

The Risk-Adjusted Performance of US-Buyouts

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Abstract:

This paper assesses the risk-adjusted performance of US buyouts. It provides evidence for a significant outperformance of this asset class compared to a mimicking portfolio of equally risky levered investments in the S&P 500 Index. It draws on a unique and proprietary set of data on 199 US buyout fund investments between 1984 and 2004. For each of these transactions, we determine a public market equivalent investment that matches the buyout with respect to its systematic risk. The regression of the buyout internal rates of return on the internal rates of return of the mimicking portfolio yields, after a correction for selection bias in our data, a positive and statistically significant alpha. Our sensitivity analyses highlight the importance of a comprehensive risk-adjustment that considers operating risk *and* leverage risk for an accurate assessment of buyout performance. The analyses further confirm the notion that buyout investors choose industries with low operating risks, make use of financial leverage when advantageously, and transfer an important portion of the transaction risks to the lenders.

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1. Introduction

Since the late 1970's buyouts¹ have become both a phenomenon of great economic impact and an important asset class. Yet relatively little is known about the risk and return characteristics of this type of investment. This is largely due to two factors. First, buyout investments differ substantially from public market investments along several important characteristics, especially regarding liquidity and information symmetry. This implies theoretical challenges with respect to the assessment of risk and return of buyout investments. Second, buyout investments are a sub-category of the private equity asset class for which general disclosure requirements do not exist. Absent detailed information on investment characteristics and transaction cash flows risk-adjusted returns are difficult to calculate.

The present paper assesses the risk-adjusted performance of buyout transactions based on a comparison to public market investments with an equal risk profile. For this comparison, we draw on a unique and proprietary set of data on the internal rates of return (IRR), the financial leverage and industry characteristics of 199 US buyout fund investments into US companies.

Based on this information we construct a mimicking portfolio of investments in the S&P 500 Index, with additionally borrowed or lent funds. The investments of this portfolio match the buyout investments in terms of the timing of their cash flows, and their systematic risk pattern. The systematic risk of buyout transactions usually changes during the holding period. Being initially high due to the amount of debt used for the financing of the transaction, the risk decreases in the following periods by the redemption of debt. Our mimicking portfolio replicates the evolution of the buyout risk pattern over time.

¹ In the literature buyout transactions are variously labelled (e.g., leveraged buyout, management buyout, institutional buyout, management buyin, etc.) and often used synonymously. In this paper the term "buyout" as being the broadest is preferred which comprises the different facets of this transaction type.

The chosen public market equivalent approach does not imply any claim that buyouts can be easily replicated with traded securities. It is simply used to track them in a best possible way. Thereby we control for the systematic risks involved and investigate which asset class yielded *ex post* superior returns. For our approach we adopt the perspective of a well-diversified investor, such as a fund of fund investor, pension fund or a university endowment. This is a reasonable assumption as such investors are the primary capital providers for buyout transactions. Consequently, we do not consider idiosyncratic risks in our analysis. We assume that the investor has the choice to either invest in buyouts or in quoted assets and investigate, which asset class yielded *ex post* superior returns.

The regression of the annually compounded IRRs of the buyout investments on the IRRs of the mimicking investments shows that under conservative assumptions, and after correcting for the selection bias of our sample, the buyouts outperform the public market gross of all fees. And the magnitude of the outperformance exceeds the typical level of fees.

Our results further provide insights into the nature of buyout transactions and confirm that in general buyout fund managers search low risk industries for their investments. Additionally, they suggest that buyout transactions become more successful if the buyout fund managers are able to transfer substantial parts of the risk to the lenders. Finally, we illustrate through a number of sensitivity analyses that it has to be considered inadequate to assess the performance of buyout transactions without thoroughly determining leverage ratios, specifying the risks born by lenders and controlling for the systematic risks carried by the sponsors.

2. Definition of Buyouts

Buyout investments represent one strand within the private equity (PE) asset category. This category is based on the relationship between an institutional investor and an intermediary (the PE fund or investee). A PE fund is usually structured as a limited

partnership, and is comprised of a management team (the general partner, GP), which manages the investments of the limited partner (LP). The PE fund's investors hold shares of the limited partner. Buyout funds invest in companies that are in later stages of their lifecycle. Subsequent to the transactions the target companies' shares are not quoted. The investments are typically structured as equity claims (common and preferred), or very similar to equity claims. For each individual transaction an investment vehicle is created and receives funding from one or several PE funds and other potential parties, such as senior and subordinated debt providers and mezzanine investors. The target company's management team, its employees or new external managers may also subscribe for equity stakes, but their stakes are usually small compared to the investment of the institutional investors. The transaction vehicle acquires assets or shares of the target company and/or will merge with it, thus creating a unique opportunity to specify a certain capital structure and to design particular claims and incentives.

The transaction date is called closing date. At the end of the holding period (called exit) all claims are sold to third parties either privately negotiated or via Initial Public Offerings. Unsuccessful engagements are written off, eventually to zero value.

Buyout funds usually play a role as active investors. This entails monitoring, managing and restructuring the target companies to create value. It is often argued in literature that this aspect plays the major role for the success of buyout transactions. To secure their influence on the target companies buyout funds tend to own the majority of voting rights either by themselves or together with other financial investors via equity syndications.

Venture capital (VC) investments make up the other strand of the PE asset class. buyouts and venture capital differ substantially in terms of the risk profile of their investments. While buyout funds acquire majorities of mature companies in traditionally stable industries and use financial leverage, VC funds typically invest in minority stakes of

early stage businesses in volatile growth industries under minimal use of debt financing. This makes it necessary to treat the two sub-categories of the private equity asset class separately in the assessment of risk and return and motivates the focus of this paper on buyout transactions only.²

3. Related Literature

The present paper builds on several recent contributions to the literature that address the question of risk and return of private equity.

Gompers and Lerner (1997) address the “stale price” problem and propose market tracking as a tool for measuring risk-adjusted returns of buyouts. The term “stale price” is used to describe the circumstance that market valuations of PE transactions are only available, if at all, at two certain dates, the entry and the exit date. Hence, moments of historical returns, such as the standard deviation, are meaningless as an instrument to measure the inherent transaction risk. The authors build equally weighted indexes of publicly quoted companies with equal three-digit SIC codes to benchmark the individual transactions. They analyze one single buyout fund and model the quarterly exposure of its investments using these indexes as a performance indicator in the absence of a cash payment or write-off. If any payment or write-off takes place, then a new company value can be calculated and attributed to the transaction. The authors concede that their approach assumes perfect correlation between the target company valuations and the chosen index. They argue that this could overstate the risk involved. Using this approach, the authors find superior performance for this buyout fund.

² A comprehensive overview of buyouts, venture capital, private equity in general, and typical transaction characteristics is given by: Lowenstein (1985), Sahlman and Stevenson (1985), Wright and Coyne (1985), Jensen (1986), Smith (1986), Jensen (1989a), Jensen (1989b), Kaplan (1989a), Kaplan (1989b), Kaplan and Stein (1990), Lichtenberg and Siegel (1990), Sahlman (1990), Jensen (1991), Kaplan (1991), Bygrave and Timmons (1992), Kaplan and Stein (1993), Gompers and Lerner (1997), Black and Gilson (1998), Gompers (1998), Wright and Robbie (1998), Gompers and Lerner (1999), Gompers and Lerner (2000), Lerner (2000), Cotter and Peck (2001), and Berg and Gottschalg (2005).

Ljungqvist and Richardson (2003) use extensive data from a fund of fund investor on cash outflow, inflow and management fees from investments in 73 different PE funds. To determine risk-adjusted returns they calculate industry beta factors using the methodology of Fama and French (1997). Lacking data on the leverage of the target companies, they are unable to correct for different leverages and therefore implicitly assume average industry debt/equity ratios within their analysis. From this, they obtain an average beta factor of all the different PE fund portfolios of 1.08 and an average annual internal rate of return of 21.83%. The annual performance of the S&P 500 Index during the same period was 14.1%. The authors argue that, provided the degrees of leverage were no higher than twice the average industry leverage, this would lead to a risk-adjusted premium for the PE transactions. However, they acknowledge the possibility that their sample of PE funds may not be a random draw from the population of PE funds.

Jones and Rhodes-Kropf (2003) investigate the idiosyncratic risks of PE transactions, arguing that they play an important role that must be priced. They find that investors in PE funds do not earn positive alphas. Surprisingly, they also find that funds exposed to more idiosyncratic risk earn higher returns than more diversified portfolios.

Quigley and Woodward (2002) and Woodward and Hall (2003) develop a VC price index based on the Repeat Sales Regression Method introduced by Bailey, Muth, and Nourse (1963) to benchmark real estate investments. Quigley and Woodward (2002) further correct for sample selection bias with the Heckit Two Step Regression. They use proprietary data on 5,607 companies that received venture capital in 12,553 financing rounds between 1987 and 2000. They calculate Sharpe-ratios of their VC index and of the S&P 500, and the NASDAQ index. Both indexes have to be considered superior to VC in terms of risk and return. They conclude that for diversification purpose, securities portfolios should include 10% to 15% of VC exposure.

Cochrane (2005) points out that empirical VC research usually only observes valuations if target companies go public, receive new financing or are acquired by third parties. These events are more likely to occur when good returns have already been experienced. This results in a sample selection bias that the author overcomes via a maximum likelihood estimate.³ He uses data on 16,613 financing rounds between 1987 and June 2000 for 7,765 target companies from the VentureOne database. This database includes buyout and venture capital transactions but the VC segment notably dominates the data. With his reweighing procedure Cochrane (2005) calculates an arithmetic mean return of 59% and underlines the high idiosyncratic return volatilities of the particular transactions. He directly models the returns to equity and does not control for leverage risks. He compares the returns with the corresponding returns of the S&P 500 index and with several portfolios taken from the NASDAQ index. Considering these different benchmark portfolios he finds alphas ranging from 22% to 45%. Regarding the slopes of the regressions he argues that VC is riskier than the S&P 500 index. Depending on the choice of the NASDAQ portfolio VC can be either less risky equally risky or riskier than the benchmark. For the different NASDAQ portfolios he determines slopes of the regressions between 0.5 and 1.4.

Most recently, and similar to this paper, Kaplan and Schoar (2005) employ a public market equivalent approach to benchmark PE funds. They construct a mimicking portfolio for a large sample of PE funds contained in the Thomson Venture Economics database, investing an equal amount over an equally long period in the S&P 500 Index and comparing the PE fund performance to the index returns. They conclude that average venture capital and buyout fund returns net of fees roughly equal those of the S&P 500. Gross of fees both asset classes earn returns exceeding the chosen benchmark. They also report a strong persistence of the performance (negative as well as positive) of the particular funds and a higher

³ For a similar approach see Peng (2001a and 2001b).

performance for larger funds and more experienced management teams. The authors acknowledge however, that their results may be misleading because they do not control for different systematic risks and do not correct for a potential selection bias that might exist in their sample.

Phalippou and Zollo's (2005) paper constitutes an extension of the Kaplan and Schoar (2005) article. Using additional information on the characteristics of the fund's underlying investments they are able to assign every transaction to an industry according to the Fama and French (1997) classification. Then they calculate unlevered beta factors with a method similar to the one we will apply in this study to perform a risk-adjustment for operating risk. However absent any data on the leverage of the target companies, they are still unable to correct for different degrees of leverage of their sample transactions. They refer to Cotter and Peck (2001) who provide detailed information on capital structures within buyout transactions and calculate equity beta factors with initial debt/equity ratios of 3 and final debt/equity ratios at average industry levels. Within their approach of unlevering and relevering the beta factors they do not differentiate between the risks of debt and tax shields in the quoted and in the unquoted market segment. Based on this analysis, they find underperformance of PE.

Strikingly, recent research on risk and return of private equity lead to contradictory findings. It seems as if the differences in the treatment of risk-adjustment may be responsible for a large part of these inconsistencies. Furthermore, it is important to note that most studies do not sufficiently differentiate between the different risk characteristics of the venture capital and the buyout asset class.

This study differs from and aims to extend prior work in several ways. First and most importantly, it constitutes the first large-scale analysis on the performance of buyouts that fully corrects for the operating *and* the leverage risk of this asset class. Using precise

information on the valuations of individual target companies, their competitors, respectively their industry sector, and on the capital structures of the investment vehicles at the closing date and at exit, it becomes possible for us to attribute financial risk measures to every individual transaction. Thus, we can control for this risk in constructing a well-defined equally risky mimicking portfolio to which the performance of buyout investments can be compared. The consideration of leverage risk is of great importance, as existing research has frequently noted that any findings regarding the performance of buyout investments that do not appropriately adjust for the effect of leverage risk have to be interpreted with great caution.⁴

Second, this paper focuses exclusively on investments of buyout funds, as the category of PE in which leverage plays a crucial role. It thereby avoids the mix of two asset classes (venture capital and buyouts) with substantially different risk and return characteristics in the same analysis.

Third, it provides detailed insights into risk characteristics and drivers of performance of this asset class. It documents the performance differences between buyout investments on the one hand and public market investments on the other, controlling for operating risk, and financial leverage. It further contrasts the performance impact of (a) operating risk and (b) leverage risk in buyouts, with (c) the joint impact of both factors, and explicitly analyzes the importance of different assumptions regarding the riskiness of debt, credit spreads and the operating risk of the transactions.

4. Data Collection and Sample Description

The availability of data of sufficient breadth and depth has been one of the key challenges to answer the question of risk and return of buyouts. The comparison of the returns of buyout investments to similar public market investments on a risk adjusted basis

⁴ See e.g. Ljungqvist and Richardson (2003), Kaplan and Schoar (2005), and Phalippou and Zollo (2005).

requires information on (a) the timing and amount of underlying cash flows, (b) the capital structure of the acquiring investment vehicles at entry and exit and (c) information regarding the industry segment of the target companies. Such data records are not publicly available and are not contained in any of the commonly used databases, such as Thomson Venture Economics or VentureOne. Instead, such data can only be gathered directly from institutions that invest in buyouts, either as GPs or as LPs. While this approach has advantages regarding the depth of available data, it leads to potential selection and survivorship biases. In the following, we describe the data sources and sample characteristics of the data used in this study and discuss and correct for the biases.

a) Data Collection

Our dataset is compiled from information on buyout funds made anonymously available either directly by GPs or LPs. LPs collect detailed information on GPs as part of the due diligence processes for their fund allocations. Our research partners are among the world's largest buyout fund investors and collectively manage more than US\$40 billion in the PE asset class. In their due diligence processes, LPs often screen hundreds of new buyout funds per year. GPs describe their previous transactions for the purpose of raising a new fund in a special offering document (the so-called Private Placement Memorandum - PPM). The PPM are submitted to potential investors and used by them to assess the quality and strategy of the general partners. Typically these documents contain information about all past transactions carried out by the GP. Most of the information used in this study has been extracted from PPM. Given the confidential nature of these documents, they have never before been used in academic research.

As no standard format exists for the presentation of previous transactions in PPM, these documents are very heterogeneous in terms of the level of detail provided on each transaction – both within one fund and across GPs. Consequently we found all the necessary data to

perform a risk-adjusted performance assessment only for a sub-set of transactions. Moreover, only fully exited transactions are being considered, since interim valuations for buyout funds are generally not reliable and heavily bias the results.⁵

The detailed analysis of 122 PPM made available by our research partners with information on 2264 realized buyout investments (thereof 1001 in the US) made through 170 buyout funds raised between 1981 and 2004 yielded a sample of 152 transactions. For these transactions, all of the following data has been available. First, for closing, the date, company valuation, acquired equity stake, amount paid for the equity, target-company industry and a short product and market description, or description of competitors (in order to determine its SIC code). Second, for the exit, the date, company valuation, equity stake and amount returned to the buyout fund. Finally, the investment's gross internal rate of return that is reported in the PPM has been used in order to verify that the underlying cash flows have been correctly matched. The vast majority of the 152 companies in our sample are headquartered in the in the United States, with the remainder based in the United Kingdom, continental Europe and Japan. As the non-US results would lack statistical weight for any individual country while also distorting the US results, we decided to omit all non-US transactions, which leaves us with 133 transactions carried out by 41 different funds. For each of these transactions we are able to create the financial risk profile from initial leverage and subsequent redemption of debt. In several transactions, additional "add-on payments" in subsequent financing rounds and premature disbursements occurred. Considering all these additional payments our sample totals 199 cash flows (each with one investment and one divestment), to which we can attribute a well-defined risk pattern.

table 1 about here

⁵ See e.g. Rotch (1968), Poindexter (1975), Peng (2001a and 2001b), Quigley and Woodward (2002), and Cochrane (2005)

Our sample of 199 risky cash flows has the following characteristics (see table 1 for descriptive statistics). The first transaction was made in October 1984 and the last has been divested by July 2004. The holding periods range from one month (for some add-on payments) to 15 years plus one month. The average and the median are below four years. The equity stakes range from 8% to 100% ownership. The average (median) is 76% and (86%). This figure in general reflects the strategy of securing majority-voting rights in target companies in order to be able to control them effectively. The minor equity stakes represent syndicated equity layers.

Regarding the degrees of financial leverage, the average (median) was 2.94 (2.49) at closing, and 1.28 (0.64) at exit. Some of the transactions did not include any debt. However, some of the buyouts were highly levered with degrees up to 17.05. The high average and median degree of financial leverage found in our sample underlines the need to consider the effect of leverage risk in the performance assessment.

At closing the enterprise values of the target companies range from \$3.5 million to almost \$9,000 million. The average (median) is \$343.5 million (\$88.0 million). At exit the enterprise values range from \$0.001 million (a write off) to almost \$13,500 million with an average (median) of \$548 million (\$135 million). Similarly the amount of equity invested at closing ranges from \$0.2 million to almost \$1,150 million signaling the large exposure in certain transactions. On average (median) the amount of equity invested is \$46.5 million (\$18 million). The lowest amount invested represents an add-on investment in a smaller transaction. The final payoffs range between \$0.001 million (a write off) and almost \$1,800 million with an average of \$145 million and a median of \$58 million. This leads to internal rates of return of between -100% (total write off within a year) and an astonishing 472% p.a. However, the mean average IRR of all transactions and the median are 50.08%

p.a., and 35.70% p.a., respectively. Since these figures do not consider differences in either the amounts invested or duration of the different investments we also calculate the aggregate IRR over all the underlying cash flows, which is 33.19% p.a. This corresponds to the gross return an investor would have gained if she had participated in all of our sample transactions at a constant proportion. We also calculate the invested capital-weighted IRR of all the cash flows, which is 30.95% p.a. These IRR figures seem high, though others e.g. Peng (2001a), Peng (2001b), Ljungqvist and Richardson (2003), and Cochrane (2005) report similarly high returns. In the following we will discuss the potential bias of our sample in more detail, assess its magnitude and correct for it.

b) Sample Bias Assessment and Correction

Given the source of our data, there are good reasons to suspect an upward bias in our sample. First we have to consider a possible selection bias based on the GP's reporting policy. GPs have an incentive to provide detailed information only for their successful transactions in the PPM, which is primarily a marketing instrument for fundraising purpose. Second, we have to expect a survivorship bias based on the mechanism that unsuccessful GPs will find it difficult or even impossible to raise another fund. Hence, they will never write a PPM that reports their past investments. A sample like our which is derived from PPM information will therefore be systematically biased towards the more successful fund managers who 'survive' in the sense that they are trying to raise a new fund.

To first test for a possible selection bias, we compare the characteristics of the investments in our sample to the characteristics of the entire sample of 1001 realized US buyouts derived from our 122 PPM. The latter include many buyouts for which the IRRs, but no additional details such as the industry sector of the acquired company or the financial structure of the transaction vehicle have been reported. The sample mean comparison revealed that our sample transactions do not significantly differ from the overall population in

terms of the IRR or the holding period. However, the transaction values are significantly larger ($p < 0.001$) than the average buyout in our database. This finding leads to the conclusion that our sample of buyouts represents a random draw with respect to the internal rate of return from our overall database of PPM reported buyouts.

In a next step we assess the magnitude of the bias in our sample, comparing our sample returns with return data on buyout funds from Thomson Venture Economics⁶, the industry standard for return data on private equity funds and the best possible proxy for the entire fund population⁷. From the Venture Economics dataset we derive a sample of comparable buyout funds. It is composed of 244 limited partnerships raised from 1983 to 1996 in the United States. These funds probably began operations at approximately the same time as our sample's first transaction and probably also were divested by the time of the latest exit in our sample.⁸

The Thomson Venture Economics return data is aggregated on a fund level and these 244 funds correspond several thousand individual transactions. These funds have a mean IRR of 14.99% p.a., a median of 11.94% p.a., and a standard deviation of 26.82% (pts.). However, we have to keep in mind that Thomson Venture Economics reports data net of all fees, while our own sample return data are gross of fees. We thus have to correct for this difference in our comparison.

⁶ The authors would like to thank Gemma Postlethwaite and Jesse Reyes from Thomson Venture Economics for providing generous access to their data.

⁷ The adequacy and potential biases of the Thomson Venture Economics and affiliated databases in general are comprehensively discussed in Gompers and Lerner (2000), Kaplan, Sensoy, and Stromberg (2002) and Ljungqvist and Richardson (2003). Despite the shortcomings mentioned in these studies, a more reliable source regarding return information does not exist. Further, since our focus is on buyout transactions, some of the selection problems discussed in the above mentioned literature should not be as crucial as they are for the VC segment.

⁸ Rotch (1968), pp. 142, already notes a six-year average holding period, Huntsman and Hoban (1980), pp. 45, calculate five years, but emphasize that some very long holding periods also exist. Ljungqvist and Richardson (2003), p. 2, argue that it usually takes six years to invest 90% of the committed capital and that the payments break even after eight years on average. According to our calculations, the average holding period is 3.67 years. We hold from our observations that on average a year passes between fundraising and the first transaction. Further, we believe that funds being raised after 1996 cannot fully be divested by 2004.

Typically, the fees are structured as an annual percentage of the capital under management ('management fee' of 1-4%) plus a performance related share ('carried interest' of 15%-35% of the returns), which is usually subject to a hurdle rate.⁹ We know from the PPM we analyzed that an annual fee of 2% of committed capital is typically paid to the general partner. Assuming that committed capital is steadily and fully invested over the lifetime of a fund this yields 4% on invested capital. The return on the invested capital is further reduced by the carried interest. We also know from our PPM that the carried interest is on average 20% of the internal rate of return subject to a hurdle rate of 8%.

Hence, we can correct for the fees as follows:

$$\left(\text{IRR}_{\text{gross}} - 4.00\% \right) - 8.00\% * 0.80 + 8.00\% = 14.99\%$$

This correction yields a mean average IRR gross of fees of 20.73%.

Based on this analysis, we correct for the higher mean IRR in our sample in the following way. In our regressions of the IRRs of our sample transactions on the IRRs of the mimicking investments we deduct the difference in means (gross of fees) between Thomson Venture Economics funds and our own data from the intercepts we receive. Here we use the most conservative approach possible, using the maximal span between the two means according to the above mentioned alternative definitions. The maximal difference is 50.08% - 20.73% = 29.35%, as we use the 20.73% gross of fees mean IRR of the Thomson Venture Economics funds and the 50.08% mean average IRR of our sample transactions. This implies that the IRRs of the cash flows of our transactions are on average 29.35% points higher than the IRRs of the overall population according to Venture Economics. The regression line is therefore always shifted by this offset.

⁹ A comprehensive description and discussion of compensation models can be found in Bygrave, Fast, Khozlian, Vincent, and Yue (1985), pp. 96, Jensen (1989a), pp. 68, Jensen (1989b), pp. 37, Sahlman (1990), pp. 491, Murray and Marriott (1998), pp. 966 Gompers and Lerner (1999a), pp. 57, and Gompers and Lerner (1999b), pp. 7.

To further assess the representativeness of the performance distribution in our sample, consider the following logic. Our sample is composed of individual transaction cash flows rather than aggregate fund returns. However, our cash flows could belong to a subset of funds in the Thomson Venture Economics database. Hence, we simulate several funds with our sample data to receive an IRR distribution on the fund level. We therefore randomly draw 244 times 30 transactions out of our sample and calculate the capital weighted IRRs of each of these draws. This way we artificially create the 244 funds out of our sample to match the 244 funds in the Thomson Venture Economics population. The simulation results, the distribution of our sample IRRs (gross of fees) as well as the IRRs of the population (net of fees) are presented in the following chart 1.

chart 1 about here

The shapes of the return distributions show that there seems to be no structural difference between our sample and the Thomson Venture Economics database.

5. The Portfolio Mimicking the Buyouts

To assess the risk-adjusted performance of buyouts, we follow the approach introduced by Kaplan and Ruback (1995) to value such transactions based on the creation of a mimicking portfolio of similar public market investments. These investments are designed to replicate the risk profile of the buyouts in terms of their timing and their systematic risk.

The determination of the mimicking portfolio requires for each buyout (a) the identification of a peer group of publicly traded companies with the same operating risk, (b) the calculation of the equity betas for each of these ‘public peers’, (c) the unlevering of these beta factors to derive their operating or unlevered betas, (d) the determination of a market weighted average of these operating betas for every peer group, and (e) the relevering of

these averaged betas on the level of the buyout transactions at closing, and exit. The unlevering and relevering procedures also require the specification of the risk, which is borne by the lenders, the risk of tax shields, as well as an applicable corporate tax rate.

With this data the mimicking portfolio can be established as follows: For every buyout transaction, the equal amount of equity is invested in a representative market portfolio which is levered up with borrowed funds until it matches the equity beta factor of the buyout at closing. If the buyout's beta is lower than one, funds can be lent. The timings of the mimicking investments correspond with the closing dates. The risk of the public market transaction is then adjusted every year, tracking the risk of the buyouts. Therefore every position is liquidated annually, interest is paid, debt is redeemed and the residual equity is levered up again with borrowed funds (respectively funds are lent) to the prevailing beta risk of the buyout. This procedure is repeated until the exit date. Then the position is closed and after serving debt we receive a residual cash flow to the investor, which represents the final payoff.

The individual steps and the underlying assumptions to construct the mimicking portfolio are discussed in detail in the Appendix. The approach allows the analyses described in the following section.

6. Analysis and Results

First, we can contrast the leverage pattern of buyouts with that of their publicly quoted peers (see table 1). With respect to *leverage risk*, we find that at closing the average debt/equity ratio of the buyout investments is 2.94 and their median is 2.49. At exit those ratios are 1.28 (mean average), respectively 0.64 (median). In comparison, the mean average leverage ratio of all quoted peers over the five years is 1.38, and the median is 0.83. That means that on average our sample transactions are initially levered more than twice as much

as their public peers. When exited, the target companies have even lower leverage ratios than their public peers.

Second, we take a look at the *operating risk* and find that the resulting unlevered beta factors range between 0.30 and 2.03. The mean average of the unlevered beta factors is 0.67 and their median is 0.56. This is not surprising as buyout fund managers typically choose low volatile businesses for their investments and hence, the unlevered beta factors of target companies should be low in general.¹⁰

Third, the resulting *systematic risk* of the transactions ranges between 0.30 and 7.96 at closing with a mean of 1.40 and a median of 0.94. At exit the equity betas are between 0.30 and 7.96 with a mean of 1.01 and a median of 0.71.

Fourth, we can assess the *risk-adjusted performance* of the sample of buyouts by comparing pairs of cash flows with identical risk patterns, the buyout cash flows and the cash flows of the mimicking investments. Every cash flow from a buyout transaction has its risk-adjusted public market equivalent. The IRRs of these cash flows can be directly compared through a regression analysis based on the following formula:

$$\tilde{r}_{BO} = -\delta + \alpha + \beta \tilde{r}_{Mimicking} + \tilde{\varepsilon} \quad (1)$$

where:

- \tilde{r}_{BO} Internal Rates of Return of the buyout cash flows
- $\tilde{r}_{Mimicking}$ Internal Rates of Return of the mimicking investments
- α Intercept of the regression
- β Slope of the regression
- δ Offset for the sample selection bias correction

¹⁰ See e.g. Jensen (1989), p. 64, Smith (1990), pp. 154, DeAngelo and DeAngelo (1987), table 1, or Lehn and Poulsen (1989), pp. 774. The lower end of the range of unlevered beta factors could also result from the selection of infrequently traded peers. We attempted to exclude this kind of peers from our selection. To nevertheless verify the sensitivity of our results to this factor we consider this case in our sensitivity analysis.

ε White noise error term

The intercept of the regression, corrected for selection bias, will be comparable to a Jensen (1968) alpha and thus provides information about superior or inferior performance of the buyout transactions. As described, we correct for selection bias by subtracting from the regression intercept the difference in means of gross of fees returns between our sample and that of the Thomson Venture Economics distribution.

The slope of the regression can be regarded as a “Buyout-beta” relative to the mimicking portfolio. It reveals the systematic risk of the buyouts relative to the mimicking transactions. It is important to remember in this context, that the mimicking portfolio consists of levered index investments and hence is riskier than the index itself.

The mimicking investments have a mean IRR of 12.9% and the regression yields an alpha of 12.6%, and a slope of 0.63. Calculating a standard error for the alpha and performing a t-test reveals that this alpha is significant on a 95% level. Hence, the buyout transactions significantly outperform the mimicking portfolio. It has to be emphasized, that this result is gross of management fees to the GPs, but the returns of the mimicking investments are calculated without considering any fees either. The magnitude of the regression alpha is such, that even if we deducted management fees from the alpha the outperformance prevailed.

The regression slope leads us conclude that the buyouts are characterized by less systematic risk than the levered public market equivalent. The relatively low R^2 of 0.025 is not surprising, regarding the large idiosyncratic risks of the individual buyout transactions.

In addition to this findings, our data allows us to derive a number of additional important risk and return characteristics of the buyouts.

a) Sensitivity Analyses: The Importance of Risk Adjustment

Our findings of a risk-adjusted outperformance of buyouts relative to equally risky public market investments is somewhat consistent with the results of Kaplan and Schoar (2005), and Ljunqvist and Richardson (2003), but in contrast to those of Phallippou and Zollo (2005). All three studies differ from ours in the approach to the risk-adjustment they use. We want to gain further confidence in our results and illustrate the importance of an accurate risk-adjustment for the assessment of buyout performance. To this end we conduct four sensitivity analyses. In these we use different approaches for the risk-adjustment in the determination of the mimicking portfolio. We then replicate the previously described regression of the buyout IRRs on the IRRs of each new mimicking portfolio and compare the results to our base case. The equity betas for our base case and the four scenarios are summarized in table 2, the mean IRRs of the mimicking portfolios and the regression results can be found in table 3.

table 2 and table 3 about here

The first scenario replicates the approach followed by Kaplan and Schoar (2005). This corresponds to a comparison of the buyout transactions with a time-matched series of investments in a public market index without any adjustment for differences in the risk profile of the two. The mimicking portfolio then always has a beta of 1, compared to the betas in our base case, that vary substantially over time and across transactions. On average the systematic risk of such a mimicking portfolio is lower than the systematic risk in our base case. Accordingly, the mean IRR of the mimicking portfolio decreases to 11.9%.

The regression in this scenario yields a non significant alpha of only 4.3%. This result is consistent with the finding of Kaplan and Schoar (2005), who report a slightly better

performance of buyouts compared with their public market equivalent gross of fees. The regression slope in this scenario becomes much steeper as 1.38. This suggests that our sample transactions are more risky than the market index.

The results of this scenario have two important implications. First, we gain further confidence in the quality of our data and the accuracy of our approach to correct for the selection bias. Using the same approach to the treatment of risk, we are able to replicate the findings by Kaplan and Schoar (2005) even though these are based on a different and much larger data source. Second, these findings point to the importance of an accurate treatment of risk in the assessment of buyout returns. It seems as if the significant outperformance of buyout transactions becomes visible only if one thoroughly considers the differences in risk between buyouts and a broad public market index in the comparison.

The next scenario constructs the mimicking portfolio in a way that controls for the industry mix of our sample. We apply the average equity beta factors of our peer groups to the mimicking investments but do not consider the additional leverage. This leads to a partial risk adjustment, as such a mimicking portfolio replicates the industry mix of our buyouts but does not capture the effect of (additional) leverage. In other words, here we directly compare the buyouts to an equity investment in their public peers. The approach leads to equity betas between 0.31 and 2.04 that do not change over the holding periods. Their mean average is 0.78, and the median is 0.70. Thus, the betas are lower than the market beta and lower than the betas of our base case. This results in a mean IRR of the mimicking portfolio of 9.7%. The regression yields a statistically non-significant alpha of 6.8%. The slope of the regression is with 1.44 the largest of our scenarios.

This again has two important implications. First, buyouts are riskier than a mimicking strategy that focuses on the replication of the industry mix only and does not control for

leverage risks. Second, we see again that without the consideration of leverage risks the actual outperformance of buyouts cannot be assessed.

In a third scenario, we take a look at the impact of leverage alone on the returns. We set all the investments of the mimicking portfolio to have an unlevered beta of 0.84, which is the unlevered beta factor of the S&P 500 index. Here we draw on data provided by Bernado, Chowdhry, and Goyal (2004), who determine unlevered beta factors for the Fama and French (1997) industry classification.¹¹ We then lever up each investment in the mimicking portfolio with the actual leverage of the corresponding buyout. This corresponds to a comparison of the buyouts with a levered and time-matched investment in a hypothetically leverage-free public market index. This scenario adjusts for differences in leverage risk, but not for the impact of different operating risks in the chosen industries.

The resulting betas at closing range from 0.84 to 8.20 with a mean average of 2.11 and a median of 1.92. At exit they are still between 0.84 and 6.92 with a mean of 1.40 and a median of 1.13. Thus the betas are larger, on average, than in our base case. The mimicking portfolio has a mean IRR of 17.3%, and the regression reveals a statistically non-significant alpha of 7.2% with a slope of 0.78.

Here we see that buyouts are less risky than a mimicking strategy that focuses on the replication of the leverage only and does not control for the industry mix. Further, we realize again that the consideration of leverage risks alone is not sufficient to identify the actual outperformance of buyouts. Both, leverage and operating risks have to be considered in an accurate assessment of the risk-adjusted performance of buyouts.

In our final scenario we replicate the approach used by Phallippou and Zollo (2005), assuming initial debt/equity ratios of 3 for the buyout transactions which then decrease to the industry average until exit, and using industry-matched operating risks for the calculation of

¹¹ Refer to Bernado, Chowdhry, and Goyal (2004), table 1, panel C, means of 1978-2002 data column.

the mimicking portfolio. This results in betas ranging between 0.30 and 6.90 at closing with a mean average of 1.50 and a median of 1.03. The betas decrease until exit to a range between 0.30 and 2.37 with a mean of 0.82 and a median of 0.73. It turns out that this approach is similar to our in terms of the betas achieved, but our base case still has little larger average equity betas. Accordingly, the mean IRR to the mimicking portfolio of 12.5% is slightly lower than in our base case.

The regression yields very interesting findings. Given the lower mean IRR of the mimicking portfolio in this case, one would expect the alpha to be larger than in our base case. However this is not the case. This scenario finds a statistically non-significant alpha of 11.8%. The reason for this lies in the change in the shape of the regression. In fact the regression slope increases to 0.71 compared to our base case of 0.63. Obviously the latter scenario is riskier than our base case, compared to the levered mimicking portfolio. Once again, this highlights the necessity to correctly specify the leverage risks in every individual transaction, rather than assuming average leverage ratios over all the buyouts. Thus this scenario qualitatively confirms the findings by Phalippou and Zollo (2005), who - using the same approach to the treatment of risk - do not find outperformance of buyouts.

b) Robustness Checks: Debt and Operating Betas

To gain further confidence into the robustness of our analyses and to better understand the sensitivity of our finding to key assumptions of our calculations, we conduct a number of (unreported) robustness checks. The results of four of these robustness checks provide interesting insights into the determinants of buyout performance and will thus be briefly discussed in this section. They focus on the role of different assumptions regarding the debt and operating betas we used in our calculation. The beta risks, and the mean IRRs of the mimicking portfolios, as well as the regression results for the sensitivity analyses are summarized in tables 4 and 5:

table 4 and table 5 about here

As a first robustness check, we test the sensitivity of our results to the calculation of the operating betas for the peer group companies. Buyout transactions often take place in niche markets in which shares might be infrequently traded. Infrequently traded assets do not sufficiently follow the market movements (Fisher (1966), Pogue and Solnik (1974), Scholes and Williams (1977), Schwert (1977), and Dimson (1979)). As a result, the business risk of the target companies could be downward biased. Along the same lines one could argue that our approach inherently leads to a lower bound of risk for the buyout transactions as we use comparables transferred from the public market to the unquoted segment. Another reason to perform this check is that we might have miss-specified the risk of debt, of debt tax shields, or the applicable tax rate in our unlevering/relevering approach (as described in the appendix).

Hence, we increase the operating risk of each of the investments in the mimicking portfolio arbitrarily by a factor that corrects for a suspected understatement of the operating betas by 25% in our calculations. Consequently, the resulting equity betas increase (always compared to our base case) to a range from 0.40 to 12.54 at closing, with a mean of 2.22 and a median of 1.70. At exit they range still from 0.40 to 12.54 with a mean of 1.50 and a median of 1.09.

As one would expect, the mean IRR of the mimicking investments increases to 15.7%. Intuitively, this larger mean should translate into a lower alpha in the regression analysis. Surprisingly however, the alpha is 13.5%, the largest and most significant value in any of the scenarios. The regression slope decreases to only 0.46, which reflects the fact that the buyouts are by far less risky than the equity of this mimicking portfolio with increased

operating risks. This analysis shows that even if our calculations of the operating betas understate the actual operating risks of the buyout transactions, our main finding regarding the risk-adjusted outperformance of buyouts still holds.

In a second check, we analyze the impact of the chosen assumption regarding the riskiness of debt. As explained in detail in the appendix, we use a debt beta of 0.41 in our base case analysis. In this check, we replicate our calculations using risk free debt to lever-up the mimicking portfolio instead. When no risk can be transferred to the lenders, the whole risk of the levered transaction has to be born by the equity sponsors. Therefore the equity betas for our mimicking transactions increase substantially. They range at closing from 0.37 to 13.74 with a mean of 2.57 and a median of 1.99. At exit they range from 0.34 to 13.74 with a mean of 1.53 and a median of 1.07 respectively.

Accordingly, the mean IRR of the mimicking investments rises to 17.6%. The regression reveals still a high, but statistically non-significant alpha of 11.5%, and a slope of only 0.53. The low regression slope can be explained by the fact that the buyouts are less risky than the equity investments of this highly levered mimicking portfolio. This analysis points to the importance of the ability of buyout investors to transfer the risk partly to the lenders. Only if they are able to do so, buyouts generate risk-adjusted returns that are significant above those of comparable public market investments.

In our third robustness check we go in the opposite direction and look at what happens if lenders take on an even higher proportion of risk than assumed in our base case. This assumption can be reasonable as high yield bonds or mezzanine money is often used in large amounts to structure buyout transactions. It is also consistent with prior research finding even higher debt betas for buyouts such as Kaplan and Stein (1990). Hence, we arbitrarily increase our debt beta to 0.50 to lever up the mimicking investments in this robustness check.

The resulting equity betas range from 0.30 to 6.70 at closing, with a mean of 1.19 and a median of 0.72. At exit the betas range from 0.30 to 6.70, with a mean of 0.92 and a median of 0.65. As more risk is transferred to the lenders now, the mean IRR of the mimicking investments decreases to 11.8% compared to our base case. However, the alpha only slightly increases to significant 12.8%, while the slope of the regression is 0.67. This leads us to conclude that the outperformance becomes larger if we assume that GPs are able to structure buyout transactions transferring a substantial part of the transaction risks to the lenders. The latter is a common feature in buyout transactions where some debt layers are often provided against insufficient or even without collateral.

The final robustness check introduces a credit spread into the set of the mimicking investments. The cost of debt does not affect the resulting equity betas, but is probably more adequate regarding the degrees of leverage to replicate the buyouts. A constant spread of 4% on the risk free rate over all the years of our sample transactions (consider that the one year US-treasury rate ranged between 10.9% and 1.2% in that period) has been chosen. A credit spread of 4% (without considering bid and ask) is, of course, a rough approximation, but only shall demonstrate the sensitivity of our model. The mimicking investments in this case, have a mean average IRR of 11.1%. However, the shape of the regression changes only slightly: the slope increases to 0.74 while the alpha stays constant at 12.6%. The significance level of the alpha even increases. Thus, we can argue that having larger cost of debt, while setting up the mimicking portfolio, better replicates real world conditions, but does not have any major influence on the results.

7. Discussion and Conclusion

In this paper, we measure the risk-adjusted performance of US buyouts in comparison to a portfolio of levered investments in the S&P 500 Index that matches the buyouts with respect to the timing of their cash flows and their systematic risks. Based on our comparison

of the IRRs of 199 US buyout fund investments between 1984 and 2004 with the IRRs from public market investments with an equal risk profile, we document the significant outperformance of this asset class gross of fees. The magnitude of outperformance is large enough to still prevail after the deduction of fees usually paid in buyout fund partnerships.

Our study builds on and extends existing work on the comparison of the performance of public and private equity in several respects. First and most importantly, it leverages the detailed information available on a large sample of individual buyouts to perform a risk-adjusted assessment of their performance. Using precise information on the valuations of individual target companies, their competitors, respectively their industry sector, and on the capital structures of the investment vehicles at the closing date and at exit, it becomes possible for us to attribute operating and leverage risk measures to every individual transaction. Thus, we can comprehensively control for the transaction risks in constructing a well-defined equally risky mimicking portfolio to which the performance of buyout investments can be compared. Our study thus overcomes one of the major challenges of performance assessment in buyouts that also has been acknowledged in existing work.

Our sensitivity analyses highlight the importance of a comprehensive risk-adjustment, that thoroughly considers operating risks and leverage risks for an accurate assessment of buyout performance. The analyses further confirm the notion that buyout investors choose industries with low operating risks, make use of financial leverage where favorably, and transfer an important portion of the risks to the lenders.

Moreover our study provides detailed insights into risk characteristics and drivers of performance of this asset class. It further contrasts the performance impact of (a) operating risk and (b) leverage risk in buyouts, with (c) the joint impact of both factors, and explicitly analyzes the importance of different assumptions regarding the riskiness of debt, debt tax shields, credit spreads and the operating risk of the transactions.

But how do we explain the finding of buyouts outperforming public market investments? One possible answer could be, that in fact there is no excess return at all and that we simply discovered an illiquidity premium. However, for the typical buyout investors, such as pension funds, funds of funds, university endowments, etc. the illiquidity of buyout fund investments is less of a concern in their well-diversified portfolios. So the finding of buyouts outperforming public market investments could explain the increasing popularity of this asset class among institutional investors.

If, on the other hand, we conclude that buyout outperformance, beyond what investors could demand as illiquidity premia, is a fact, several theoretical arguments can be made to explain it. Possible reasons for this outperformance could be given either by arguments of the free cash flow hypothesis or by some kind of mispricing in the unquoted market segment. One could argue that there exist arbitrage opportunities between the quoted and the unquoted market segment. Sophisticated investors collect information to overcome information asymmetries and benefit from these opportunities.

Alternatively, according to the free cash flow hypothesis, advantages of the buyout transactions could arise from the efforts of active investors in private companies and from the burden of debt.¹² The efforts range from the implementation of incentive schemes to align interests, to closer monitoring and improved governance of the holdings. Such initiatives and the burden of debt can lead to superior productivity, hence to growth of free cash flows and company valuations. Moreover, the specific governance structure of buyouts and the effect of the active ownership of the buyout fund managers together with efforts by management

¹² See Jensen (1986), Jensen (1989a), Jensen (1989b), Kaplan (1989a), Kaplan (1989b), Hite and Vetsuypens (1989), Lehn and Poulsen (1989), Marais, Schipper, and Smith (1989), Lehn, Netter, and Poulsen (1990), Lichtenberg and Siegel (1990), Asquith and Wizman (1990), Palepu (1990), Smith (1990), Opler (1992), Holthausen and Larcker (1996), Bae and Simet (1998), Elitzur, Halpern, Kieschnick, and Rotenberg (1998), Nohel and Tarhan (1998), Wright, Hoskisson, Busenitz, and Dial (2000), Cotter and Peck (2001), Holmstrom and Kaplan (2001), and Bruton, Keels, and Scifres (2002).

teams may lead to a reduction of operating risks e.g. by focusing on safer (i.e. less volatile) business strategies.

8. Chart and Tables:

Chart 1: IRRs Net of Fees of 244 Later Stage Buyout Funds, Provided by Thomson Venture Economics and Simulation of 244 Funds where Each Fund Randomly Draws 30 Transactions of our Sample with Capital Weighted IRRs Gross of Fees

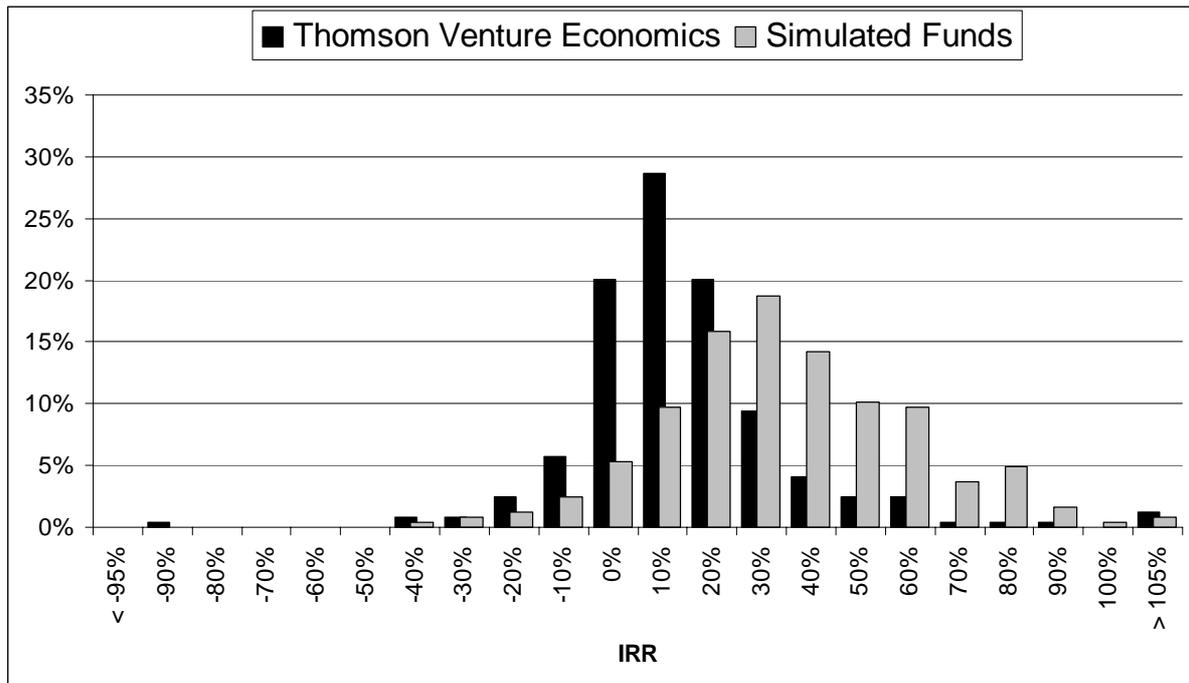


Table 1: Descriptive Statistics of Sample Data

	Min	Max	Average	Median	Std. Dev.
Closing Date	Nov 84	Mar 03	Nov 95	Jul 96	
Exit Date	Feb 88	Jun 04	Jul 99	Dec 99	
Holding Period [years]	0.08	15.08	3.67	3.08	2.63
Equity Stake at Closing	8%	100%	76%	86%	25% (pts.)
Equity Stake at Exit	8%	100%	74%	86%	27% (pts.)
Initial Debt/Equity	0.00	17.05	2.94	2.49	2.75
Exit Debt/Equity	0.00	14.09	1.28	0.64	1.99
Enterprise Value at Closing [\$m]	3.50	almost 9,000	343.52	88.00	870.17
Enterprise Value at Exit [\$m]	0.001	almost 13,500	547.90	135.00	1,366.82
Equity Investment [\$m]	0.20	almost 1,150	46.53	18.00	100.70
Final Payoff [\$m]	0.001	Almost 1,800	145.42	57.80	580.22
IRR (p.a.)	-100.00%	472.00%	50.08%	35.70%	91.66% (pts.)

Table 2: Equity Betas for the Base Case and 4 Scenarios

#	Scenario	Closing				Exit			
		Min	Max	Mean	Median	Min	Max	Mean	Median
0	Base Case	0.30	7.96	1.40	0.94	0.30	7.96	1.01	0.71
1	Kaplan/Schoar (2005)	1	1	1	1	1	1	1	1
2	Industry Mix	0.31	2.04	0.78	0.70	0.31	2.04	0.78	0.70
3	Leverage Only	0.84	8.20	2.11	1.92	0.84	6.92	1.40	1.13
4	Phallippou/Zollo (2005)	0.30	6.90	1.50	1.03	0.30	2.37	0.82	0.73

Table 3: Mean IRRs of the Mimicking Portfolios and Regression Results of the Scenarios

#	Scenario	Mean IRR of Mimicking Portfolio	Regression Alpha	Regression Slope	R ²	t Value Alpha	t Value Slope
0	Base Case	12.9 %	*12.6 %	*0.63	0.025	1.717	2.262
1	Kaplan/Schoar (2005)	11.9 %	4.3 %	*1.38	0.064	0.550	3.656
2	Industry Mix	9.7 %	6.8 %	*1.44	0.052	0.887	3.302
3	Leverage Only	17.3 %	7.2 %	*0.78	0.056	0.965	3.407
4	Phallippou/Zollo (2005)	12.5 %	11.8 %	*0.71	0.029	1.597	2.444

*) significant on a 95% level

Table 4: Equity Betas for the Robustness Checks

		Closing				Exit			
#	Robustness Check	Min	Max	Mean	Median	Min	Max	Mean	Median
1	Increased Operating Betas	0.40	12.54	2.22	1.70	0.40	12.54	1.50	1.09
2	Risk Free Debt	0.37	13.74	2.57	1.99	0.34	13.74	1.53	1.07
3	Increased Risk of Debt	0.30	6.70	1.19	0.72	0.30	6.70	0.92	0.65
4	4% Credit Spread	0.30	7.96	1.40	0.94	0.30	7.96	1.01	0.71

Table 5: Mean IRRs of the Mimicking Portfolios and Regression Results of Robustness Checks

#	Robustness Check	Mean IRR of Mimicking Portfolio	Regression Alpha	Regression Slope	R ²	t Value Alpha	t Value Slope
1	Increased Operating Betas	15.7 %	*13.5 %	*0.46	0.031	1.914	2.526
2	Risk Free Debt	17.6 %	11.5 %	*0.53	0.041	1.608	2.917
3	Increased Risk of Debt	11.8 %	*12.8 %	*0.67	0.024	1.734	2.209
4	4% Credit Spread	11.1 %	*12.6 %	*0.74	0.035	1.778	2.677

*) significant on a 95% level

9. Appendix: Setting up the Mimicking Portfolio

We take the perspective of a well diversified investor who is not exposed to idiosyncratic risks of the particular buyout transactions. Accordingly, timing and equity betas of the mimicking strategy have to correspond to those of the buyout transactions. To track the transactions, we construct an index portfolio and allow funds to be borrowed or lent. We assume that borrowing and lending is possible in unlimited amounts at the risk free interest rate. In the course of robustness checks, this assumption is stressed to investigate the effect of credit spreads. We use the total return calculations for the S&P 500 Index, provided by DataStream as the performance benchmark. This index assumes dividends to be reinvested, which accurately reflects the fact that during buyout transactions dividends are not usually paid. The exact approach to track the equity betas of individual buyout transactions is described in the following.

a) Framework

For the theoretical background for our mimicking strategies we refer to Modigliani and Miller (1958), assuming that every company is exposed to some unavoidable and constant economic risk by its business. This risk has to be borne by the investors of a company. If a company is fully equity financed, the investors are directly exposed to that risk. If debt financing is used, risk is allocated to the equity investors and the debt providers according to ratios discussed below. For the purpose of our analysis, the constant risk class assumption means that a risk class shall be attributed to every target company defined by the operating risk of its public peers. This assumption merits discussion in general,¹³ but especially regarding buyouts. There, efforts are often made by management teams to reduce operating risks e.g. by focusing on safer (*i.e.* less volatile) business strategies.¹⁴ However, we cannot correct for this kind of risk class transition because: first, we do not have sufficient information about the strategic activities of the target companies after closing, and second, we would be unable to assess how the activities had influenced the companies' business risk. For these reasons, we base our approach on the assumption of unchanging risk classes.

There are also practical reasons to assume constant risk classes since it is practically impossible to identify adequate peer group companies and obtain the necessary data for the time our sample transactions actually took place. Hence, we perform all the calculations for the business class-risks with present data. Therefore the peers' weekly stock prices and annual balance sheet data between 1999 and 2003 are used. The results are then transferred to the time of the actual transaction. In this way, we assume that typical business class risks remain constant even over a very long time horizon.

¹³ For early discussions of the constant risk class hypothesis refer to Ball and Brown (1967), who argue, that according to some typical ratios, different risk classes can be attributed to enterprises. Gonedes (1969) tests the constant risk class assumption. He finds some support against the hypothesis. Sharpe and Cooper (1972) investigate risk classes at the New York Stock Exchange and find evidence for the existence of constant risk classes.

¹⁴ Some evidence that target companies focus less risky businesses after buyouts close is provided by Hite and Vetsuypens (1989), pp. 959, Kaplan (1989a), pp. 224, Lehn and Poulsen (1989), pp. 776, Marais, Schipper, and Smith (1989), pp. 167, Asquith and Wizman (1990), pp. 197, Muscarella and Vetsuypens (1990), pp. 1398, Palepu (1990), pp. 248, Smith (1990), pp. 145, Opler (1992), pp. 28, Holthausen and Larcker (1996), pp. 328, Bae and Simet (1998), pp. 159, Elitzur, Halpern, Kierschnick, and Rotenberg (1998), pp. 352, Nohel and Tarhan (1998), pp. 197, Cotter and Peck (2001), pp. 105, Holmstrom and Kaplan (2001), pp. 127, and Bruton, Keels, and Scifres (2002), pp. 713. The operating risk is thereby generally expressed by the steadiness of operating earnings or by the ratio between fix costs and variable costs.

1. Unlevering the Peer Groups' Business Class Risks

Since buyout transactions often occur in very particular niche markets we do not want to rely on broad industry definitions to classify our sample transactions. We rather aim to be as precise as possible assigning peer groups to our 133 sample companies and identify their 116 different industry sectors. Some transactions are initial acquisitions followed by consolidating investments in the same industry. Other transactions were made simply in the same business. For these industry sectors we determine peer groups of quoted comparable companies. A peer group is defined by an equal four-digit SIC code and by company headquarters in the United States. For some transactions, the principal competitors are named in the documents, thus facilitating the peer group analysis. The majority of the peers however, is defined by the description of the relevant market and the target companies' products/services. This approach leads to suitable peer group samples. An advantage of focusing on later stage transactions is that reasonable comparable quoted companies usually exist. The accuracy of the peer group selection is qualitatively verified by comparing the major business units and products of the peers and the targets. As an additional filter we require the peer companies to be traded regularly.

We decided that in order to be meaningful, a peer group has to consist of at least three companies. In a few cases we find more than 20 peer group members. In these cases, we narrow the search by including an appropriate company size in terms of market capitalization. We eliminate those companies from the peer group that are out of the range of 50% to 200% of the equity value of the target. We are aware that this approach excludes non-successful competitors with low market capitalization that might face operating difficulties or even bankruptcy. However, this is in line with our basic assumption of not incorporating non-systematic risk such as bankruptcy. Finally we identify 1,207 peers to be incorporated in our analysis.

We measure the business class risks for our transactions by a market-weighted average of the unlevered beta factors of the relevant peer group companies. To gain these beta factors, we calculate the actual levered beta factors of every single peer-group company using the S&P 500 Index as a benchmark and weekly returns from January 1999 to December 2003. To unlever these beta factors, we determine leverage ratios of the companies during the same time from balance sheet and market data, obtained from DataStream. Therefore we net total debt of each period (which includes short and long-term interest bearing debt) by cash positions and divide it by the year-end market capitalizations (of straight and preferred equity). Finally, we determine the arithmetic average over the periods. Thus, we assume the nominal value of balance sheet debt to equal its market value. This implies that the beta factors reflect current leverage ratios, but do not anticipate them. Once we determined the arithmetic average of the leverage ratios we use a beta transformation formula to derive the hypothetical beta factor for the company without any debt. Such a formula has to consider the role of the tax benefit of debt financing (the tax savings that result from deducting interest from taxable earnings). In the simplest case where debt is perpetual and risk free, the interest expense can always be fully deducted from the taxable earnings, and the tax rate and the interest rate do not change, the capitalized value of the tax shield simplifies to τD .¹⁵

While in general, the assumption of unchanging risk classes has to be accepted, the postulate of debt being risk-free should be stressed for our analysis to allow for real market conditions, such as credit risk on corporate bonds. Mandelker and Rhee (1984) present how

¹⁵ This was originally derived by Modigliani and Miller (1958 and 1963), first empirically tested by Hamada (1972) and transferred into the CAPM by Rubinstein (1973). Refer to Drees and Eckwert (2000) for a critique of this approach.

operating company risk is borne by equity investors and risky debt providers according to the applied leverage ratio:¹⁶

$$\beta^u = \frac{\beta^e + \beta^d(1 - \tau)\frac{D}{E}}{1 + (1 - \tau)\frac{D}{E}} \quad (2)$$

where:

- β^d systematic risk borne by debt providers (debt beta)
- β^e systematic risk borne by equity investors (levered equity beta)
- β^u systematic operating risk (unlevered beta)
- τ marginal tax rate
- D market value of debt (all tax-deductible sources of capital such as senior, subordinated and mezzanine debt)
- E market value of equity (common and preferred)

Having calculated a debt beta factor β^d (which is discussed subsequently), and fixed the marginal tax rate at 35%,¹⁷ we can calculate the unlevered beta factor for every single peer-group company applying its average debt-to-equity ratio. Finally, we determine the market capitalization weighted average of the unlevered beta factors of all the companies of a peer group. We refer to this as our measure for the systematic operating risk of the target companies.¹⁸

2. Levering Up the Individual Transactions

Formula (1) reflects the assumption that uncertainty regarding the company's ability to gain the tax benefits from debt financing is best measured by the rate at which its creditors lend the money. This is the cost of debt r^d . As long as the leverage ratios are moderate, this seems to be the correct relationship between the systematic operating risk and the risk borne by the shareholders and debt financiers. If leverage ratios increase, the company may be unable to realize the tax benefits either fully or partially, simply because it does not generate sufficient income and will be unable to carry losses forward.¹⁹ The risk of not being able to fully profit from debt finance is then as high as the risk of obtaining the income itself (the operating systematic risk). Then, the more appropriate rate for discounting the tax benefits equals the unlevered cost of capital.²⁰ The operating company risk is then borne by the equity and debt investors according to the following relationship:²¹

$$\beta^u = \frac{\beta^e + \beta^d\frac{D}{E}}{1 + \frac{D}{E}} \quad (3)$$

¹⁶ See Mandelker and Rhee (1984), equation (3) and footnote 2.

¹⁷ See for a similar approach Graham (2000).

¹⁸ A comprehensive discussion regarding degrees of operating and financial leverages and the implications on operating and equity beta factors is lead by Hamada (1972), Gonedes (1973), Lev (1974), Beaver and Manegold (1975), Hill and Stone (1980), Gahlon and Gentry (1982), Frecka and Lee (1983), Huffman (1983), Mandelker and Rhee (1984), Lee and Wu (1988), Healy and Palepu (1990) and Darrat and Mukherjee (1995).

¹⁹ See Modigliani and Miller (1963), Footnote 5.

²⁰ See the discussions about this topic in Myers (1974), p. 22, Riener (1985), pp. 231, Myers and Ruback (1987), p. 9, Kaplan and Ruback (1995), p. 1062, Arzac (1996), pp. 42 and Graham (2000), pp. 1917.

²¹ See Ruback (2002), Equation 34.

We assume that for the publicly quoted companies of our peer groups, the degrees of leverage are moderate and therefore, the tax benefits are discounted by the cost of debt. We follow Kaplan and Ruback's (1995) argument regarding buyout transactions and capitalize the tax benefits by the operating cost of capital. Hence, we make use of Formula (2). This approach is based principally on two typical features of buyout transactions. First, on average, the amount of debt used in initiating a buyout leads to leverage ratios far higher than the average debt-to-equity ratios of quoted companies.²² This results in a higher risk association with tax shields because the companies might not achieve enough income to fully benefit from the tax-deductible interest payments. Second, attempts are usually made to redeem debt levels as quickly as possible. Therefore, it is common to liquidate assets and to use free cash flows for debt service.²³ This results in uncertain and highly negatively correlated future debt levels to free cash flows generated by asset sales and by the operating business. Hence the uncertainty about future interest payments (and therefore the tax benefit) is as high as the uncertainty about the operating business.

As discussed, the resulting equity beta factors are influenced by the assumption regarding the risk of achieving the future tax shields. Since some transactions in our sample have lower debt levels and therefore higher probabilities of benefiting from tax shields, it could be argued that Formula (1) is more appropriate at least for some of the transactions. Further, it could be argued, that in accordance with Kaplan (1989b), the tax benefits of buyout transactions are most meaningful to investors. Thus the investors ensure that the risk of receiving the tax benefits is rather low and therefore again, Formula (1) would be the more appropriate to lever up the beta factors for the buyout transaction. Since both arguments seem rich, we consider both approaches in the sensitivity analysis.

Again, after having specified the systematic risk of debt β^d (as described in the following section), we can calculate the equity betas for every single buyout and adjust them annually for the redemption abilities of the target companies. This provides *ex post* equity beta transition patterns between closing and exit for the individual transactions.

3. Deriving Debt Betas

We next need to specify the systematic risk of debt in order to be able to lever and unlever the systematic equity risk according to Formulas (1) and (2). We distinguish between the moderately levered publicly traded companies and the (in general) more highly levered buyout transactions. An adequate measure of the systematic risk of the debt layers of the quoted companies would be provided by the beta factor of investment grade debt. Due to different maturities and decreasing durations and therefore, decreasing volatility over time, it is not clear which bonds would be best suited to measuring systematic debt risk.²⁴ This problem is exacerbated when calculating a risk proxy for the buyout debt. Therefore low grade/high yield bonds would be the benchmark. These bonds usually have larger coupon payments, are called, converted or default more frequently than investment grade bonds.²⁵ This leads to the problem that on average the duration and hence, the volatility, might be even lower than for investment grade bonds.²⁶

²² See De Angelo, De Angelo, and Rice (1984), pp. 373, Marais, Schipper, and Smith (1989), pp. 159, Kaplan and Stein (1993), table 3, Cotter and Peck (2001), pp. 105 and our table 1.

²³ See Shleifer and Vishny (1992), pp. 1362 and Kaplan and Stein (1993), pp. 333

²⁴ See Fisher and Weil (1971), Boquist, Racette, and Schlarbaum (1975), Lanstein and Sharpe (1978), pp. 657, Livingston (1978) and Cox, Ingersoll, and Ross (1979).

²⁵ See Altman (1989), pp. 913, Asquith, Mullins, and Wolff (1989), pp. 928, and Blume, Keim, and Patel (1991).

²⁶ See Cornell and Green (1991), pp. 47.

We follow Cornell and Green (1991) and calculate average debt beta factors from the price data of open-end bond funds. This resolves the issue of lacking price data on low-grade bonds, defaults, calls, and conversions. We retrieved weekly gross returns and 2004 year-end market capitalizations for 314 open-end funds investing in investment-grade corporate debt and we retrieved the same data for 101 open-end bond funds investing in low-grade debt securities.²⁷ Using the S&P 500 Index as a market proxy over a two-year horizon, we calculated the beta factors for each fund. We then determined the market capitalization weighted average for the investment grade and for the high yield samples. For the investment grade sample, we determined a debt beta factor of 0.296 and of 0.410 for the high yield sample. Since the risk profile of our sample transactions is highly dependent on the assessment of the debt betas, we will perform a sensitivity analysis and include other research results on debt beta calculations.

Blume, Keim, and Patel (1991) directly calculate betas with the S&P 500 for different periods using Scholes and Williams' (1977) and OLS-regressions of returns on government bonds and on low-grade bonds with at least ten years to maturity. They find beta factors for the government bonds ranging between 0.16 and 0.83 and betas for the low-grade bonds of between 0.32 and 0.71 (less than the maximum of the government bonds!). Cornell and Green (1991) calculate debt betas for different bond risk classes and periods using bond fund returns. Their investment-grade debt betas range from 0.19 to 0.25 and their high-yield betas range from 0.29 to 0.54.

Kaplan and Stein (1990) determine implied debt betas for a sample of 12 leveraged recapitalizations of publicly quoted companies. They calculate equity beta factors before and after the transactions and provide the implied debt betas under two different assumptions. In this way, they use three different estimation models. With their first assumption, that operating risks do not change, they find that the equity betas rise surprisingly little, between 37% and 57% on average (depending on which method is used to estimate them). This leads to average (median) implied debt beta factors of 0.65 (0.62) for all debt layers of the individual transactions, such as senior and junior debt. Their second assumption is that the operating beta factor is reduced by approximately 25%. This reduction is linked to the market-adjusted premium paid at the recapitalization, which could represent an anticipation of decreased fixed costs. In this case, the corresponding average (median) implied systematic debt risk is 0.40 (0.35). The method developed by Kaplan and Stein (1990) also offers an alternative way of calculating reduced operating beta factors. If a fixed beta factor for the debt is inserted into their model, a hypothetical reduced operating beta factor can be calculated. They refer to Blume, Keim, and Patel (1989) who provide beta factors for low-grade bonds during different time periods, and use 0.25 as the debt providers' systematic risk for the relevant period.²⁸ This results in an average reduction of operating betas by 41%. Kaplan and Stein (1990) argue that their research should be best considered as yielding ranges of risk, rather than a single estimate. Following their reasoning, the above-cited information on debt betas will be addressed in our sensitivity analysis. Also, in a few cases the debt betas are larger than the calculated unlevered betas of the target companies. Since equity claims (as residual claims) must be at least as risky as debt claims, we always truncate the risks of debt at the levels of the operating risks. This assumes that in the less risky transactions, debt and equity investors bear the same (low) risk.

²⁷ Data was retrieved from Bloomberg.

²⁸ See Blume, Keim, and Patel (1989) published (1991), table V.

b) Treatment of the Individual Transactions

Each transaction is analyzed thoroughly in terms of the timing and the character of the underlying cash flows. Our data provides us with the dates and payments at closing and at exit and for add-on investments and premature distributions. Likewise, principle claims linked to the equity and debt cash flows are recorded. For our analysis, common and preferred equity are treated as equivalent. Similarly, all debt is treated as straight debt. Unfortunately, lacking information about the structure of claims, we cannot differentiate rankings or collateral for particular debt layers. We assume that all buyout fund investments are equity investments unless they are explicitly declared as higher ranking properly collateralized debt instruments. If this is the case, this amount is deducted from the fund's exposure, in order for us to focus on equity risk and performance. This approach considers the fact that investments by a buyout fund can usually be regarded as equity investments in terms of their inherent risk. Even if investments are structured as debt (e.g. shareholder loans), their economic character and risk differs from that of loans. They are usually of a junior rank and are unaccompanied by substantial collateral, thus making all investments resemble equity. All remaining layers other than common or preferred equity provided by third parties are treated as debt.

To build the mimicking portfolio we attribute the same systematic risk as that of the buyout transactions to the mimicking cash flows. The systematic risk for buyout investors consists of the two elements of operating risk and leverage risk. For the operating risks, we use the peer group operating betas as proxies. The leverage risk is determined by the individual transaction structure adopted (and subsequently changed) in the buyout transaction. We know all cash flows from and to investors within the buyout and we know the capital structures for the entry and the exit dates. With this data, we can calculate the initial leverage ratios and the ratios at exit. Between closing and exit we assume that the leverages change linearly. Kaplan (1989) finds evidence for asset sales and immediate reduction of the degree of leverage following the closing of buyout transactions. Muscarella and Vetsuypens (1990) and Opler (1992) report decreasing investments after closing, while Zahra (1995) cites lower R&D expenditure. Their results are compatible with the buyout strategy of focusing on core businesses and improving operations and organization during the holding period. However given this, the typical deleveraging pattern should be hyperbolic rather than linear but given the absence of parameters for estimating a hyperbolic function we retain the linearity assumption.

In order to determine a transaction's risk structure we must differentiate between two general outcomes. First, the investment was successfully exited, providing us with the company valuation and hence the degree of leverage at exit. These transactions will be referred to as "non write-offs". Second, the investment was written off ("write-offs"). We assign different assumptions regarding the leverage linearity to both outcomes. The "non write-offs" are entered and exited at certain leverage ratios. During the holding period the leverage ratio either decreases (as in most cases), it linearly grows or stays constant. The "write-offs" are entered into at a given degree of leverage and by definition, are written off at an infinitely large leverage ratio. This is because the equity value approaches zero while the debt is usually somehow collateralized and therefore retains some value. This leads to problems in terms of the mimicking strategies, because it implies the unrealistic need to leverage investments in public market securities to an infinite exposure. Therefore, we refer to the cause of bankruptcy and assume that the investment was written off because covenants were breached and debt providers claimed their rights. In most cases, this should explain the loss of invested capital. With this reasoning, one can argue that the targeted leverage ratios, defined by loan contracts and covenants could not be maintained. The debt providers in

buyouts usually do not allow their risk to be increased. On the contrary, they insist on debt redemption. For us, this leads us to keep leverage risk constant over the total holding period of the “write off” transactions. As the leverage ratios could not be successfully lowered, and banks would not allow them to be increased, this would appear to be the most rational treatment of them. This approach is further supported by accounting guidelines and best practice rules of immediately writing off investments once substantial changes in value such as a breach of covenant takes place.²⁹

In the simplest case without add-on investments and premature disbursements, the cash flows can then be duplicated by a single payment at closing and a single payoff at exit. The initial payment takes place at a certain systematic risk level characterised by the operating risk and the additional leverage risk. The systematic risk level at closing is determined by the initial equity beta of the corresponding buyout. The mimicking strategy is structured by investing the same amount of equity in the S&P 500 Index portfolio and leveraging it up with borrowed funds to achieve an equal systematic risk. If the equity beta of the buyout is lower than one, funds are lent. We assume that the buyouts are settled on the last trading day of the proposed month. The systematic risk of the mimicking strategy is adjusted each year until exit, to secure parity with the buyout. Therefore, the mimicking portfolio is liquidated every year, interest on debt is paid, debt is redeemed and the residual equity is invested in the S&P 500 Index portfolio being levered to the prevailing systematic risk. Again, if the prevailing beta factor is lower than one, funds are lent. In a first setting, we assume risk free borrowing and lending at the one-year US treasury-bill rate. In the sensitivity analysis we introduce a credit spread, but without bid and ask differences. The value change of the benchmark portfolio is measured by a total return index on the S&P 500 index provided by DataStream. The risk adjustment procedure is repeated until the exit date. The final payoff of the mimicking strategy and the initial equity investment determine its internal rate of return. If the residual equity of a mimicking investment approaches zero at any time within the holding period, the position is closed, and the internal rate of return is calculated up to that point.

c) The Treatment of Add-on Investments and Premature Payoffs

To consider add-on investments by the funds and premature payoffs to the funds, we need to know the amounts and the investment dates. For the “non write-offs” we simply extrapolate the equity beta at the time of either the add-on investments or the early disbursements. Provided that the payments are not accompanied by changes in debt, they immediately affect the leverage ratios and then follow the same risk pattern as the initial investments. Since we have details of neither the company valuations, nor the prevailing leverage ratios at the time of the add-on investments or disbursements, we cannot correct for the “leverage-jumps”. We implement add-on investments and disbursements in our linearity approach. The add-on investments are reflected by the degrees of leverage at exit and hence are incorporated into the transactions’ final risk levels. This approach might smooth the overall risk patterns. However, if the equity add-on is accompanied by debt in the same proportion as the prevailing capital structure at that time, this approach should hold true. In the mimicking strategy, add-on payments are treated like the initial investments, but take place at a later stage. From the time they are made, they follow the same risk pattern as the initial transaction. Early disbursements lower the capital at risk and therefore we deduct them at the relevant month from the prevailing equity. We determine the internal rate of return of the mimicking strategy until that date and calculate the present value of the disbursement at the transaction closing. That present value is then subtracted from the initial payment giving

²⁹ See e.g. EVCA (2003).

us two separate cash flows. The remaining equity following disbursement is retained in the mimicking portfolio until the exit, except should it have become zero or negative. In this case, the position is closed on the disbursement.

For the “write offs” the approach is straightforward.³⁰ Add-on investments in the “write off” cases are usually made to prevent the debt providers from claiming bankruptcy. Debt is recapitalized by equity. The add-on payments would lower the leverage ratio immediately. However, the debt providers would not necessarily have asked for additional equity if the company’s prospects were still good. Debt providers thus demand the payment in order to maintain an acceptable leverage ratio. This leads us to consider that the leverage ratios are unaffected by the add-on investments in “write off” companies. This is supported by the fact that these engagements finally had to be written off, meaning that the debt claims could obviously not be serviced sufficiently and hence the leverage ratios could not be lowered.

d) Changes in Ownership

In some transactions the ownership structure changes within the holding period, either due to non-proportional add-on investments or distributions or by any execution of contingent claims such as conversion rights, or call or put options. If the ownership structure changes, it is noted in the transaction description but not in sufficient detail to permit further investigation. We account for these types of changes in the proportion of the equity stake at exit, thus again assuming that all changes in ownership structure develop linearly over the holding period.

³⁰ Premature disbursements in “write-off” transactions were not observed in our sample.

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