the relatively poor performance of the industry overall (Kaplan and Schoar, 2005).

3. Successful PE sponsors mainly use three different instruments to generate high returns (see, e.g., Kaplan and Strömberg, 2009, Guo et al., 2011, Achleitner et al., 2010): (1) Governance improvements through a combination of the disciplining effect of debt in dealing with agency problems (Jensen, 1989), management incentives, and active monitoring through board control. (2) Operational engineering, i.e. provision of operational and industry expertise. (3) Financial engineering, i.e. increased tax shields and use of the leverage effect.

This research shows that the returns yielded by PE investments come along with considerable risks and that only few PE sponsors are able to consistently cope with these risks in order to generate persistent returns. The high levels of leverage in buyouts - one of the main reasons for these high risks - particularly have recently received considerable attention (see, e.g., Nikoskelainen and Wright, 2007, Acharya et al., 2010, Axelson et al., 2010). In this

context, Axelson et al. (2009) have proposed the convincing theoretical argument that the typical compensation structure of PE funds gives PE firms an incentive to undertake risky but unprofitable investments, i.e. with a negative net present value, if there is at least one possible state of nature with a positive outcome. The basic idea of this theory is that PE sponsors as general partners (GPs) only provide a small fraction of the funds they invest in companies, but participate in the success of transactions through their compensation scheme. In contrast, their downside risk, in case of failure, is limited and mainly borne by the investors into their fund, the so-called limited partners (LPs). This situation resembles a call option for the PE sponsor as it faces a strong upside potential if the investment turns out to be successful, but the lion's share of downside risk is borne by their investors. This problem of potential over-investment can be mitigated by the use of external leverage in financing buyout transactions as banks will be hesitant to provide debt for unprofitable deals that PE firms might otherwise undertake.

While our approach is not limited to issues of leverage, this theory as general framework provides at least two predictions that are relevant to the central goals of our study. First, Axelson et al. (2009) have argued that during periods in which external debt providers perceive investment opportunities to be favorable, over-investment will be more likely. If they are right with their theory, we should find that the risk appetite of PE sponsors is higher during PE boom periods, i.e. times characterized by a favorable credit market environment. Second, the agency problem in the option-like situation could also be mitigated by alternative mechanisms. Diamond (1989) has theoretically shown that the creditor's reputation is an important factor in debt markets. This theory states that reputation is an asset which reduces the creditor's incentives to engage in risk shifting. If this is correct we should observe in our cross-sectional analyses of deal-level risks that more highly reputed PE sponsors should exhibit a reduced risk appetite as failure would threaten their reputation (Axelson et al., 2009).

Overall, we consider risks associated with PE investments of extraordinary importance toward any understanding of the business. In this regard, we see two major challenges for researchers in the field that we would like to address in this study.

The first major challenge is of a conceptual nature and relates to which is the appropriate model to use to measure the risk of PE transactions on investment level. This problem arises from the illiquidity and opaqueness of the PE business (see, e.g., Ljungqvist and Richardson,

2003). Market valuations of enterprise and equity values can hardly be observed or appropriately calculated over the holding period of the PE sponsor, i.e. the time span between purchasing and selling the target company. However, the (observable) fluctuation in a value is fundamental to the calculation of risk, e.g. the standard deviation, of any asset. Consequently, calculating risk indicators for PE-sponsored companies is considerably more difficult compared to publicly listed, and therefore continuously or at least frequently valued, companies.

So far, we have not found a satisfactory solution for this conceptual challenge. Previous studies often focus on systematic risks excluding unsystematic risk factors (see, e.g., Franzoni et al., 2009, Groh and Gottschalg, 2009). However, both risk components are obviously inherent in single PE investments as it is often impossible to fully diversify PE funds that often embrace no more than 20 investments. For example, Lossen (2006) reports an average number of portfolio companies per buyout fund of 15.5. On the other side, one could argue that only systematic risk matters as investors in PE do not hold only one PE fund, but many such funds. In addition, typical investors in PE funds only commit a small part of their overall wealth into PE. However, in order to fully understand risks and their determinants in individual PE transactions it is essential to include systematic as well as idiosyncratic risks. This is in line with Müller (2010) who provides evidence that idiosyncratic risk matters when explaining equity returns for owners of private companies. Similarly, Jones and Rhodes-Kropf (2003) find that idiosyncratic risk is correlated with net fund returns.

Other studies focus on venture capital (VC) investments (see, e.g., Cochrane, 2005). However, we consider a distinction between VC and buyout investments to be inevitable given the special set-up of leveraged buyouts (LBOs). For example, the relatively high leverage ratios and the related effects on the corporate governance of a buyout target in the sense of Jensen (1989) are only prevalent in buyout transactions. This makes the risk profile of these transactions considerably different compared to VC investments. In this context, banks play a very important role in LBO transactions as they provide a significant part of the required capital to finance a buyout transaction. This is completely different to VC investments where the role of debt financing is mostly negligible.

Methodologically, a common procedure is to match buyout transactions with comparable (i.e. of similar risk) public benchmarks, either on the transaction level (see, e.g., Groh and

Gottschalg, 2009, Acharya et al., 2010) or on the fund level (see, e.g., Kaplan and Schoar, 2005). However, given the structural differences between publicly listed and PE-backed companies (e.g. in terms of size, ownership structure, governance mechanisms, management incentive schemes, leverage ratios) this approach seems suboptimal, even if it is possible to account for some of these differences.[42]

One of the rare studies explicitly dealing with risk associated with buyout investments including unsystematic risks is Groh et al. (2008). The authors introduce a contingent claims analysis model based on Ho and Singer (1984) that allows them to compute asset and equity value volatility. While that paper represents an important conceptual contribution, we think that the underlying model is overly simplistic and does not incorporate central characteristics of the PE business model. Our main concern is that the model is discrete and only allows for debt redemption and interest payments as well as default at two points in time during the holding period of the PE sponsor.

In this paper, we capitalize on the basic idea of Groh et al. (2008) and present a new model for pricing equity and debt of buyouts on the firm level. We think this model is more adequate in this context as it allows for continuous default and redemption payments during the holding period and because such a continuous model displays real PE transactions to a superior degree. Based on the Black-Cox default model (Black and Cox, 1976), we develop a new approach to calculate deal-specific implied asset and equity risk. These risks represent the ex-ante assumptions, i.e. at investment entry, of the PE sponsor regarding the expected volatility of the company/enterprise value (asset risk) and equity value (equity risk). The latter represents the risk appetite of a PE sponsor since it can be interpreted as the intentionally chosen risk level from the perspective of the PE sponsor, given a certain willingness of banks to provide leverage.

We are aware that one major assumption which underlies our risk measure and which we have had to make to allow for the use of standard deviation, is that returns are normally distributed and that this assumption is questionable in the context of PE returns. However, Eling and Schuhmacher (2005) and Eling and Schuhmacher (2007) show that for hedge funds the use of different risk-adjusted performance measures (with changing assumptions with

[42] For example, Acharya et al. (2010) account for different leverage ratios by calculating unlevered returns.

regard to the underlying return distribution) does not change the ranking between different hedge funds. This even holds true if significant deviations in hedge fund returns from a normal distribution exist. We think that these arguments are also applicable to the PE business as both asset classes share common factors with regard to (the distribution of) returns (e.g. illiquidity, opaqueness of asset classes and positive skewness of returns). Consequently, we are confident that the risk measures we introduce are serviceable in assessing risks associated with PE investments.

The second major challenge involved in research on risks in PE investments is to get access to appropriate data sets. The limited availability of reliable data on PE deals has been repeatedly discussed in recent literature (see, e.g., Nikoskelainen and Wright, 2007, Metrick and Yasuda, 2010). For example, in the only study somewhat comparable to ours, the mathematical model of Groh et al. (2008) is empirically applied using a small (40 transactions) and obviously biased sample.[43] In general, empirically reliable evidence on the PE industry, in particular at deal level, is still relatively scarce.

In order to overcome this second major challenge and to shed light on risks associated with PE sponsored buyouts and their relation to returns, we construct a proprietary dataset. We obtain detailed information about the financial structure of buyout transactions and the corresponding cash flows between the buyout companies and their PE sponsors gross of any fees or payments. We end up with a final sample of 460 transactions from North America as well as Western Europe which were acquired between 1990 and 2005. Unlike most previous studies, we do not rely on information about buyouts of public companies but also observe more common private buyout transactions. In considering our sample of international transactions covering different market cycles of the PE industry as an interesting setting for longer temporal analyses, we provide a description of equity volatilities, asset volatilities and default probabilities within the relevant market cycles of the PE markets introduced by Strömberg (2008), i.e. the boom periods between 1995-1999 and 2003-2005, as well as the relative bust periods between 1990-1994 and 2000-2002. We find high equity volatilities in the periods from 1995 to 1999 and 2003 to 2005 accompanying higher probabilities of

[43] The authors themselves confine the explanatory power of their empirical analysis with the following statement: „As it is not the purpose of this paper to calculate idiosyncratic risks of historic transactions, but to propose an approach for benchmarking current and future ones (in which appropriate interest rates can be considered), our simplification seems acceptable."

default. In line with the theoretical predictions of Axelson et al. (2009), we argue that this has been induced by increasing availability of debt and decreasing costs of debt resulting in increasing deal activity and higher leverage levels. Looking at it in detail, there are two potential explanations for this observation. First, PE sponsors may simply be using the improved availability of debt (independent from the costs of debt) which is suggested by their asymmetric risk profile, even at the expense of LPs. This would imply a rather negative view on the use of debt in boom periods and indicate a severe agency conflict between GPs and LPs. Second, our findings could also mean that if more debt is available and costs of debt are not priced adequately, PE sponsors use more inadequately priced debt since the costs for higher probabilities of default are not reflected in the interest rates. This could also be beneficial for the LPs and consequently represents a rather positive view of the use of debt during boom periods.

After investigating the temporal patterns of PE sponsors' risk appetite during boom and bust periods, we intend to shed some light on these issues by addressing the determinants of cross-sectional variation in transaction-level equity risks. We also want to identify relevant buyout company and PE sponsor characteristics, and to find out whether PE market environment patterns found before are robust for the inclusion of several control variables. Indeed, our regressions support the findings from our time series analysis. In addition, deals entered during times of high volatility in public equity markets (representing a high uncertainty with regard to future economic development) exhibit lower equity risks. This implies that the risk appetite of investors in both public and private equity markets is at least partially influenced by similar factors. We also find that larger buyout targets are subject to less equity risk. This finding suggests that PE sponsors do not offset the equity risk-reducing effect of larger firms' lower asset risk by excessive leverage. We continue by showing that an increasing risk exposure of PE sponsors, in terms of the share of ownership they acquire, goes along with decreasing risk appetite. This fits into the view of Axelson et al. (2009) as participation in downside risks (irrespective of leverage) generally increases with the ownership stake. Furthermore, we find that more experienced, higher reputed PE sponsors exhibit less risk appetite. Again, this is convincing evidence supporting the prediction of Axelson et al. (2009) that reputational assets of PE sponsors can mitigate the risk shifting problem. Overall, these findings suggest that some PE sponsors use excessive debt, also at the

expense of LPs, and that certain mechanisms (e.g. ownership stake and reputation) help to align the interests between GP and LP.

Our findings are related to the PE literature in several regards. We contribute to the discourse on deal-level risks associated with PE investing (see, e.g., Cochrane, 2005, Axelson et al., 2010). While other studies do not focus exclusively on buyout investments or only concentrate on leverage (which is only one part of equity risk), we take a more general stance and calculate total equity risk, determined by both the leverage ratio as well as the asset volatility of the buyout target company. Further, we contribute to the current discussion on agency conflicts between GP and LPs (see, e.g., Axelson et al., 2009) and provide evidence that PE sponsors with a strongly pronounced risk appetite do not act in the interest of the LPs.

The remainder of the paper is organized as follows: In Section 2 we mathematically develop our model and provide an intuitive interpretation. Section 3 describes the data set and reports descriptive statistics of the sample. Section 4 provides empirical results for cross-sectional drivers of equity risk. Section 5 summarizes our findings and concludes.

2. The Model

This section presents a new model for pricing equity and debt of buyouts on transaction (firm) level. With the help of this model, the main idea is to calculate an implied volatility, using deal-specific information concerning time horizon, debt and equity prices, average recovery rates, as well as quoted riskless rates and bond spreads.

Following the seminal papers of Black and Scholes (1973) and Merton (1974), the company's equity is seen as a call option on its total value, with its total debt corresponding to the strike price. This accounts for the intuitive fact that a company is forfeited to the debt holders as soon as its total value falls below its total debt. This option-like valuation for highly leveraged firms is also empirically supported (see, e.g., Arzac, 1996, Green, 1984).

The Merton model, assuming constant debt and allowing for no default during the lifetime of the transaction, is, however, too simplistic a model for buyouts. Buyouts are characterized by substantial debt redemptions after the transaction entry and a continuous default risk (see, e.g., Groh et al., 2008). There are several extensions that allow for more realistic assumptions. First, Black and Scholes (1973), Geske (1979) as well as Brockman and Turtle (2003) see equity as a (path-dependent) option that allows for continuous default. However, these models either assume constant debt or neglect the fact that debt usually does not decrease to zero at the end of the investment horizon.

Second, Ho and Singer (1984) present a two-step extension that allows for two redemption payments during the lifetime of the PE transaction. Groh et al (2008) apply this model to price LBOs. This underlying assumption of only two payments during the holding period is, however, unrealistic.

The idea of this paper is to combine these two extensions to gain a more realistic model for pricing equity and debt of buyouts. First, we follow Ho and Singer (1984) and use the following assumptions for a firm value model:

1. The firm's capital structure consists of a single equity and a single debt layer.
2. The yield curve is flat and non-stochastic.
3. Until the maturity of the debt, the firm's investment decisions are known.

4. The firm does not pay dividends and does not make any other contributions to shareholders.
5. Amortization payments are fixed in the indentures.
6. Amortization payments are financed with new equity.
7. Default occurs when the firm (enterprise) value *V(t)* falls below the face value of debt *D(t),* $0 \leq t \leq T$. In this case, the debt holders have the right to take control of the firm and the shareholders need to forfeit the buyout company's assets to the lenders without cost.

While it is mathematically possible to relax most of the given assumptions, the limited availability and level of detail of PE data makes it practically difficult to calibrate more complicated models with many parameters. For this reason we stay at this level of simplification and present the mathematical framework in the next section.

2.1 Mathematical Description

The firm's asset $V(t)$, $0 \leq t \leq T$ are modeled as a Geometric Brownian motion (GBM) with drift μ_V and volatility σ_V:

$$dV(t) = V(t)(\mu_V dt + \sigma_V dW_t), V(0) > 0, \quad (1)$$

where W_t is a standard Brownian motion.

The face value of debt $D(t)$ bears continuous interest at a rate c. The debt holders receive a continuous rate λ that consists of (part of) the interest payments plus a potential amortization payment. Both rates c and λ are assumed to be constant over time. Thus, the face value of debt at time t is given by

$$D(t) = D(0)e^{(c-\lambda)t}, \quad (2)$$

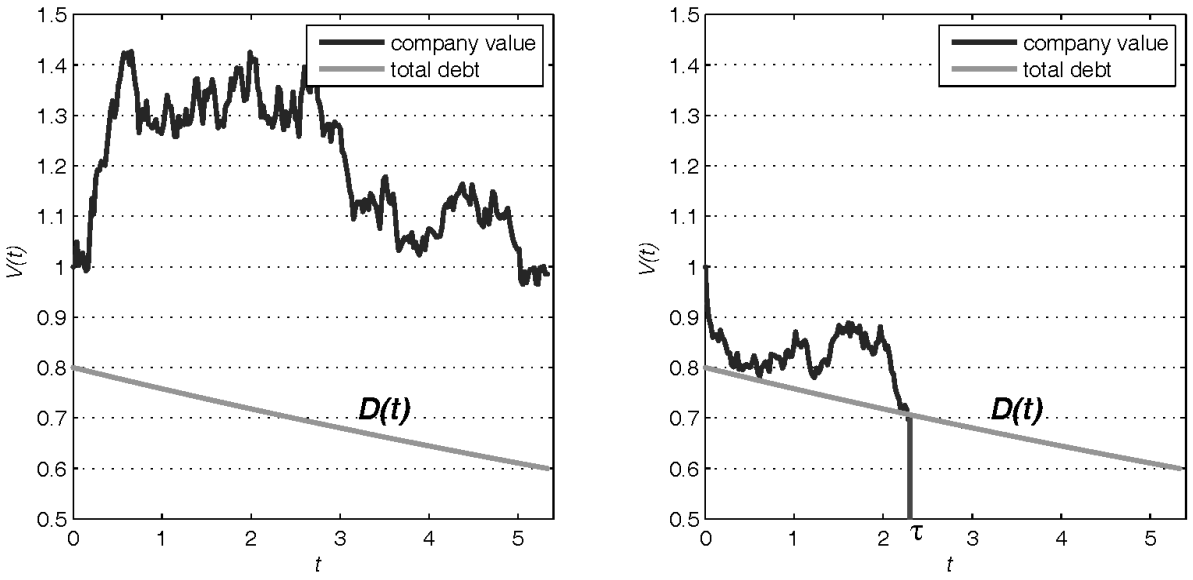
The company defaults when the firm's assets $V(t)$ falls below the face value of debt $D(t)$ (see Assumption (7)). The time to default is the so-called first-passage time τ defined as

$$\tau := \inf\{t : V(t) \leq D(t)\}, \quad (3)$$

Figure II-7 displays the two possible outcomes of a sample PE transaction.[44] While on the left-hand side, the company value (black line) stays above the face value of debt (gray line) until maturity T, the black path on the right-hand side hits the face value of debt and the company defaults. The time to default is the first-passage time τ defined in Equation (3).

Figure II-7: Default Barrier

This figure gives an example of a private equity transaction with parameters: firm's asset value V(0)=1.0, initial face value of debt D(0)=0.8, time to maturity T=5.3, asset drift μ=5.0%, asset volatility σ=18.2%, debt yield c=8.0%, and redemption rate λ=13.4% (one sample transaction from our database). Two samples of the firm value path (black line) were generated using Monte Carlo simulation. The company defaults whenever its value hits the current face value of debt (gray line).

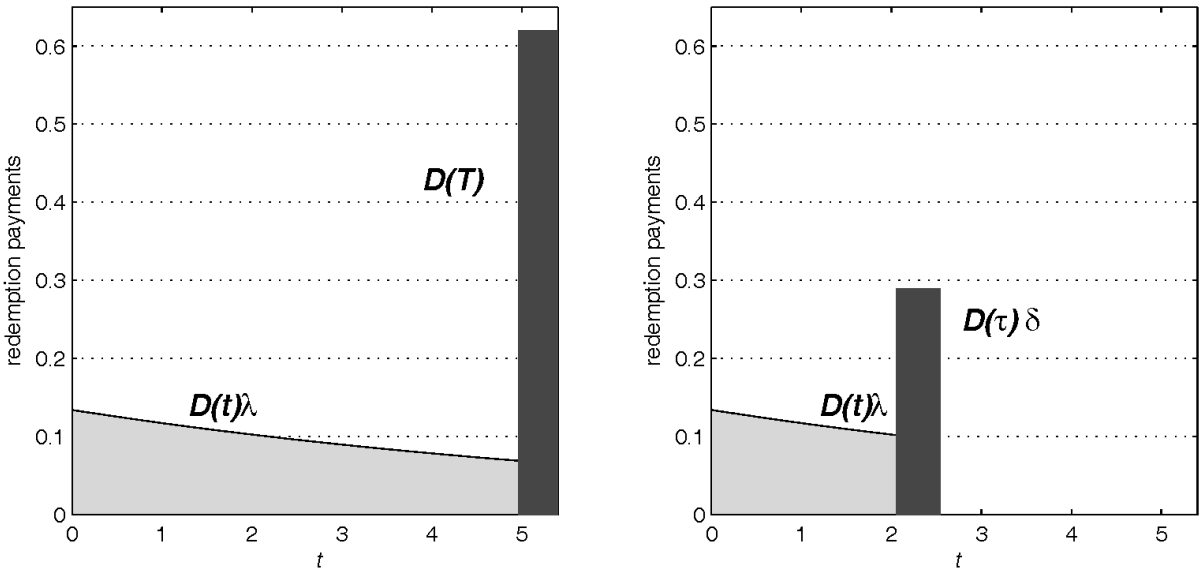


As already mentioned, the debt holders receive the redemption payments of the continuous rate λ until the company either defaults or matures in T. Apart from those redemption payments, the debt holders demand the remaining debt as soon as the transaction is terminated. If the company defaults, they receive $D(\tau)$ times a recovery rate $0 \leq \delta \leq 1$ at time τ, or else the remaining debt D(T) in T. Figure II-8 displays the payments to the debt holders for the two possible cases of no default (left) and default (right).

[44] We randomly picked one transaction from our data set.

Figure II-8: Payments to Debt Holders

Payments to debt holders. This figure shows the payments to the debt holders in case of no default (left) and default (right). The chosen parameters are the same as in Fig. 1, the recovery rate δ is 0.62 (Wilson et al., 2010).



A well-known result by Black and Scholes (1973) is the continuous barrier-hitting probability in the presented continuous setting. Lemma 1.1 summarizes the main findings.

Lemma 1.1. Barrier hitting probability Geometric Brownian Motion

Let V(t) denote a Geometric Brownian motion (GBM) over [0; T] as defined in Equation 1, starting at V(0) > D(0). The barrier level is D(t) = D(0) $e^{(c - \lambda)t}$, d = ln (D(0)/V (0)) is the initial leverage ratio and r the riskless interest rate. The survival probability

$$Q(\tau > T) = Q(V(t) > D(t), \forall t \in [0, T]$$

abbreviated by $\phi^{GBM}_{d,\mu_{\mu*},\sigma_V}(T)$, simplifies to

$$\phi^{GBM}_{d,\mu_{\mu*},\sigma_V}(T) \coloneqq \phi\left(\frac{-d+\mu_{V*}T}{\sigma_V\sqrt{T}}\right) - e^{\frac{2\mu_{V*}d}{\sigma_V^2}}\,\phi\left(\frac{d+\mu_{V*}T}{\sigma_V\sigma\sqrt{T}}\right) \quad (4)$$

where $\mu_{V*} \coloneqq r - c + \lambda - \frac{1}{2}\sigma_V^2$ *and* $\phi(.)$ *denotes the standard normal cumulative distribution function and ln(.) the natural logarithm.*

Proof: If V(t) is a Geometric Brownian motion with drift μ_V and volatility σ_V, then, according to Îto's Lemma, ln(V(t)/D(t)) is a Brownian motion with drift μ_{V*} and volatility σ_V. The corresponding result for Brownian motion is given in Musiela and Rutkowski (2004), p. 61, Lemma 3.2.

If we continuously test for default, the total value of debt $V_D(0)$ can be priced using results on structural credit risk models. For an introduction and more details on those models see, e.g., Scherer and Zagst (2010). $V_D(0)$ is seen as a coupon bond with initial face value D(0) and continuous payments λD(t)dt. Then,[45]

$$V_D(0) = \left[\int_0^T e^{-rt}\lambda\, D(t)dt + e^{-tT}D(T)\right] Q(\tau > T)$$

$$+ \int_0^T \left[\int_0^S e^{-rt}\lambda\, D(t)dt + \delta e^{-rs}D(s)\right] dQ(\tau \le s), \qquad (5)$$

where $dQ(\tau \le s)$ is the density of the first-passage time distribution (see Lemma 1.1).

Equation (5) implies that default can occur at any time during the holding period [0, T]. As soon as the firm's assets V(t) is less than the face value of debt D(t), the equity holders forfeit their company. Equation (5) consists of the survived (first term) and defaulted (second term) firm value paths. Those terms contain the discounted redemption payments $\int_0^{\min(\tau,T)} e^{-\tau t}\lambda D(t)dt$ plus the discounted remaining debt value at maturity ($e^{-rT}D(T)$) or at default ($\delta e^{-r\tau}D(\tau)$).

Theorem 1.2 gives an analytic expression for the bond in Equation (5).

Theorem 1.2. Pricing the face value of debt

The total value of debt $V_D(0)$ can, under the risk-neutral measure $\mathbb{Q}$ with riskless interest rate r, be priced as

$$V_D(0) = -D_0\frac{\lambda}{c-r-\lambda} + D_0 e^{(c-r-\lambda)T}\frac{c-r}{c-r-\lambda}\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*},\sigma_V}(\mathrm{T})$$

[45] $V_D(0)$ is the general formula for the market price of defaultable debt. Note that in the case of λ > c, the face value of debt decreases over time, while it increases for λ < c. Also note that the spread c is a par spread, i.e. at the closing of the transactions it is set such that D(0) = $V_D(0)$.

$$+ D(0)\mathrm{e}^{-\frac{\mathrm{d}(\breve{\mu}-\mu_{V*})}{\sigma_V^2}}\left(\delta+\frac{\lambda}{\mathrm{c-r-\lambda}}\right)(1-\Phi^{\mathrm{GBM}}_{\mathrm{d},\breve{\mu},\sigma_V}(\mathrm{T})), \tag{6}$$

where the notation is the same as in Lemma 1.1, $\mu_{V*} = r - c + \lambda - \frac{1}{2}\sigma_V^2, \breve{\mu}_{V*} =$

$\sqrt{(\mu_V)^2 * +2(c-r-\lambda)\sigma_V^2}$, $d = ln(D(0)/\,V(0))$ *and* $\lambda \neq c - r$.

Proof. It holds that

$$\int_0^{\min(\tau,T)} e^{-rt}\,\lambda D(t)dt = D_0\int_0^{\min(\tau,T)} e^{(c-r-\lambda)t}\,\lambda dt = D_0\frac{\lambda}{c-r-\lambda}(e^{(c-r-\lambda)\min(\tau,T)}-1)$$

Equation (5) can then be rewritten as

$$V_D(0) = \left[D(0)\frac{\lambda}{c-r-\lambda}\left(e^{(c-r-\lambda)\mathrm{T}}-1\right)+e^{-rT}D(T)\right]\mathbb{Q}(\tau>T)$$

$$+\int_0^T\left[D(0)\frac{\lambda}{c-r-\lambda}\left(e^{(c-r-\lambda)\mathrm{s}}-1\right)+\delta e^{-rs}D(s)\right]d\mathbb{Q}(\tau\le s)$$

$$= -D(0)\frac{\lambda}{c-r-\lambda}+D(0)\,e^{(c-r-\lambda)\mathrm{T}}\frac{c-r}{c-r-\lambda}\,\mathbb{Q}\,(\tau>T)$$

$$+D(0)\left(\delta\frac{\lambda}{c-r-\lambda}\right)\int_0^T e^{(c-r-\lambda)s}d\mathbb{Q}(\tau\le s).$$

The latter integral is solved in Scherer and Zagst (2010), Theorem 3.3.

$$\int_0^T e^{(c-r-\lambda)s}d\mathbb{Q}(\tau\le s) = e^{-\frac{d(\breve{\mu}_{V*}-\mu_V)}{\sigma_V^2}}(1-\Phi^{\mathrm{GBM}}_{\mathrm{d},\breve{\mu}_{V*},\sigma_V}(\mathrm{T})),$$

with the notation of Lemma 1.1, $\mu_{V*} = r - c + \lambda - \frac{1}{2}\sigma_V^2$, and $\breve{\mu}_{V*} = \sqrt{\mu_{V*}^2 + 2(c-r-\lambda)\sigma_V^2}$.

Then,

$$V_D(0) = -D(0)\frac{\lambda}{c-r-\lambda}+D(0)e^{(c-r-\lambda)T}\frac{c-r}{c-r-\lambda}\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*},\sigma_V}(\mathrm{T}))$$

$$+\mathrm{D}(0)\mathrm{e}^{-\frac{\mathrm{d}(\breve{\mu}_V-\mu_V)}{\sigma_V^2}}\left(\delta+\frac{\lambda}{\mathrm{c-r-\lambda}}\right)(1-\Phi^{\mathrm{GBM}}_{\mathrm{d},\breve{\mu}_{V*},\sigma_V}(\mathrm{T})).$$

Theorem 1.2 can be applied to obtain an implied asset volatility σ_V using data on d, T, r, λ, and δ. This can, for example, be achieved using Brent's algorithm (see, e.g., Brent, 1973).

The following results in Theorem 1.3 can then be used to retrieve an equity volatility σ_E from the asset volatility σ_V. The proof is an application of Îto's Lemma and can be found in Schönbucher (2003), p. 276.

Theorem 1.3. Equity volatility.

With the notation of Lemma 1.1, it holds that

$$\sigma_E = \sigma_V \frac{\partial V_E(0)}{\partial V(0)} \frac{V(0)}{V_E(0)}, \tag{7}$$

where $V_E(0)$ denotes the initial equity value of the firm.[46]

Using the results of this section, we are able to calculate deal-specific asset and equity volatilities. The application to a large PE data set is shown in Sections 3 and 4.

2.2 Intuitive Explanation

Before empirically applying this model, we first provide an intuitive interpretation in order to outline the rationale behind the mathematical model and its application in the PE context. The basic sequence of actions is as follows:

1. The parties arranging a buyout transaction (incl. the seller of a company, PE sponsor and banks) make assumptions about the future development, especially future cash flows, of the buyout target and conduct different scenario analyses. These forecasts are based on various assumptions and conditions (e.g. expected holding period of the PE sponsor, revenue development of the company, etc.). Since a PE transaction implies a total recapitalization of the company, they do not consider the existing capital structure of the buyout company.

[46] The calculation of $\partial V_E(0)/\partial V(0)$ is shown in Appendix.

2. As a result, the parties agree on a certain enterprise value [$V(0)$]. This price to be paid is partly financed with debt [$D(0)$] at cost [c]. The remaining sum (delta of enterprise value and debt value) is covered with equity from the PE sponsor's fund [$E(0)$].[47] The parties' assumptions about future developments determine the price paid and the transaction structure that is imposed. The final capital structure is supposed to secure the desired return on equity for the PE sponsors on the one hand, but at the same time the company must be capable of servicing the debt providers' requirements regarding redemption and debt covenants. In other words, PE sponsors intend to increase leverage (as it increases expected equity return) as much as possible given that debt providers' requirements can be met.

3. Consequently, the involved parties implicitly assume certain volatilities in the target company's asset (σ_V) and equity (σ_E) values when they agree on debt and equity prices. This implies that a company with relatively low inherent (unlevered) asset volatility, e.g. a company in a stable industry, is less likely to default in terms of debt payments and is therefore more highly levered.

4. The deal-specific equity risk calculated by our model reflects the equity risk borne by a PE sponsor. Since the equity risk is mainly determined by the buyout target's asset volatility and its specific financing structure, i.e. debt to equity ratio, it can also be interpreted as the risk appetite of a PE sponsor. However, it is reasonable to assume that banks might (at least sometimes) restrict the maximum accepted debt level. Consequently, PE sponsors are not always able to use the desired financing structure fully corresponding to their risk appetite.

[47] Note that we assume that the market value of equity $V_E(0)$ equals the value of the equities E(0) paid by the PE sponsor's fund.

3. Data description

3.1 Data Sources and Sample Selection

Our initial sample of 1,290 buyout transactions initiated between 1990 and 2005 is drawn from proprietary databases of two international PE funds-of-funds. When considering investing into a PE fund, these investors request detailed information on historical transactions managed by the PE sponsor. This information is a key element of their fund due diligence process. The PE funds-of-funds grant us access to all information they possess (in anonymous form), irrespective of their final investment decision. This means we have information on deals sponsored by a variety of PE firms and the investment pattern exhibited by the PE funds-of-funds is not a source of sample selection. Nevertheless, as these investors are more likely to engage in due diligence processes with previously successful PE sponsors, there is likely to be a bias in our sample towards deals from more successful funds.

While all of the buyouts included in our initial sample have been realized, i.e. the PE sponsor has already sold the company, a substantial share of these transactions does not meet the data requirements as imposed by our mathematical model. We remove all buyouts with missing values for variables which are relevant for our model (581 transactions). Because we do not consider “quick flips", i.e. short-termed investments in which PE sponsors do not aim at realizing the actual value potential of the buyout firms, to be PE (Kaplan and Strömberg, 2009), we also delete all transactions for which the reported holding period, i.e. the time span between acquisition and exit, is six months or shorter (11 transactions). Finally, for some transactions the final debt levels reported in the databases exceed the compounded initial debt. In these cases, the companies were apparently financed with further external capital within the holding period. As our model does not allow for such additional financing rounds (if not anticipated at investment entry) we discard these 168 deals. In addition, we have to remove 70 deals for which certain deal-related data is not available (e.g. industry affiliation of the target company, PE sponsor characteristics etc.), ending up with 460 buyouts.

We identify the 5-Year US Treasury Notes at the date of transaction as proxy for the riskless interest rate [r]. We decide to use this maturity as it is closest to the holding periods said to be characteristic for buyouts (e.g. six years as reported by Strömberg, 2008) and similar to those observed in our sample. The default spread consists of an interbank rate and a

deal-specific spread. In order to obtain information on these loan characteristics, we use Reuters' LPC DealScan database (DealScan).[48] DealScan reports comprehensive information on syndicated loan deals sponsored by PE firms. We were able to match 95 of our total 460 transactions in the final sample. For these deals DealScan provided information on the interbank rate underlying the loans and the size and spread of each debt tranche. The spreads were all based on the London Interbank Offered Rate (LIBOR) or the Euro Interbank Offered Rate (EURIBOR). Historical data is publicly available for both rates and we retrieved them from the European Central Bank.[49] We calculate the corresponding historical offered rate for each of the 95 matched deals in our sample by using the geometric mean of all monthly interbank rates during the holding period of the transaction. Further, we compute the tranche size-weighted average spread for each matched deal. By adding up the interbank base rate and the weighted total spread for each of the matched deals we obtained the total cost of debt [c].

We fill the missing values of the default spread for the other 365 deals we were unable to find in DealScan by imputation. Imputation is a procedure which has been shown to be superior to ad-hoc filling of missing data in finance research (Kofman and Sharpe, 2003) and is common among other researchers in the field (see, e.g., Bernstein et al., 2010). We impute missing default spreads by constructing fitted values from a regression of default spreads on deal size, the ratio of net debt to equity, the ratio of net debt to EBITDA, the yield spread on corporate bonds (Moodys BAA bond index) on the risk-free rate over time, a dummy variable distinguishing European and North American deals, and industry variables.

Further, since our model allows for default during the holding period of the PE sponsor we have to make assumptions about the debt recovery rate [δ] in case of default. In line with Wilson et al. (2010) we assume a recovery rate of 62% throughout the paper.[50] With regard to the calculation of Lambda [λ], i.e. the continuous rate the debt holders receive (including interest and debt redemption payments), we calibrate λ using the equation $D(t) = D(0)e^{(c-\lambda)t}$ and $D(0)$, $D(T)$ from our database. In other words, since all transactions used in

[48] Data from DealScan was retrieved while Reiner Braun was a visiting researcher at Said Business School, Oxford University.

[49] http://sdw.ecb.europa.eu.

[50] Wilson et al. (2010) report a recovery rate of 62-63% for secured debt of PE-backed firms which is more than twice the recovery rate of public companies.

our analyses are already realized we can resort to the actual value of debt at investment exit in order to make assumptions about [λ].

In addition, in order to calculate variables relating to the PE sponsor experience at the time of each transaction we use Thomson Venture Economics (TVE). First, we count the number of transactions the respective PE firm had historically sponsored before the deal at hand as reported in TVE. Second, we calculate the total assets under management of the PE sponsor accumulated in the five years before each transaction. Finally, in order to account for the volatility in public equity markets we use the MSCI website[51] to obtain data on the MSCI World index.

3.2 Sample Characteristics and Representativeness

Table II-24 provides descriptive statistics of our sample. While most studies dealing with data on buyout-level are either from Western Europe (including the UK) or North America (the US and Canada), our data set covers both regions which represent the lion's share (about 95%) of the global PE market in the years between 1990 and 2005 (Kaplan and Strömberg, 2009). However, our study is overweighting Western European buyouts as 77% of our transactions are from this region, while they accounted for only 42% of the total number of global transactions in the PE universe (Kaplan and Strömberg, 2009). This bias is due to the focus of due diligence activities of the funds-of-funds providing us with data.

The enterprise values at entry [V (0)], i.e. when the buyout company is acquired, in our final sample range from 0.9 to 8,800 million US dollars, with a mean of 239 million US dollars and a median of 78 million US dollars. These numbers are quite similar to those of the entire PE universe with a mean of 318 million US dollars and a median of 61 million US dollars as reported by Strömberg (2008) for the period between 1970 and 2007.

Our sample shows that the repayment of debt imposed at the time of acquisition is a key element of PE sponsors' business model. While the median equity value at entry [E (0)] is 30.5 million US dollars, it increases to 99.1 million US dollars at exit [E(T)]. Conversely, the median net debt value at entry [D (0)] is 48 million US dollars and decreases to 34.5 million

[51] http:///www.mscibarra.com.

US dollars at exit [$D(T)$]. This development becomes apparent in the drop of the net debt to equity ratio over the holding period [T] from 1.6 to 0.4.

Table II-24: Descriptive Statistics

This table presents summary statistics for our final sample of 460 leveraged buyout transactions. Equity IRR is calculated from monthly cash flows between private equity (PE) sponsor and the portfolio company gross of fees and carried interest in percent. It is the discount rate that equates the present value of the cash flows to zero in percent. We winsorized this variable at the 95th percentile in order to account for outliers. Enterprise, equity, and net debt values at entry are the amounts in millions of US dollars at the time when the buyout company was acquired by the private equity sponsor. In turn, the values at exit are the amounts in millions of US dollars when the PE sponsor sold the buyout company to someone else. Holding period is the time span in years between entry and exit. Similarly, we report the net debt to equity ratios at both points in time for each deal. We report the ownership stake of the PE sponsor at investment entry which is the share of equity the PE sponsor buys at entry. For 152 transactions in our final sample the data sets provided by the funds-of-funds included explicit information on the share of equity that was purchased by the PE sponsor. For all remaining transactions, we calculated the PE sponsor's ownership stake by dividing the reported investment sum by the reported total equity value. PE number of deals is the number of historical buyout transactions by the respective PE sponsor at the time of the transaction as reported by Thomson Venture Economics. PE assets under management are the amount of the total assets under management (in millions of US dollars) of the PE sponsor accumulated in the five years before investment entry as reported by Thomson Venture Economics. MSCI World Index Volatility is the average volatility (standard deviation) in the last twelve months (LTM) prior to the investment entry date of the respective PE transaction of the MSCI World Stock Index.

	Variable	Notation	n	Mean	Median	Std. Dev.	Min.	Max
(1)	Equity IRR [% p.a.]		460	45.0	33.5	58.2	-100.0	212.5
(2)	Enterprise Value at Entry [$m]	V(0)	460	238.5	78.0	556.1	0.9	8,800.0
(3)	Enterprise Value at Exit [$m]	V(T)	444	458.6	142.1	1,041.7	0.2	14,086.7
(4)	Equity Value at Entry [$m]	E(0)	460	85.9	30.5	236.8	0.3	4,100.0
(5)	Equity Value at Exit [$m]	E(T)	402	340.3	99.1	925.6	-216.5	13,167.7
(6)	Net Debt Value at Entry [$m]	D(0)	460	152.6	48.0	337.8	0.7	4,700.0
(7)	Net Debt Value at Exit [$m]	D(T)	452	125.3	34.5	275.6	-99.0	2,548.4
(8)	Net Debt/Equity at Entry		460	2.2	1.6	2.5	0.0	25.0
(9)	Net Debt/Equity at Exit		401	0.6	0.4	1.5	-2.7	23.7
(10)	Holding Period [years]	[T]	460	4.7	4.1	2.5	0.6	13.8
(11)	PE Ownership Stake [%]		460	59.2	61.0	34.6	0.1	100.0
(12)	PE Number of Deals		460	187.7	34.0	384.4	0.0	1,599.0
(13)	PE Assets Under Management [$m]		418	1,892.5	681.8	2,247.0	20.8	9,826.0
(14)	MSCI World Index Volatility		458	1.5	1.6	0.5	0.1	2.8

The median deal-level equity internal rate of return (IRR) gross of carried interest and any management fees in our final sample is 33.5%. This median return is similar to comparable studies dealing with deal-level returns of buyouts (see, e.g., Lopez-de Silanes et al., 2009, Acharya et al., 2010). Again, the fact that the funds-of-funds granted us access to their entire databases irrespective of the investment decision largely precludes that there would be any positive bias in our sample.

The median PE sponsors' ownership stake in a buyout target is 61% at investment entry. It should be mentioned that our data set only includes explicit information on the ownership stake of the PE sponsor for 152 deals. For the residual 308 transactions we calculate the ownership stake by dividing the total capital invested by the PE sponsor by the total equity value at investment entry. Given that equity injections during the holding period (not related to the purchase price) are relatively uncommon in buyout transactions, this simplification seems acceptable (see, e.g., Nikoskelainen and Wright, 2007).

From Panel B of Table II-25 it can be derived that around 44% (203 out of 460) of our sample transactions occurred between 1995 and 1999, compared to 29% in the same period in the PE universe according to Strömberg (2008). While the relative shares of transactions in our sample are representative for the periods 1990-1994 and 2000-2002 the overweighting in the late 1990s is at the expense of more recent deals between 2003 and 2005. While these buyouts make up 20% in our sample they account for 38% of the deals in the period between 1990 and 2005 in Strömberg (2008).

Altogether, even though our final sample is more representative of the universe of buyouts in comparison to most previous research, our study still has a bias towards European deals and buyouts carried out in the late 1990s. However, as we will show in the cross-sectional analyses our main results are robust in controlling for region, size and time.

4. Equity Risk in Buyout Investments

In this section we analyse the risk appetite of PE sponsors reflected in deal-level equity volatilities. The first part deals with patterns of PE sponsors' risk appetite over time, i.e. in different cycles of the PE market. In the second part we report the results of cross-sectional analyses to assess the role of several drivers explaining equity volatility variation among PE transactions. We put a particular emphasis on factors related to the PE sponsor.

4.1 Time Trends

Table II-25 shows summary statistics on the equity volatilities, i.e. the standard deviations resulting from our model, over time in our dataset grouped by investment year (Panel A) and PE market cycles (Panel B) according to Strömberg (2008). These volatilities represent the annual implied equity volatilities for the individual transactions and are calculated with our mathematical model. The mean and median values in the entire final sample are 80% and 72% respectively. This is considerably higher than the average firm equity volatility of 51.3% p.a. and the median firm equity volatility of 43.6% p.a. reported by Choi and Richardson (2008) who calculate the implied equity volatility for over 150,000 public companies. However, given that in general PE-backed firms have higher leverage ratios (which, ceteris paribus, increases equity risk) this result is intuitive (see, e.g., Guo et al., 2010). This finding confirms the general feeling that PE deals are particularly risky, at least from the perspective of equity investors. In line with this argument, Cochrane (2005) reports an annualized standard deviation of equity returns of 89% for a sample of VC-backed firms. Taking into consideration that Cochrane (2005) also analyses VC investments, which are thought to be even more risky than buyout transactions, this finding is intuitive.

Our equity risk numbers reflect the risk appetite of a PE sponsor in the sense that they are mainly determined by the buyout target's asset volatility and its specific financing structure. Both factors can be influenced by the PE sponsor. Even if one argues that the financing structure is mainly determined by the willingness of banks to provide debt, since the PE sponsor always takes as much debt as possible, it is still the choice of a PE sponsor to choose a company with a relatively high or low asset volatility. As Table II-25 shows banks do not always offset investments in companies with high asset volatilities by providing less debt, which would imply a constant equity risk for all deals. Significant rank sum tests indicate

considerable fluctuations of equity risk levels over time. Overall, our results imply that it is reasonable to assume that the PE sponsor can significantly influence this process, especially during boom periods when banks have a relatively pronounced risk appetite.

In this context, Table II-26 shows the mean and median asset volatility and net debt to equity ratio grouped by the same PE market cycles as table II-25. Interestingly, our mean and median asset volatility of 32% and 27% respectively is considerably lower than the mean and median asset volatility of 40% and 31% reported by Choi and Richardson (2008). This finding supports the assumption that appropriate buyout targets are companies with low inherent asset volatilities. However, given the relatively high equity risks of buyout transactions, PE sponsors obviously offset the low asset volatilities by deploying high leverage ratios. In this context Table II-26 also reveals another interesting observation. The relatively high mean asset risk of 38% for deals conducted in the 2003-2005 period is very close to the result by Choi and Richardson (2008) which indicates that during boom periods, which in general are accompanied by increasing fundraising activity, higher investment pressure might induce PE sponsors to invest in less appropriate companies, i.e. companies with more volatile cash flows and consequently higher asset risk. This could be due to the fact that elevated supply of capital meets a relatively inflexible demand, i.e. a somewhat given pool of appropriate buyout companies. This is an intuitive assumption as there are only a limited number of appropriate buyout companies, i.e. firms that produce stable and predictable cash flows allowing the forecasting of interest payment and debt repayment schemes over any given holding period (Opler and Titman, 1993). This finding is in line with the over-investment problem described by Axelson et al. (2009).

Table II-25: Equity Risk over Time

This table presents summary statistics on the computed equity risk from our model across time. In Panel A we sort the leveraged buyout transactions according to the entry year, i.e. the year when it was acquired by the private equity (PE) sponsor. In Panel B, we classify the transactions into four categories which represent different cycles of the PE market based on Strömberg (2008). Each transaction is assigned to a category based on the entry year. At the bottom of Panel B we report tests on the significance of time trends based on the four time categories with two methods: On the left-hand side we report t-tests to test on the equality of means. On the right-hand side we report Wilcoxon rank-sum (Mann–Whitney) tests (equality test of unmatched data). *, **, and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. A (+) indicates that the latter of both comparison groups has a significantly higher mean or median value, a (−) indicates a lower value.

	No. of Deals	Equity Risk			
		Mean	Median	Min	Max
Panel A: Investment year					
1990	1	0.64	0.64	0.64	0.64
1991	11	0.71	0.68	0.36	1.00
1992	8	0.85	0.75	0.47	1.62
1993	13	0.74	0.74	0.28	1.42
1994	15	0.86	0.68	0.41	2.04
1995	19	0.95	0.90	0.34	2.01
1996	34	0.95	0.79	0.44	2.51
1997	48	0.90	0.75	0.29	2.99
1998	39	0.73	0.69	0.21	1.48
1999	63	0.76	0.67	0.29	1.79
2000	47	0.70	0.66	0.34	1.68
2001	33	0.69	0.63	0.34	1.59
2002	38	0.64	0.63	0.31	0.97
2003	35	0.89	0.76	0.38	2.27
2004	33	0.81	0.82	0.46	1.42
2005	23	1.02	0.90	0.65	2.89
Total	*460*	*0.80*	*0.72*	*0.21*	*2.99*
Panel B: Time Categories					
1990-1994	48	0.79	0.68	0.28	2.04
1995-1999	203	0.84	0.73	0.21	2.99
2000-2002	118	0.68	0.64	0.31	1.68
2003-2005	91	0.89	0.82	0.38	2.89
Total	*460*	*0.80*	*0.72*	*0.21*	*2.99*
1990-1994 vs. 1995-1999		(+)	(+)		
1995-1999 vs. 2000-2002		(-)***	(-)***		
2000-2002 vs. 2003-2005		(+)***	(+)***		

Table II-26: Asset Risk and Debt to Equity Ratio over Time

This table presents summary statistics on the computed equity risk from our model across time. In Panel A we sort the leveraged buyout transactions according to the entry year, i.e. the year when it was acquired by the private equity (PE) sponsor. In Panel B, we classify the transactions into four categories which represent different cycles of the PE market based on Strömberg (2008). Each transaction is assigned to a category based on the entry year. At the bottom of Panel B we report tests on the significance of time trends based on the four time categories with two methods: On the left-hand side we report t-tests to test on the equality of means. On the right-hand side we report Wilcoxon rank-sum (Mann–Whitney) tests (equality test of unmatched data). *, **, and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. A (+) indicates that the latter of both comparison groups has a significantly higher mean or median value, a (−) indicates a lower value.

	No. of Deals	Asset Risk				Debt to Equity			
		Mean	Median	Min	Max	Mean	Median	Min	Max
1990-1994	48	0.34	0.27	0.09	1.01	2.61	1.59	0.03	17.50
1995-1999	203	0.31	0.27	0.06	1.01	2.59	1.82	0.06	25.00
2000-2002	118	0.29	0.25	0.07	1.10	1.83	1.56	0.13	7.13
2003-2005	91	0.38	0.32	0.02	1.22	2.56	1.62	0.01	71.65
Total	*460*	*0.32*	*0.27*	*0.02*	*1.22*	*2.39*	*1.64*	*0.01*	*71.65*
1990-1994 vs. 1995-1999		(-)	(-)			(-)	(+)		
1995-1999 vs. 2000-2002		(-)	(-)			(-)***	(-)**		
2000-2002 vs. 2003-2005		(+)***	(+)***			(+)	(+)		

Another intuitive and interesting observation from Table II-25 is the high average equity volatilities in the periods from 1995 to 1999 and 2003 to 2005. The period after 1994 was a period with increasing deal activity after the burst of the first leverage buyout bubble around 1990 (Guo et al., 2011). Similarly, the period beginning after 2003 is considered to be a boom period in the PE market (see, e.g., Axelson et al., 2010) with increasing deal activity, decreasing costs of debt and, consequently, high leverage levels. This situation emerged out of the bust period between 2000 and 2002 after the bursting of the dot.-com bubble. This can be seen in a sharp decline of deals observed in our sample and the considerably lower equity risk compared to the late 1990s.[52] The patterns of risk appetite of PE sponsors shown in Panel B of Figure 4 are intuitively in line with the market cycles of the PE market.

[52] The most recent period 2003-2005 contains relatively few deals considering that it is a boom period of the PE market. This is a direct result from our sampling requirement since we can only use realized deals for calculating equity risk. Hence, at the time the fund-of-fund investors obtained information on these deals, fewer deals entered in the most recent period were realized, even though deal activity was relatively high.

We argue that these findings result from agency problems inherent in the PE business in combination with loose debt market conditions. PE funds are limited partnerships with the PE sponsor acting as the GP who manages the fund. Institutional or other investors are LPs and provide most of the capital. In turn, PE sponsors only provide a relatively small amount of the capital (typically about 1 percent) (Kaplan and Strömberg, 2009). PE sponsors as fund managers are (at least) compensated through management fees and a share of the profits of the fund (carried interest).

As described by Axelson et al. (2010) PE sponsors have an incentive to use as much leverage as possible for each transaction since they hold a call-option-like stake in the fund. Through the carried interest they disproportionately participate in the up-side potential of the fund, while being exposed to a limited downside risk only, which is mainly borne by the LPs as providers of most of the capital invested. In other words, the equity stakes in the PE sponsor's portfolio companies, which can be seen as call options on the firm values, increase in value if the volatilities of the underlying assets, i.e. the volatility of the PE-backed firms, increase.

However, while this argumentation explains why PE sponsors generally prefer risky deals it does not sufficiently explain the increasing risk appetite from 2003 onwards. A closer look at the debt markets during this period could help to find another pattern of explanation. First, in times of favorable debt market conditions PE sponsors are simply able to use more debt to finance a transaction as banks probably demand a lower minimum equity stake from a PE sponsor. Given their asymmetric payoff profile they use as much debt as possible. Second, as Axelson et al. (2010) and Demiroglu and James (2010) show, the overall debt financing terms for PE sponsors improved considerably after 2003. If costs of debt are not priced adequately due to overheating debt markets it might be rational for any investor to use more inadequately priced debt since the costs for higher probabilities of default are not reflected in the interest rates. This means in the present context that equity volatility in PE market boom periods increases. Furthermore, in addition to the increased use of leverage, PE sponsors also invest in companies with higher asset volatilities as shown in Figure 5. Apparently, both factors explain the significant increase in equity risk.

Table II-27 shows that the increased risk appetite of PE sponsors during PE market boom periods also has a downside as default risk increases as well. The assumed ex-ante median

probability that a PE company will default within the first year after the buyout increased from about 2% in 2000-2002 to more than 5% in 2003-2005. The average and median default rates for the whole sample are 4.3% and 3.5% respectively. This supports the notion of an incentive conflict between the PE sponsor on the one side and LPs as well as other stakeholders of the company, e.g. employees and creditors, on the other side, as PE sponsors, at least partially, try to shift risks from themselves to others.

With regard to the explanatory power of our model, a comparison with other studies delivers encouraging results. Given that the probability of default in our model is at a maximum in the first year after the PE sponsor acquired a company (due to high interest and redemption payments) this number is comparable to the average annual default rates of 1.2% and 2.8% per year in Strömberg (2008) and Jason (2010), respectively, neither of whom account for the fact that the probability of default is not equally distributed over the holding period.[53]

[53] For example, our median default rate of 3.5% is not an annualized default rate over the holding period, but the probability that a firm defaults within the first year after the buyout. In year two, three, etc. the probability of default decreases.

Table II-27: Default Probabilities

This table reports yearly summary statistics on the probabilities of default of buyout targets for the first year after the private equity (PE) sponsor acquired a company over the period from 1990 to 2005. The numbers are calculated based on the model introduced in this study. In this model a company defaults when the enterprise value falls below the value of debt. We sort the leveraged buyout transactions according to the entry year, i.e. the year when it was acquired by the PE sponsor. At the bottom we report tests on the significance of time trends based on the four time categories applying mean comparison tests (ttests) and Wilcoxon rank-sum (Mann–Whitney) tests. *, **, and *** indicate statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively. A (+) indicates that the latter of both comparison groups has a significantly higher mean or median value, a (−) indicates a lower value.

	No. of Deals	Default Probability			
		Mean	Median	Min	Max
1990-1994	48	4.35%	3.03%	0.00%	22.41%
1995-1999	203	4.92%	4.52%	0.00%	16.54%
2000-2002	118	2.38%	1.91%	0.00%	10.92%
2003-2005	90	5.59%	5.41%	0.27%	15.44%
Total	*459*	*4.34%*	*3.53%*	*0.00%*	*22.41%*
1990-1994 vs. 1995-1999		(+)	(+)		
1995-1999 vs. 2000-2002		(-)***	(-)***		
2000-2002 vs. 2003-2005		(+)***	(+)***		

In Section 4.2 we will extend the explanatory power of our results by conducting multiple regression analyses using equity volatility as dependent variable.

4.2 Regression Analysis

In our analyses of drivers of deal-level risk appetite we focus on buyout company size, PE sponsor experience and equity risk exposure, public market volatility, and, finally, the PE market cycles introduced in Section 4.1.

To begin with, larger buyout companies are assumed to have a higher lending capacity as they are less risky (Nikoskelainen and Wright, 2007, Halpern et al., 2009) and less exposed to asymmetrical information (Chen, 1983, Chan et al., 1985). In addition, larger companies are assumed to be more diversified and consequently less exposed to industry shocks. According to this argument, we would expect larger companies to have lower asset volatilities, which, ceteris paribus, would result in lower equity volatilities. However, the lower asset risk of larger companies might be offset or even outweighed by more leverage deployed by the PE sponsor. If this holds, we would rather expect larger buyout companies to have higher equity volatilities. Since there are arguments in both directions it remains an empirical question. We address this question by including the logarithmized enterprise value of the buyout company at investment entry in our regressions.

Regarding PE sponsor characteristics, more experienced PE sponsors are thought to be more reputable (Gompers and Lerner, 2000, Kaplan and Schoar, 2005). As reputation can be an important competitive advantage, e.g. in terms of lending capacity (Demiroglu and James, 2010, Ivashina and Kovner, 2010), especially in the PE industry, more reputed PE sponsors would not risk their reputation by taking excessive risks (Diamond, 1989). Therefore, we expect a negative relation between PE sponsor reputation and equity risk. In order to assess this relationship we include the logarithmized number of previously completed deals by the respective PE sponsor at investment entry as proxy for PE sponsor reputation (Demiroglu and James, 2010). As the measures of PE sponsor experience are controversially discussed in the literature (e.g. Gompers and Lerner, 1999) we also use the logarithmized total assets under management of the PE sponsor accumulated in the five years before investment entry as proxy for PE sponsor experience (Gompers and Lerner, 1999, Kaplan and Schoar, 2005).

Another PE sponsor-related deal characteristic is its ownership stake in the company which can be interpreted as the equity risk exposure. While in a typical buyout transaction the PE sponsor purchases majority control (Kaplan and Strömberg, 2009), the ownership stake,

and accordingly the equity risk exposure, varies. The intuition behind this is that if a PE sponsor owns a large part of the equity value, the willingness to take excessive risks might be reduced. This argument fits into the concept of equity stakes as call options on firm values (Axelson et al., 2009). If the PE sponsor provides a higher share of the enterprise's equity value the downside risk, ceteris paribus (in particular regarding leverage levels), increases. We expect a negative relation between PE sponsor ownership and equity risk. Accordingly, we include the total capital invested by the PE sponsor divided by the total equity value at investment entry in our regressions.

Apart from company- and PE sponsor-related characteristics, it is reasonable to assume that the conditions of public equity markets also have an influence on the chosen deal-level equity risk. Very volatile public equity markets may indicate a relatively high uncertainty with regard to future economic development which could lead to a reduced risk appetite among all participants in both public and private equity markets. In order to test for these more general market effects we assign the average volatility of the MSCI World Index in the last twelve months (LTM) before the entry date of a specific PE transaction to each deal. Considering that we have a regionally diverse sample of European and North American transactions, the MSCI World Index may be the best measure to account for worldwide market volatility and is consequently the best proxy for the level of uncertainty about future economic development. As a result, we expect a negative relationship between LTM public market volatility and deal-level equity risk.

In order to account for the effects of PE market cycles outlined in Section 4.1 we include time dummies to control for systematic time patterns in the buyout market. Again, we resort to the PE market cycle time categories introduced by Strömberg (2008) and described above.

Furthermore, there are some other standard factors we include in our analysis: First, to control for significant systematic differences between European and North American deals a dummy variable is used which adopts a value of 1 if the PE transaction took place in Europe and a value of 0 if the deal took place in North America. Second, we include eight ICB industry dummies to control for industry specific risks.

Table II-28 shows the regression results on our final sample of 460 buyout transactions using the equity volatility resulting from our model as a dependent variable. We use the logarithmized value in our regression analysis since equity volatility can only take non-negative numbers. In our first specification, which only includes the volatility of the MSCI World Stock Market Index before the transaction, our PE market cycles and control variables, we find that deals conducted in a relatively bullish economic environment (i.e. the periods between 1995-1999 and 2003-2005) are riskier than those carried out during the relatively bust period during the years 2000-2002 that we use as reference category. For instance, buyout transactions entered between 2003 and 2005 have a 26% ($e^{0.23}$ = 1.26) higher equity risk compared to the deals entered during the period 2000-2002. The coefficients for the boom periods of the PE market are highly significant throughout all specifications and strongly support our findings concerning time patterns reported in Section 4.1.

Throughout all specifications we find a significantly (5% and 1% level) negative relation between the LTM volatility of the MSCI World Index and deal-level equity risk. For example, a 10% increase from the mean MSCI World volatility of 1.52 in specification (1) results in an 1.18% lower equity risk ($1.1^{-0.127}$ = 0.9882). Higher volatility in public markets represents a strong uncertainty with regard to the economic outlook. Apparently, this situation also reduces the risk appetite of PE sponsors who craft less risky deal structures in such an environment.

The highly significant (1% level) negative coefficient of buyout company size in specification (2) confirms the argument that larger deals are less risky. A 10% increase in the mean enterprise value at investment entry, a change of about 22 millions of US dollars in our sample, results in an approximately 0.43% lower equity risk ($1.1^{-0.045}$ = 0.9957). Apparently, PE sponsors do not use excessive leverage in order to offset the lower asset volatility of larger companies.

Our findings consistently show that PE sponsor reputation is significantly (1% level) negatively related to deal-level equity risk. Measured by the logarithm of historical deals in specifications (3) and (4), we find that a 10% increase in PE sponsor experience (a change of about 16.5 historical deals) results in a 0.28% drop in equity risk ($1.1^{-0.0295}$ = 0.9972). Specification (5) shows a similar result when using the logarithm of assets under management

as proxy for PE sponsor reputation.[54] A deal done by a PE sponsor with 10% higher experience (an increase of about 176.4 million US dollars at the mean value in our sample) embraces a 0.48% lower equity risk ($1.1^{-0:05} = 0.9952$). While this estimated coefficient is significant at the 1% level, the relationship decreases in statistical and practical significance when including deal size in specification (6). We think that this finding is intuitive as larger PE funds conduct larger deals. Hence, there is a strong positive correlation between assets under management and deal size which has a moderating effect on the relationship between PE sponsor experience and equity risk. In addition, some very experienced and highly reputed PE sponsors deliberately restrict their maximum fund size in order to avoid putting their fund-level performance at risk. As the assets under management proxy would indicate low PE sponsor experience, we believe that our first reputation proxy is a superior proxy in this context. Thus, we argue that more experienced and higher reputed PE sponsors exhibit less risk appetite because they fear losing their reputation and its corresponding competitive advantage.

[54] We only have data on PE sponsor's assets under management for 416 transactions.

Table II-28: The Determinants of Equity Risk

This table presents the results of ordinary least squares regressions with heteroscedasticity-robust errors on the determinants of equity risk using our final sample of 460 leveraged buyouts acquired between 1990 and 2005. The dependent variable is the logarithmized equity risk volatility as computed in our model. In order to account for temporal effects, a value of one is assigned to all buyouts that, for example, were done between 1990 and 1994 for this variable and zero otherwise. Again, these categories represent different cycles of the PE market based on Strömberg (2008). We have chosen the period between 2000 and 2002 as the base category. In addition, we include eight ICB industry category dummies accounting for industry effects. We also include the logarithmized value of the average volatility in the last twelve months (LTM) prior to the investment entry date of the respective PE transaction of the MSCI World Stock Index to account for public market volatility. Finally, the Region Dummy obtains a value of one if the buyout target company's headquarters is in Europe and zero if it is located in North America. While specification (1) only contains these control variables, we add the natural logarithm of the enterprise value at entry in millions of US dollars as proxy for deal size in specification (2). In specification (3) we include the natural logarithm of the number of historical buyout transactions by the respective PE sponsor at the time of the transaction as reported by Thomson Venture Economics. We use this variable as proxy for PE sponsor experience and reputation. In specification (4) we add a PE sponsor ownership variable. For 152 transactions in our final sample the data sets provided by the funds-of-funds include explicit information on the share of equity that was purchased by the PE sponsor. For all remaining transactions, we calculate the PE sponsor's ownership stake by dividing the reported investment sum by the reported total equity value. We also logarithmized this variable. Finally, we test the robustness of our results by the inclusion of an alternative PE sponsor reputation variable in specifications (5) and (6). This proxy is the natural logarithm of the total assets under management (originally in millions of US dollars) of the PE sponsor accumulated in the five years before investment entry as reported by Thomson Venture Economics. For all variables, the numbers in the upper rows represent the regression coefficients. *, ** and *** indicate p-values of 10 percent, 5 percent, and 1 percent significance level, respectively. In the lower rows the detailed t-statistics are reported in parentheses.

VARIABLES	(1) Ln (Equity Volatility)	(2) Ln (Equity Volatility)	(3) Ln (Equity Volatility)	(4) Ln (Equity Volatility)	(5) Ln (Equity Volatility)	(6) Ln (Equity Volatility)
Ln (Enterprise Value)		-0.046***	-0.046***	-0.048***		-0.037**
		(-3.284)	(-3.326)	(-3.453)		(-2.584)
Ln (Number of Deals)			-0.020**	-0.027***		
			(-2.005)	(-2.675)		
Ln (Ownership)				-0.023**	-0.022**	-0.021**
				(-2.454)	(-2.410)	(-2.314)
Ln (Assets Under Management)					-0.041***	-0.020
					(-2.730)	(-1.343)
Ln (LTM MSCI World Volatility)	-0.293**	-0.269*	-0.251*	-0.257*	-0.397**	-0.396**
	(-2.014)	(-1.804)	(-1.673)	(-1.692)	(-2.529)	(-2.483)
1990-1994	0.024	-0.009	-0.039	-0.046	-0.065	-0.062
	(0.333)	(-0.125)	(-0.508)	(-0.590)	(-0.820)	(-0.781)
1995-1999	0.147***	0.146***	0.128***	0.121***	0.078*	0.093**
	(3.454)	(3.521)	(3.075)	(2.934)	(1.800)	(2.169)
2003-2005	0.151*	0.175**	0.204**	0.183**	0.065	0.063
	(1.767)	(2.026)	(2.283)	(2.008)	(0.672)	(0.644)
Industry Dummies						
Region Dummy						
Observations	458	458	458	458	416	416
R-squared	0.092	0.117	0.124	0.133	0.130	0.144

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Our specifications (4) to (6) consistently show a significantly negative relationship between the ownership stake at investment entry and equity risk. A 10% higher equity ownership stake in the mean buyout company (holding 54.4% of the buyout company`s shares) results in an approximately 0.17% lower equity risk ($1.1^{-0.0183} = 0.9983$). Our results are in line with viewing PE investors' equity stakes as call options. As higher equity stakes go along with reduced risk appetite, lower stakes in the total equity values could trigger "gambling for resurrection" behaviour (Axelson et al., 2009, 2010).

5. Conclusion

During the last two decades, PE has become an important source of capital for companies and considerable amounts of money have flown into these funds from investors around the globe. While academic work has made significant progress in recent years, evidence on the risks associated with PE investing is still relatively scarce. The main reasons for this situation are the conceptual problems to compute risks for these illiquid investments as well as the limited availability of appropriate data sets. Using a proprietary data set of 460 realized European and North American buyouts entered between 1990 and 2005, this paper has analysed time patterns and determinants of the risk appetite of PE sponsors. Applying the Black-Cox debt pricing model we were able to calculate deal-specific implied asset and equity volatilities including both systematic and idiosyncratic risks.

We started by developing a mathematical model to calculate deal-level asset and equity risk which is based on the Black-Cox default model. This model allows for continuous interest and redemption payments as well as for continuous default. We think that the implied deal-level asset and equity risks resulting from our model represent good indications of the PE sponsors' assumptions about the development of the asset and equity risk over the holding period at investment entry.

We then calculated the deal-level equity volatilities for our transactions in order to analyse the risk appetite of PE sponsors over time. We have found that the risk appetite of PE sponsors fluctuates remarkably over time indicating that these investors adjust their attitude towards risk according to the economic environment. In this context we have found that PE sponsors take more risk during boom periods which explains (or can be explained by) boom and bust cycles in the buyout market. It is important to note that it is not only banks issuing

cheap debt in times of economic upturns which causes overheating buyout markets but also the increasing risk appetite of PE sponsors. PE sponsors could use more equity to finance a transaction and not accept all supplied debt or offset higher leverage ratios by choosing companies with lower asset risk.

In this context we also have found high volatility in public equity markets prior to the investment entry of a PE sponsor, i.e. in the twelve month before the PE sponsor buys a company, has a negative influence on deal-level equity risk. Obviously, high uncertainty with regard to future economic development leads to reduced risk appetite of PE sponsors and/or a reduced willingness by banks to provide debt to finance a transaction.

In a next step, we have taken a detailed look at the determinants of PE sponsors' risk appetite. We find that larger buyouts exhibit lower equity risks. This finding indicates that PE sponsors do not use excessive leverage in order to offset the lower asset volatility of larger companies. If they were to do so, the equity risk increases through heightened leverage would outweigh the effect of low asset risk embraced in the company. Further, regarding PE sponsor characteristics we find that buyouts initiated by more experienced and higher reputed PE sponsors are less risky in terms of equity volatility. We attribute this reduced risk appetite to their fear of damaging their reputation and its corresponding competitive advantage which has been repeatedly shown to exist in the PE context (Achleitner et al., 2010b, Demiroglu and James, 2010, Ivashina and Kovner, 2010). Finally, we have found that an increasing ownership stake by the PE sponsor is related to a decreasing risk appetite. This finding is in line with viewing the PE investors' equity stake as a call option. If the price the PE sponsor has to pay for his option rises, the risk appetite decreases. Since we have found that equity volatilities increase during boom periods and that reputation (as well as ownership stake) is negatively related to equity risk, we argue that PE sponsors do not always act in the interest of LPs when they deploy a certain debt to equity ratio on a buyout target, but take excessive risks. This is further support for agency conflicts between GPs and LPs which can (at least partially) be solved through reputation.

We think that this study sketches out some paths for future research on deal-level risk in PE investments and, in a next step, the linkage to returns. For instance, having more information on deal-level risk and return as well as PE sponsor characteristics could reveal more information on the persistence phenomenon, i.e. the fact that some PE sponsors

continuously outperform their competitors, (Kaplan and Schoar, 2005). Perhaps, such investors exhibit similar characteristics in terms of deal-level risk-return preference which result in superior performance. Alternatively, the deal-level investment behaviour of the PE sponsors contingent on the fund's performance situation appears to be an interesting field for future research. Probably, such research reveals that the compensation structure of PE funds incentivizes PE managers of underperforming funds to impose excessive equity risks on their deals in order to "gamble for resurrection", i.e. gamble all in hope of a recovery of the overall fund performance.

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Appendix

This section derives an expression for $\partial V_E(0)=\partial V(0)$.

A *Down-and-out call option (DOC)* guarantees the holder a payoff of 0 in case of default ($\tau < T$) and a final payoff max $\{V(T) - D(T)\}$, where $D(T)$ denotes the strike price at maturity and $D(t)$ the time-varying default barrier. The price of such an option, $DOC^{\mathrm{GBM}}_{\mathrm{d},\mu_{\mathrm{v}*},\sigma_{\mathrm{v}}}$ ($V(0), D(0), T$), is presented in the following Lemma 5.1 and can be found in, e.g., Hull (2006), p. 534.

Lemma 5.1. Down-and-out call option (*DOC*)

Let V(t) be the value of the firm's assets at time t (see Equation (1)). The time to maturity is T, r the risk-free interest rate, and D(0) the strike and knock-out barrier.

Then, the value of a DOC option is given by

$$DOC^{\mathrm{GBM}}_{\mathrm{d},\mu_{\mathrm{v}*},\sigma_{\mathrm{v}}}(\mathrm{V}(0), \mathrm{D}(0), \mathrm{T}) = V(0)\,\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{\mathrm{v}*}+\sigma_V^2,\sigma_{\mathrm{v}}}(T) - e^{-rT}\,\mathrm{D}(0)\,\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{\mathrm{v}*},\sigma_{\mathrm{v}}}(\mathrm{T}).$$

Theorem 5.2. Equity value $V_E(0)$

The equity price $V_E(0)$ in the presented model is given by

$$V_E(0) = V(0)e^{(c-\lambda)T}\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{\mathrm{v}*}+\sigma_{\mathrm{v}}^2,\sigma_{\mathrm{v}}}(T)$$

$$+D(0)\frac{\lambda}{c-r-\lambda} - D(0)e^{(c-r-\lambda)T}\frac{c-r}{c-r-\lambda}\,\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{\mathrm{v}*},\sigma_{\mathrm{v}}}(T)$$

$$-\,\mathrm{D}(0)\,\mathrm{e}^{-\frac{\mathrm{d}(\mu_{\mathrm{v}*}-\mu_{\mathrm{v}*})}{\sigma_{\mathrm{v}}^2}}\frac{\lambda}{\mathrm{c}-\mathrm{r}-\lambda}\left(1-\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{\mathrm{v}*},\sigma_{\mathrm{v}}}(T)\right). \qquad (8)$$

Proof: The equity holders have to pay redemption payments of the continuous rate λ until the company either defaults or matures in T. They receive $V(T) - D(T)$ if the company survives until T, else they receive nothing. Thus

$$V_E(0) = \mathbb{E}\left[e^{-rT}\;1_{\{\tau > T\}}\max\{\mathrm{V}(\mathrm{T}) - \mathrm{D}(\mathrm{T}), 0\}\right]$$

$$-\left[\int_0^T e^{-rT}\,\lambda\,D(t)\,dt\right]\mathbb{Q}(\tau > \mathrm{T}) - \int_0^T\left[\int_0^s e^{-rs}\,\lambda\,D(t)dt\right]d\mathbb{Q}(\tau \le s)$$

$$= e^{(c-\lambda)T}\, DOC^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*},\sigma_V}(\mathrm{V}(0),\mathrm{D}(0),\mathrm{T})$$

$$- \left[D(0)\frac{\lambda}{c-r-\lambda}\, e^{(c-r-\lambda)T} - 1\right] \mathbb{Q}\,(\tau > \mathrm{T})$$

$$- \int_0^T \left[D(0)\frac{\lambda}{c-r-\lambda}\, e^{(c-r-\lambda)s} - 1\right] d\mathbb{Q}\,(\tau \le s)$$

$$= e^{(c-\lambda)T}\left(V(0)\,\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*}+\,\sigma_V^2,\sigma_V}(T) - \, e^{-rT}\, D(0)\,\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*},\sigma_V}(T)\right)$$

$$+ D(0)\frac{\lambda}{c-r-\lambda} - \, D(0)e^{(c-r-\lambda)T}\,\frac{\lambda}{c-r-\lambda}\,\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*},\sigma_V}(T)$$

$$- \mathrm{D}(0)\,\mathrm{e}^{-\frac{\mathrm{d}(\breve{\mu}_{V*}-\mu_{V*})}{\sigma_V^2}}\,\frac{\lambda}{c-r-\lambda}\left(1-\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*},\sigma_V}(T)\right)$$

$$= \, V(0)e^{(c-\lambda)T}\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*}+\,\sigma_V^2,\sigma_V}(T)$$

$$+ D(0)\frac{\lambda}{c-r-\lambda} - \, D(0)e^{(c-r-\lambda)T}\,\frac{\lambda}{c-r-\lambda}\,\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*},\sigma_V}(T)$$

$$- \mathrm{D}(0)\,\mathrm{e}^{-\frac{\mathrm{d}(\breve{\mu}_{V*}-\mu_{V*})}{\sigma_V^2}}\,\frac{\lambda}{\mathrm{c}-\mathrm{r}-\lambda}\,(1-\,\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*},\sigma_V}(T)),$$

using the results from Lemma 5.1.

Lemma 5.3. Delta $\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*},\sigma_V}(T)$

The derivative of the default probability $\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*},\sigma_V}(T)$ *(see Lemma 1.1) with respect to V(0) is given by*

$$\Delta^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*},\sigma_V}(T) = \frac{\partial\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*},\sigma_V}(T)}{\partial\, V(0)}$$

$$= \, \frac{2}{V\,(0)\,\sigma_V\,\sqrt{T}}\,\phi\left(\frac{-d+\mu_{V*}T}{\sigma_V\sqrt{T}}\right) + \frac{2\mu_{V*}}{\sigma_V^2 \mathrm{V}(0)}\, e^{\frac{2\mu_{V*}d}{\sigma_V^2}}\,\Phi\left(\frac{d+\mu_{V*}T}{\sigma_V\sqrt{T}}\right),$$

where $\Phi(.)$, respectively $\phi(.)$, denotes the standard normal cumulative distribution function, respectively the standard normal density function.

Proof.

$$\frac{\partial \Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*},\sigma_V}(T)}{\partial\, V(0)} = \frac{1}{V(0)\,\sigma_V\,\sqrt{T}}\,\phi\left(\frac{-d+\mu_{V*}T}{\sigma_V\sqrt{T}}\right) + \frac{1}{V\,(0)\,\sigma_V\,\sqrt{T}}\,e^{\frac{2\mu_{V*}d}{\sigma_V^2}}\,\phi\left(\frac{d+\mu_{V*}T}{\sigma_V\sqrt{T}}\right)$$

$$+\frac{2\mu_{V*}}{\sigma_V^2 V(0)}\,e^{\frac{2\mu_{V*}d}{\sigma_V^2}}\,\Phi\left(\frac{d+\mu_{V*}T}{\sigma_V\sqrt{T}}\right)$$

$$= \frac{2}{V(0)\,\sigma_V\,\sqrt{T}}\,\phi\left(\frac{-d+\mu_{V*}T}{\sigma_V\sqrt{T}}\right) + \frac{2\mu_{V*}}{\sigma_V^2 V(0)}\,e^{\frac{2\mu_{V*}d}{\sigma_V^2}}\,\Phi\left(\frac{d+\mu_{V*}T}{\sigma_V\sqrt{T}}\right).$$

Using the results from Theorem 5.2 and Lemma 5.3, Theorem 5.4 gives the derivative $\partial V_E(0)/\partial V(0)$. The result is a straight forward application of the product rule on Equation (8).

Theorem 5.4. Deriving $\partial V_E(0)/\partial V(0)$

The derivative of the equity value $V_E(0)$ with respect to $V(0)$ is

$$\frac{\partial\, V_E(0)}{\partial V(0)} = V(0)e^{(c-\lambda)T}\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*}+\,\sigma_V^2,\sigma_V}(T)$$

$$+\,e^{(c-\lambda)T}\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*}+\,\sigma_V^2,\sigma_V}(T)$$

$$-\,D(0)e^{(c-r-\lambda)T}\,\frac{c-r}{c-r-\lambda}\,\Delta^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*},\sigma_V}(T)$$

$$-\,\frac{D(0)}{V(0)}\,\frac{\tilde{\mu}_{V*}-\,\mu_{V*}}{\sigma_V^2}\;\mathrm{e}^{-\frac{\mathrm{d}(\tilde{\mu}\,V*-\mu V*)}{\sigma_V^2}}\;\frac{\lambda}{c-r-\lambda}\left(1-\Phi^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*},\sigma_V}(T)\right)$$

$$-\,\mathrm{D}(0)\,\mathrm{e}^{-\frac{\mathrm{d}(\tilde{\mu}\,V*-\mu V*)}{\sigma_V^2}}\,\frac{\lambda}{\mathrm{c}-\mathrm{r}-\lambda}\,\Delta^{\mathrm{GBM}}_{\mathrm{d},\mu_{V*},\sigma_V}(T).$$

III. Conclusion

1. Summary of Results, Implications and Future Research

How do private equity sponsors generate returns in buyout transactions? This is the first of two core questions this dissertation aims to shed light upon. By analyzing the role and importance of different value creation drivers, and its determinants, this thesis helps to gain a better understanding of the private equity business model. Secondly, the question of how does the riskiness of buyouts vary over time and what are the drivers of buyout investment risk is addressed. Deal-level buyout risks have not been examined sufficiently so far.

In the *first* step, the importance and value contribution of different value creation drivers is analysed. The results show that about 48% of returns to private equity sponsors can be explained by operational improvements of the portfolio company during private equity ownership, 18% are due to differences in entry and exit pricing, i.e. multiple expansion, and the remaining third can be explained by the leverage effect. This clearly indicates that private equity sponsors do not solely generate returns by making use of the leverage effect, thereby increasing the financial risk of a company, and by buying undervalued assets. In fact, almost 50% of value created is due to operational improvements during the holding period of the private equity sponsor, i.e. sales growth or EBITDA margin improvements. In addition, the EBITDA multiple can also be interpreted as a proxy for future EBITDA growth (Acharya et al., 2010). Consequently, a positive value contribution of multiple expansion, i.e. the exit multiple exceeds the entry multiple, could indicate that the competitiveness of a company has improved. Nevertheless, one cannot deny that private equity sponsors also make money by simply increasing the financial risk of a buyout target company. Overall, the results suggests that a one-sided assessment of buyout transactions (be it rather negative or positive) does not do justice to the complexity of these investments. This also implies that the generalized statements naming all private equity funds “value-destroying locusts” are inaccurate. However, due to the fact that this analysis focuses on deals completed between 1990 and 2005, it remains open how the relative importance of value drivers for deals conducted after 2005 differs. Given that the buyout market peaked in 2007/2008, followed by the burst of the credit bubble, this is an interesting area for future research.

In the *second* step, the dissertation particularly focuses on selected value drivers, which haven't been analysed satisfactorily in the literature so far, namely multiple expansion and leverage. The performance of multivariate analyses confirms that EBITDA multiple expansion is an essential factor for private equity sponsors in order to generate high equity returns. In this context, managing and timing the valuation of a buyout company is an important skill of successful private equity sponsors, and not simply a matter of luck. This "multiple expansion skill" refers to three different aspects. Firstly, there are factors directly related to the private equity sponsor as well as to the investing fund which have a strong influence on multiple expansion. For example, negotiation skills of more experienced private equity sponsors help to pay less for a transaction with a given level of leverage. Furthermore, with approaching expiration of a fund's lifetime, realized exit multiples decrease when the investing fund is a first time fund. Obviously, less experienced and reputed private equity sponsors have more pressure to realize an investment if the fund's liquidation date is nearing, as they have strong incentives to successfully raise a follow-on fund. This also implies that it is a key task of young private equity sponsors to identify attractive investment opportunities as soon as possible after a fund is launched. Consequently, the deal flow and network of young private equity sponsors are valuable assets. Secondly, the strategic direction of the portfolio company plays an important role. Obviously, a clear focus on revenue growth instead of EBITDA margin improvements are a signal of sustainable operational improvements rewarded with a higher exit valuation by a potential buyer. Thirdly, the timing of entry and exit decisions as well as the anticipation of boom and bust periods is an important factor in generating multiple expansion. Macroeconomic knowledge is a prerequisite in this context.

With regard to a more detailed analysis of the role of debt financing, the results show a robust concave relationship between debt to equity ratio and equity returns. At lower levels of leverage the positive effects of debt on returns outweigh the increasing default risk. However, at a debt to total capital ratio of about 90% it is also possible to 'over-leverage' a company leading to decreasing equity returns. Given that debt to total capital ratios higher than 90% are very uncommon in reality, these findings underline the incentive for private equity sponsors to leverage each deal up as much as possible. This is especially true in times of favourable debt market conditions when they can conduct debt-equity-arbitrage. By borrowing under-

priced debt and purchasing equity stakes in companies, private equity sponsors are obviously able to make use of the imperfections between debt and equity markets.

The incentive for private equity sponsors to implement highly leveraged capital structures might be to the disadvantage of their investors (as indicated by Axelson et al. (2010)) as well as to the buyout target's operational performance. Referring to the results based on non-risk-adjusted return measures, there seems to be no agency problem between general and limited partners. Increasing leverage, at least up to extremely high levels, results in higher returns for both parties. However, the results also show that leverage does not have a positive influence on risk-adjusted equity returns. Since limited partners provide a major share of a fund's equity capital and hence bear the major exposure to the corresponding equity risk, they should pay particular attention to risk-adjusted performance. Consequently, general partners might be willing to conduct a very risky transaction, which is attractive from their perspective, but to the detriment of their investors. This is the case when the increased possible return due to the higher risk is not enough to justify the increase in risk which implies an inefficient investment from a risk-return perspective.

On the other hand, the analysis of the relationship between leverage levels and company performance provides (weak) evidence that higher debt ratios have negative influence on sales growth. Possibly, highly leveraged firms have limited financial resources to implement growth strategies that pay off in the longer run. In contrast, there seems to be no influence of leverage on EBITDA margin improvements which indicates the minor importance of the disciplining effect of debt. However, there is certainly more research necessary in this area, especially on the relationship between equity returns, company performance and the development of a company's capital expenditures.

In the *third* step, risks associated with individual buyout investments are investigated. In this context, this dissertation distinguishes between the volatility of the enterprise value (asset risk) and equity value (equity risk). The latter represents the risk, equity investors, i.e. private equity funds, have to bear. The results show that equity risks substantially fluctuate over time and private equity sponsors take more risks during boom periods. Obviously, an increasing risk appetite among private equity sponsors goes hand in hand with the willingness of banks to provide more and cheaper debt. Given the distinctive cyclicality of the private equity market, this is a very interesting finding. A package of measures which aims at mitigating

boom and bust cycles in the buyout market also has to account for effective banking regulation.

With regard to private equity sponsor characteristics, empirical findings show that more reputed private equity sponsors conduct less risky transactions. Obviously, reputation is a valuable asset which prevents investors from conducting overly risky transactions. In this context, it is also likely that more reputed private equity sponsors have better access to suitable buyout target firms. In addition, a higher ownership stake of the private equity sponsor in a portfolio company, which implies a higher equity risk exposure, is negatively related to the accepted equity risk level. These findings are highly relevant for limited partners in selecting private equity funds to invest in.

The finding that private equity sponsor as well as fund characteristics have a significant influence on deal-level equity risk suggests further interesting research questions. How does the investment behavior of private equity sponsors change subject to the fund's current performance situation, e.g. do private equity sponsors really "gamble for resurrection"? How does the educational and professional background of private equity deal partners influence equity risks chosen, e.g. do deal managers with an Investment Banking background have a more pronounced risk appetite? These are certainly interesting paths for future research.

2. Outlook

It is remarkable that the private equity industry has experienced a number of boom and bust cycles in the last three decades. This seems to be an important feature of this industry (for an overview, see, e.g., Talmor and Vasvari, 2011). The first boom period of the LBO market in the 1980s came to an end with the collapse of the high-yield bond market in the late 1980s. In the following years, activity in the buyout market decreased substantially. The second boom period started in the second half of the 1990s when private equity firms, especially venture capital funds, heavily invested in technology-related industries. However, several buyout funds were also jumping onto the bandwagon and heavily invested in the telecommunications industry. In 2000, the burst of the technology bubble lead to a dramatic decline of the private equity market. In 2003, the private equity deal activity again accelerated, in particular the buyout market. Almost yearly new deal activity records were set,

hand in hand with the development of the leverage lending market. However, this boom also came to an end with the burst of the credit bubble in 2008.

The question is whether the recurrence of boom and bust cycles can be avoided in the future and how these cycles are related to the findings on value creation drivers and risks in buyouts obtained in this dissertation? Obviously, the buyout market bubbles in the 1980s and 2000s were related to the usage of considerable amounts of leverage in transaction financing. In line with this, the use of debt has always played an essential role with regard to the implementation of value creation drivers. Highly leveraged capital structures help to mitigate the agency conflict between managers of portfolio companies and the private equity sponsor through the disciplining effect of debt. In addition, higher tax shields can be generated and the leverage effect promoted. On the other hand, however, higher debt ratios also increase the bankruptcy risk of a company. This aspect has been underestimated in the past - or accepted by private equity sponsors because their limited partners bear most of the equity risk related to a transaction. However, it is very likely that the risk appetite of banks and institutional lenders, and herewith the availability of debt, will be reduced in the upcoming years. If debt at least partially drops out of the value creation framework, private equity sponsors will have to focus increasingly on governance improvements and the provision of industry expertise in order to continue generating satisfying returns. This will probably remain the major task over the next years.

If the private equity industry wants to avoid the distinctive cyclicality in the future, four points are especially important. Firstly, ever increasing fund sizes and the pressure to invest the committed capital make it difficult to identify enough appropriate buyout targets, e.g. companies with unfavorable investment opportunities, high cash flows, high diversification and low expected costs of financial distress (see, e.g., Opler and Titman, 1993). As a result, private equity funds should restrict their fund sizes. Secondly, private equity sponsors have to reduce their risk appetite and implement less highly leveraged capital structures, especially in times of favorable debt market conditions, when banks are willing to provide more and cheaper debt. In this context, banking regulation also plays an important role. Thirdly, the compensation structure of private equity sponsors has to be reconsidered. Obviously, the call-option character of the general partner's position in the fund causes severe incentive problems between general and limited partners. Fourthly, private equity sponsors can use several value-

enhancing mechanisms which are not related to the use of leverage, e.g. active monitoring and board control, the implementation of effective incentive schemes, the provision of industry expertise as well as access to highly talented people. These mechanisms should be emphasized more in the future. In this context, private equity funds are likely to become more specialized as industry experience helps to focus on value creation through operational improvements.

If the private equity industry is able to address at least some of these points, the occurrence of boom and bust cycles could be mitigated. If not, however, it remains to be seen if limited partners continue to invest heavily in this asset class and accept the 2/20 rule as the basis for the remuneration scheme of private equity funds.

References (Introduction and Conclusion)

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