Measuring the Risk-Adjusted Performance of US Buyouts

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Keywords: Private Equity, Risk-Adjusted Performance, Buyout, Benchmarking Alternative Assets

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1. Introduction

Since the late 1970s buyouts[1] have become an important asset class with significant economic impact.[2] 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 in several important characteristics, especially regarding liquidity and information symmetry. This implies theoretical challenges with respect to the assessment of their risk and return. Second, buyout investments are a sub-category of the private equity asset class for which general disclosure requirements do not exist. In the absence of 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 with 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), as well as the financial leverage and industry characteristics of 133 US buyouts. 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 financing the transaction, the risk decreases in the following periods as debt is repaid. Our mimicking portfolio replicates this 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 buy-in, etc.) and these terms are often used synonymously. In this paper the term "buyout" is preferred as being the broadest covering the different facets of this transaction type.

2 The historical evolvement of the asset class, different cycles and its economic impact are well reported in Lowenstein (1985), Sahlman and Stevenson (1985), Sahlman (1990), Smith (1990), and Kaplan and Stein (1993) for the late 1970s and 1980s. See Jeng and Wells (1998) for the 1980s and 1990s. See Gompers and Lerner (1999a) and (2000) for an overall summary, and see the current yearbooks of the National Venture Capital Association and the European Private Equity and Venture Capital Association for actual market data.

The chosen public market equivalent approach is not intended to imply that buyouts can be replicated adequately with traded securities. It is simply used to track them in what we regard as the best possible way. 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 providers of capital for buyout transactions. Consequently, we do not consider idiosyncratic risks in our analysis. We assume that the investor has the choice of either investing in buyouts or in quoted assets. Thereby we control for the systematic risks involved and investigate which asset class yields *ex post* superior returns.

The contribution of this paper is several. First, we propose a method to benchmark the buyout asset class with the public market that could evolve into a standard for buyout performance measurement. Second, we apply this method in an empirical analysis on a comprehensive and unique data set and document that, after correcting for sample-selection bias, buyouts outperformed the public market by 12.6% p.a. gross of all fees. The magnitude of the outperformance exceeds the typical level of fees and it has to be stressed that the benchmark portfolio performance is also calculated gross of all fees. The outperformance is persistent in several robustness checks.

Third, our sensitivity analyses and robustness checks provide further insights into the nature of buyout transactions and the drivers of their performance. The analysis confirms that in general buyout fund managers seek to invest in low-risk industries and that buyout transactions tend to be more successful if the buyout fund managers are able to transfer substantial parts of the risk to the lenders.

Fourth, we illustrate that it can be misleading to assess the performance of buyout transactions without thoroughly determining leverage ratios, specifying the risks borne by lenders and controlling for the systematic risks carried by the sponsors. This finding is important for the interpretation of results from some of the most recent literature, such as Kaplan and Schoar (2005), Phalippou and Zollo (2005), and Ljungqvist and Richardson (2003), as data limitations make our proposed way of risk separation impossible in these studies.

Another distinguishing feature of our study is that we focus on buyouts only, and do not mix this asset class as in many other papers, for example, with early stage venture capital (VC). This is particularly important as different types of risk tend to play a dramatically different role in the various financing stages of private equity. Finally, it is important to note that our approach relies on completed and audited transactions only. This removes the necessity of dealing with interim valuations and missing values, as reported by Rotch (1968), Poindexter (1975), Peng (2001a and 2001b), Quigley and Woodward (2002 and 2003), and Cochrane (2005). It is due to issues such as these that performance analyses become both difficult and questionable because the methods of correction transfer the historical development and return patterns on the non-exited and current transactions. This might cause a substantial additional bias due to meanwhile changed market conditions.

2. Background

Buyouts, as Sahlman (1990), and Lerner (2000) point out, represent one strand of the private equity (PE) asset class. This asset category is based on the relationship between an institutional investor and an intermediary (the PE fund or investee). PE funds are usually structured as a limited partnership, with a management team (termed the general partner) that manages the investments of the limited partners. Investors in the fund then hold shares as limited partners. Buyout funds concentrate their investments on mature companies. In most cases, the companies' shares are not traded on a public stock market, though a particular type of transaction described by Lowenstein (1985), called "going privates", target quoted companies. A defining feature of the asset class is that once a general partner has invested in a company, its shares are no longer publicly traded. The exposure is typically structured as, or highly like, equity claims (common and preferred). For each transaction an investment vehicle is created funded by one or several PE funds as well as other parties, such as senior and subordinated debt providers and mezzanine investors. The nature of these is investigated by Kaplan and Stein (1990) and Cotter and Peck (2001). 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 institutional investors' participation. The transaction vehicle acquires assets or shares of the target company and/or will merge with it, thus creating a unique opportunity highlighted by Jensen (1986) to specify a capital structure and design particular claims and incentives.

The transaction date is called the closing date. At the end of the holding period (called exit), all claims are usually sold either via privately negotiated sales or through Initial Public Offerings. Unsuccessful engagements are written off, eventually to a zero value. Some transactions might be only partly sold and/or releveraged to benefit once more from debt finance.

Buyout funds tend to act as active investors as comprehensively discussed by Jensen (1989a and 1989b). Their role involves monitoring, managing and restructuring the target companies to create value. Kaplan (1989a and 1989b), Lichtenberg and Siegel (1990), Smith (1990), Kaplan (1991) and Berg and Gottschalg (2005) argue that this is a key determinant for the success of buyout transactions. To secure their influence on the target companies, buyout funds seek to obtain the majority of voting rights either alone or together with other financial investors via equity syndications. This is not a necessary condition however, and depending on the buyout size and structure, the majorities can vary.

A second strand of the PE asset class is constituted by VC investments as discussed by Bygrave and Timmons (1992), Gompers (1998) and Gompers and Lerner (1999a and 2000).

Buyouts and venture capital differ substantially in terms of the investment risk profile. While buyout funds invest in mature companies in traditionally stable industries using financial leverage, VC funds typically acquire minority stakes of early stage businesses in volatile growth industries with minimal or no debt financing. These fundamental differences make it necessary to treat the two sub-categories of the private equity asset class separately in the assessment of risk and return; it is also why this paper focuses exclusively on buyout transactions.

3. Related Literature

Strikingly, recent research on the risk and return of private equity has lead to contradictory findings. As we will show in this section, different approaches to correct for sample selection biases and to adjust for risk 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. The key papers are discussed below before we highlight how our paper differs from the related literature.

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 fact that market valuations of PE transactions are only available at two dates (if at all): the entry and the exit date. Hence, the common risk measure standard deviation of returns is meaningless for the asset class. The authors benchmark the individual transactions by building equally weighted indexes of publicly quoted companies sharing the same three-digit SIC codes. They then analyze one single buyout fund using these indexes as a performance indicator (if neither cash payments nor write-offs exist) modeling the quarterly exposure of its investments. If a payment or write-off occurs, then a new company value can be calculated and attributed to the transaction. Gompers and Lerner (1997) concede that their approach assumes perfect correlation between the target company valuations and the chosen index. Moreover, the authors argue that this could overstate the risk involved. Using their approach, the authors find superior performance for this buyout fund.

Ljungqvist and Richardson (2003) use extensive data obtained from a fund of fund investor regarding cash outflows, inflows and management fees for investments in 73 different PE funds. To determine risk-adjusted returns they calculate industry beta factors using the methodology of Fama and French (1997). Without 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%. This greatly exceeds the S&P 500 Index performance during the same period of 14.1% per annum. The authors argue that, provided the degrees of leverage were no higher than twice the industry average, a risk-adjusted premium exists for the PE transactions. However, they acknowledge that their PE-fund sample may not be a random draw from the general population.

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. The authors use proprietary data on 5,607 companies that received venture capital in 12,553 financing rounds between 1987 and 2000. Quigley and Woodward (2002) calculate Sharpe-ratios of their VC index and of the S&P 500, and the NASDAQ Index. Both stock market indexes have to be considered superior to VC in terms of the ratio between risk and return. The authors conclude that for diversification purposes, securities portfolios should include 10% to 15% of VC exposure.

Similar to Peng (2001a and 2001b) and Quigley and Woodward (2002), 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 and this results in a sample selection bias that the author overcomes via a maximum likelihood estimate. He measures the probability of observing a return as the company values increase. His approach implies the arguable assumption that historical development patterns of the portfolio companies remain stable and are applicable to estimate the value of current and non-exited projects. Cochrane (2005) 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 risks 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. For the different NASDAQ portfolios Cochrane (2005) determines regression slopes between 0.5 and 1.4 and argues that VC can have either greater or less risk than the benchmark depending on the choice of the NASDAQ portfolio.

Similar to our 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 the same amount over an equally long period in the S&P 500 Index and comparing the PE fund performance to the Index returns. Within their approach, Kaplan and Schoar (2005) presume that PE investments are as risky as the S&P 500 portfolio and hence, have a beta equal to one. The authors conclude that average buyout fund returns are slightly smaller than those of the S&P 500. Gross of fees the asset class earns 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 performance for larger funds and more experienced management teams. Kaplan and Schoar (2005) acknowledge that their results may be misleading however, as by not controlling for different risk patterns in the individual transactions they assume that the transactions are as risky as the S&P 500 Index. They also do not correct for a potential selection bias that might exist in their sample.

Phalippou and Zollo (2005) extend the Kaplan and Schoar (2005) article. Using additional information on the characteristics of the fund's underlying investments the authors assign each transaction to an industry according to the Fama and French (1997) classification. Unlevered beta factors are then calculated with a method similar to the one we will apply to perform a risk-adjustment for operating risk. However, without data on the target companies' leverage, the authors are unable to correct for different degrees of leverage in their sample transactions. They refer to Cotter and Peck (2001) which provides information on average capital structures within buyout transactions and calculates equity beta factors with initial debt/equity ratios of 3 and final debt/equity ratios at average industry levels. Using the average buyout case, Phalippou and Zollo (2005) unlever and relever beta factors of all the sample transactions. They do not differentiate the risks of debt and the risk of debt tax shields in the quoted and unquoted market segment, and they do not differentiate between VC and buyout transactions. Based on this analysis, Phalippou and Zollo (2005) find underperformance of PE.

Our 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 in 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 a financial risk measure to every transaction. This risk measure is neither an average over several transactions nor constant over time. There is, rather, an individual risk pattern for every transaction, typically starting at higher risks due to initially higher degrees of leverage, and consecutively decreasing, due to the redemption of debt. Thus, we can control for this risk pattern by constructing a well-defined, equally risky mimicking investment to which the performance of the buyout can be compared. The consideration of leverage risk is of great importance. As Ljungqvist and Richardson (2003), Kaplan and Schoar (2005), and Phalippou and Zollo (2005) note, any findings regarding the performance of buyouts that do not appropriately adjust for the effect of leverage risk have to be interpreted with great caution. We are able to illustrate the effect of different choices regarding the treatment of risk for the relative performance of this asset class.

Further, this paper focuses exclusively on investments of buyout funds, as the category of PE in which leverage plays a crucial role. It thereby avoids mixing two asset classes (venture capital and buyouts) that have substantially different risk and return characteristics. Additionally, we only rely on fully completed (exited and audited) transactions. Hence, we avoid the problem of missing values and do not need to vaguely estimate interim valuations for our transactions from historical return patterns. Next, we provide detailed insights into risk characteristics and drivers of performance of this asset class. Our analyses document the performance differences between buyout investments on one hand and public market investments on the other, controlling for operating risk and financial leverage. Our findings contrast the performance impact of: (a) operating risk; and, (b) leverage risk; with (c) the joint impact of both factors. Moreover, we explicitly analyze the sensitivity of our results with respect to different assumptions regarding debt risk, the risk of debt tax shields, credit spreads, and operating risk in the industry sectors.

4. Data Collection and Sample Description

The availability of data of sufficient breadth and depth has been one of the key constraints in addressing the question of risk-adjusted returns of buyouts. Comparing the returns of buyout investments to similar public market investments on a risk-adjusted basis requires information on the industry segment of the target companies, the timing and size of underlying cash flows, as well as the capital structure of the acquiring investment vehicles at entry and exit. This data is not publicly available, nor is it listed in any of the commonly used databases, such as Thomson Venture Economics or VentureOne. It can, instead, only be gathered directly from institutions investing in buyouts as either general or limited partners. 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 potential biases.

a) Data Collection

Our dataset is compiled from information on buyout funds made available to us anonymously either directly from general partners or through limited partners. Limited partners collect detailed information on general partners as part of the due diligence processes for their funds. Each year, limited partners often screen hundreds of new buyout funds. In a special document (the so-called Private Placement Memorandum - PPM), general partners describe their previous transactions in order to raise a new fund. The PPM are submitted to potential limited partners and used by them to assess the general partner's quality and strategy. These documents contain information about all past transactions carried out by the general partner. The data on individual transactions used in this study has been extracted from PPM. Our data providers are among the world's largest limited partners and collectively manage more than US$40 billion in the PE asset class. Needless to say, PPM documents are highly confidential and, to the best of our knowledge, have never been used in academic research.

As no standard format exists for reporting transactions in PPMs, the documents are very heterogeneous in terms of the level of detail provided for each transaction – both, even within one fund, and across general partners. As a result, the data necessary to perform our proposed method of risk-adjustment was extracted only for a small subset of transactions. Moreover, as only fully exited transactions are considered here, the size of the available sample shrinks further. Because this study's objective is to assess the risk-adjusted performance of buyouts, we only consider investments performed by funds that refer to themselves explicitly as a "buyout fund". For instance, the 122 PPM supplied to us by our research partners described 2,264 realized buyout transactions (1,001 of which were in the US) made through 170 buyout funds raised between 1981 and 2004. This yields a sample of just 152 transactions for which the following data is 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, in order to verify that the underlying cash flows are correctly matched, the investment's gross internal rate of return reported in the PPM is needed. Even if the internal rate of return is not the only relevant performance measure, we base our calculations on this figure, because it is the most adequate measure to render the individual buyout transactions comparable to the mimicking investment. Additionally, it is the most frequently used performance measure in the private equity industry and could be found most consistently in the PPM we analyzed. The vast majority of the 152 target companies in our sample are based 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 and raising questions about cross-currency returns, the availability of public peers and adequate benchmark portfolios, we decided to exclude all non-US transactions. This leaves us with 133 transactions executed 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, meaningful additional "add-on payments" occurred in subsequent financing rounds as well as premature disbursements. These payments influence the investor's exposure and the internal rates of return on the particular transactions. Staged investments usually have a lower risk than the initial payment given the debt redemption that takes place until the moment of the add-on payment. Similarly, premature disbursements or large dividends financed by recapitalizations usually have a higher risk than at the end of the holding period. To accurately track the risks of these buyouts with the mimicking portfolio all underlying cash flows have to be matched. Our sample transactions exhibit the following characteristics (see Table 1 for descriptive statistics). The first transaction was closed in November 1984 and the last was exited by June 2004: 16 transactions were closed in the 1980s, 31 in the early and 74 in the late 1990s, while the remaining were closed in the new millennium. The holding periods range from three months to 15 years plus one month. The average and the median holding period are below four years, respectively. The equity stakes range from 8% to 100% ownership, where 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 in a few transactions represent syndicated equity layers.

Table 1 about here

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

While at closing, the enterprise values of the target companies range from $3.5 million to almost $9,000 million, the average (median) is $313.5 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 $547.9 million ($135.0 million). Similarly, the amount of equity invested ranges from $0.2 million in a small and syndicated transaction to almost $1,150 million signaling the large exposure in certain transactions. On average (median) the amount of equity invested is $53.4 million ($18.7 million). The final payoffs range between $0.001 million (a write off) and almost $1,800 million with an average of $160.4 million and a median of $63.1 million.

The descriptive statistics further reveal the diversity of the transactions made by the buyout funds, e.g. with holding periods ranging from three months to 15 years or equity exposure between $0.2 million and $1,150 million. With respect to transaction size, this observation is in line with prior research on buyout fund investments (Kaplan and Schoar 2005; Phalippou and Zollo 2005).

The internal rates of return range from –100% (total write off within a year) to as high as 472% p.a. However, the mean average IRR of all the cash flows involved in the 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 their duration, 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 equally. We also calculate the invested-capital-weighted IRR of all the cash flows, which is 30.95% p.a. These IRR figures seem high, but are consistent with those of Peng (2001a and 2001b), Ljungqvist and Richardson (2003), and Cochrane (2005). In the following section we discuss the potential bias of our sample in more detail, assess its magnitude and correct for it.

b) Selection Bias Assessment and Correction

As detailed information about the entire population of buyout investments is unavailable, we can only speculate whether our sample represents typical transaction sizes, transaction structures, leverage ratios, sourcing or exit channels, or preferred industry segments at the time. Given the long sample horizon – from 1984 to 2004 – it should be stressed that trends, market conditions, debt interest rates and disclosed returns on buyout transactions changed meaningful within that period. The entire capital market segment passed two cycles, as reported by Gompers and Lerner (1999a and 2000). However, the temporal composition of our sample with 16 transactions from the 1980s, 31 from the early, and 74 from the late 1990s, and the remainder after 2000 represents the historical evolvement of the asset class.

Available datasets on PE transactions (such as Thomson Venture Economics or VentureOne) usually do not contain any other economic information but the timing and the amount of cash flows. Additionally, it is impossible for us to trace our sample transactions in any one of these databases. Our data gathering process is not determined by any economic variable but only by the facts that we first need to have a relationship with a research partner, and second the available PPM must provide sufficient information on the track records. Due to these facts and the impossibility to track back our sample transactions in any other database we cannot quantify the extent to which our sample is biased through sample attrition via a probit estimation depending on any economic parameters.

Given the source of our data, there are good reasons for suspecting an upward bias in our sample. First, we have to consider a possible selection bias arising from the GPs' 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. 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 ours, which is derived from PPM information, will therefore be systematically biased towards the more successful fund managers that 'survive'.

To test for a possible selection bias, we compare the characteristics of the investments in our sample with the characteristics of the entire sample of 1,001 realized US buyouts derived from our 122 PPM. The latter include many buyouts for which the IRRs were reported, without additional details such as the industry sector of the acquired company or the financial structure of the transaction vehicle. The mean comparison reveals that our sample transactions do not significantly differ from this population in terms of the IRR or the holding period. Only the transaction values are significantly larger ($p<0.001$) than the average buyout in our larger database. This finding leads to the conclusion that our sample represents a random draw with respect to the internal rate of return from our overall database of PPM reported buyouts.

Next, we assess the magnitude of the bias in our sample, comparing our sample returns with return data on buyout funds from Thomson Venture Economics,[3] the industry standard for return data on private equity funds and the best possible proxy for the internal rate of return of the entire fund population.[4] From the Venture Economics dataset we derive a sample of comparable buyout funds. It is composed of 244 limited partnerships raised between 1983 and 1996 in the United States. It is probable that these funds began operations at approximately the same time as our sample's first transaction and also that they were divested by the time of the latest exit in our sample.[5]

The Thomson Venture Economics return data is aggregated on a fund level and these 244 funds correspond to 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.

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.[6] From the PPM we

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

[4] 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 buyouts, some of the selection problems discussed in the above mentioned literature, which refers to VC transactions, should not be as crucial.

[5] Rotch (1968), p. 142, already notes a six-year average holding period, Huntsman and Hoban (1980), p. 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 breakeven after eight years on average. According to our calculations, the average holding period is three years and nine months. 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.

[6] A comprehensive description and discussion of compensation models can be found in Bygrave, Fast, Khoylian, Vincent, and Yue (1985), p. 96, Jensen (1989a), p. 68, Jensen (1989b), p. 37, Sahlman (1990), p.

analyzed, we know 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:

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

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 our sample IRRs on the IRRs of the mimicking investments the difference between the mean (gross of fees) of the Thomson Venture Economics funds and our own data is deducted from the intercepts we receive. Here we follow a conservative approach, using the maximum span between the two means according to the above-mentioned alternative definitions. The maximum 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 is therefore adjusted by this offset.

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 use a bootstrapping approach and simulate several funds with our sample data to receive an IRR distribution on the fund level.

491, Murray and Marriott (1998), p. 966 Gompers and Lerner (1999a), p. 57, and Gompers and Lerner (1999b), p. 7.

We therefore randomly draw 30 transactions out of our sample 244 times and calculate the capital weighted IRRs of each of these draws. In this way, we artificially create the 244 funds out of our sample to match the 244 funds in the Thomson Venture Economics population. The results of this simulation, 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 Exhibit 1.

Exhibit 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 Mimicking Portfolio of the Buyouts

To assess the risk-adjusted performance of buyouts, we create 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, an 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 1, funds can be lent. The timing of the mimicking investments corresponds 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 used to construct the mimicking portfolio are discussed in detail in the Appendix. The approach enables the analyses described in the following section.

6. Analyses 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), and 0.64 (median) respectively. In comparison, the mean average leverage ratio of all quoted peers over the five years is 1.38, while 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 0.32 (0.05 percentile) and 1.40 (0.95 percentile). 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 unvolatile businesses for their investments and hence, the unlevered beta factors of target companies should be low in general.[7]

Third, the resulting *systematic risk* of the transactions ranges between 0.32 (0.05 percentile) and 3.88 (0.95 percentile) at closing with a mean of 1.40 and a median of 0.94. At exit the equity betas are between 0.32 (0.05 percentile) and 2.80 (0.95 percentile) 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 stated as follows:

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

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
$\tilde{\varepsilon}$	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

[7] See e.g. Jensen (1989a), p. 64, Smith (1990), p. 154, DeAngelo and DeAngelo (1987), Table 1, or Lehn and Poulsen (1989), p. 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. Our sensitivity analysis considers this case for its effect on our results.

the buyout transactions. As described, we correct for selection bias by subtracting the difference in means of gross-of-fees returns (between our sample and Thomson Venture Economics) from the regression intercept.

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. In this context, it is important to remember, that the mimicking portfolio consists of levered index investments and hence, it 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%-confidence level. Hence, the buyout transactions significantly outperform the mimicking portfolio. It must be emphasized that though this result is gross of GP management fees, returns of mimicking investments are also calculated without considering fees. The magnitude of the regression alpha is such that even if we deduct management fees, outperformance prevails.

The regression slope leads us to conclude that buyouts are characterized by less systematic risk than the levered public market equivalent.[8] In addition to this finding, 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 consistent with the results of Kaplan and Schoar (2005), and Ljunqvist and Richardson (2003), but in contrast to those of Phalippou and Zollo (2005). All three studies adopt a different approach to risk adjustment. Four sensitivity analyses were carried out to further illustrate the importance of an accurate risk-adjustment in assessing

[8] The relatively low R^2 of 0.025 is not surprising, given the large idiosyncratic risks of the individual buyout transactions.

buyout performance. In these, we use different approaches to risk adjustment in building a mimicking portfolio. We then replicate the regression of the buyout IRRs on the IRRs of each new mimicking portfolio and compare the results. The equity betas for our baseline 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 compares the buyout transactions with a time-matched series of investments in a public market index without adjusting for differences in the risk profiles. The mimicking portfolio then always has a beta of 1, in contrast to the betas in our baseline 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 case. Accordingly, the mean IRR of the mimicking portfolio decreases to 11.9%.

The regression yields very interesting findings. Given the lower mean IRR of the mimicking portfolio, one would expect it to have a larger alpha. That it does not can be attributed to the change of the regression's shape, which yields a non-significant alpha of only 4.3%, but therefore a slope of 1.38. This result is consistent with the finding of Kaplan and Schoar (2005), which reports a slightly better performance of buyouts compared with their public market equivalent, gross of fees. The increased slope 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 selection bias. Using the same approach to the treatment of risk, we are able to replicate the findings of

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 next scenario, we construct the mimicking portfolio that controls for industry mix. We apply the average equity beta factors of our peer groups to the mimicking investments without considering the additional leverage. This leads to partial risk adjustment as such a mimicking portfolio replicates the industry mix of our buyouts but fails to capture the effect of (additional) leverage. In other words, the buyouts are compared directly to an equity investment in their public peers. The approach leads to equity betas between 0.35 (0.05 percentile) and 1.46 (0.95 percentile) that are constant over the holding period. Their mean average is 0.78, and the median is 0.70. Thus, the betas are lower than both the market beta and that of our baseline 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, at 1.44, the largest of our scenarios.

This again has two important implications. First, buyouts are riskier than a mimicking strategy that focuses exclusively on the replication of the industry mix and does not control for leverage risks. Second, we see again that without taking into account leverage risks, the relative performance of buyouts cannot be measured accurately.

In a third scenario, we examine the impact of leverage alone on 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), which determines unlevered beta factors for the Fama and

French (1997) industry classification.[9] We then lever up each investment in the mimicking portfolio with the actual leverage of the corresponding buyout. This leads 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 range at closing from 0.93 (0.05 percentile) to 4.16 (0.95 percentile) with a mean average of 2.11 and a median of 1.92. At exit they are between 0.87 (0.05 percentile) and 2.65 (0.95 percentile) with a mean of 1.40 and a median of 1.13. Thus the betas are larger, on average, than in our baseline 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 without controlling for the industry mix. Further, we realize again that the consideration of leverage risks alone is not sufficient to identify the actual performance 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 Phalippou and Zollo (2005), assuming that each buyout transaction has an initial debt/equity ratio of 3 which then decreases to the industry average until exit, and using industry-matched operating risks for the calculation of the mimicking portfolio. Here, betas range between 0.32 (0.05 percentile) and 4.36 (0.95 percentile) at closing with a mean average of 1.50 and a median of 1.03. The betas decrease until exit to a range between 0.32 (0.05 percentile) and 1.70 (0.95 percentile) with a mean of 0.82 and a median of 0.73. It turns out that this approach is similar to ours in

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9 See Bernado, Chowdhry and Goyal (2004), Table 1, panel C, means of 1978-2002 data column.

terms of the betas achieved, though we still find slightly larger average equity betas. Accordingly, the mimicking portfolio's mean IRR of 12.5% is slightly lower than in our case.

This scenario gives a statistically non-significant alpha of 11.8% and the regression slope increases to 0.71 compared to our case of 0.63. Clearly, the latter scenario is riskier than our baseline case. Once again, this highlights the necessity of correctly specifying the leverage risks in each individual transaction. It seems as if buyout fund managers use debt according to the target companies' industry risk. In low-risk industries, they apply higher leverage ratios and *vice versa*. In this way, averaging the leverage ratios over all of the transactions induces misleading results. The scenario qualitatively confirms the findings by Phalippou and Zollo (2005), which – using the same approach to the treatment of risk – does not find outperformance of buyouts.

b) Robustness Checks: Debt and Operating Betas

To gain further confidence in the robustness of our analyses and to better understand the sensitivity of our findings to our calculations' key assumptions, we carry out a number of (also 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 we used in calculating our baseline case. 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 traded infrequently. As several studies have found, infrequently traded assets do not closely follow market movements (Fisher (1966), Pogue and Solnik (1974), Scholes and Williams (1977), Schwert (1977), and Dimson (1979)). As a result, the business risks of the target companies could be downward biased. Along the same lines, one could argue that our approach inherently leads to a lower risk boundary 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 misspecified 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 25% understatement of the operating betas in our calculations. Consequently, the resulting equity betas increase (always in reference to our baseline case) within the range of 0.45 (0.05 percentile) to 5.87 (0.95 percentile) at closing, with a mean of 2.22 and a median of 1.70. At exit, they range from 0.43 (0.05 percentile) to 3.90 (0.95 percentile) 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 of the risk-adjusted outperformance of buyouts still holds.

In a second check, we analyze the impact of the chosen assumption concerning the risk 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 instead replicate our calculations using risk free debt to lever-up the mimicking portfolio. When no risk can be transferred to the lenders, all the 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 0.69 (0.05 percentile) to 6.39 (0.95 percentile) with a mean of 2.57 and a median of 1.99. At exit they range from 0.47 (0.05 percentile) to 3.88 (0.95 percentile) 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 a still 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 risk in some part to the lenders. It is only if they are able to do so, that buyouts generate risk-adjusted returns that are significantly higher than those of comparable public market investments.

In our third robustness check we investigate what happens if lenders take on an even higher proportion of risk than that assumed in our baseline case. This assumption is reasonable as high yield bonds or mezzanine funding is often extensively used to structure buyout transactions. It is also consistent with prior research that found 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.

The resulting equity betas range from 0.32 (0.05 percentile) to 3.36 (0.95 percentile) at closing, with a mean of 1.19 and a median of 0.72. At exit, the betas range from 0.32 (0.05 percentile) to 2.68 (0.95 percentile), with a mean of 0.92 and a median of 0.65. As more risk is transferred to the lenders, the mean IRR of the mimicking investments decreases to 11.8%. However, the significant alpha only slightly increases to 12.8%, while the slope of the regression is 0.67. This leads us to conclude that the outperformance becomes greater if we assume that GPs are able to structure buyout transactions transferring a substantial part of the transaction risk to the lenders. This is a common feature in buyout transactions where debt layers are often provided against insufficient or no collateral.

A fourth robustness check introduces a credit spread into the set of mimicking investments. The cost of debt does not affect the equity betas. But, introducing higher cost of debt is probably more appropriate than using the risk-free rate 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 has been chosen (consider that the one-year US-Treasury rate ranged from 1.2% to 10.9% during the period). A credit spread of 4% (without considering bid and ask) is, of course, a rough approximation, but adopting it will demonstrate further 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 a higher cost of debt in the mimicking portfolio better replicates real world conditions, but without any large impact on the results.

In the final robustness check we exclude those transactions from our sample that could be considered "atypical" or outliers of other buyout transaction. Even with full data regarding the transactions, some would be characterized by relatively low leverage ratios, minority ownership of the active investor, or either very short, or long holding periods. Hence, we exclude transactions from our sample with a debt/equity ratio below 0.25 and where the institutional investors' equity ownership is below 50%. We further exclude transactions with holding periods below a year and above nine years. Finally, we exclude the most successful transactions with internal rates of return above 200% p.a.. This results in a reduced sample of

108 transactions. The equity betas then range between 0.31 (0.05 percentile) and 3.89 (0.95 percentile) at closing, with a mean of 1.32 and a median of 0.91. At exit, the betas range from 0.31 (0.05 percentile) to 3.12 (0.95 percentile) with a mean (median) of 1.01 (0.70). Excluding the outliers from the sample leads to a lower average internal rate of return of 33.19% p.a., and hence to a smaller correction for the sample selection bias of only 12.46% points. The mimicking portfolio yields a mean average IRR of 12.7%. After correction for the selection bias the regression alpha reveals an outperformance of 12.1% while the t-value increases to 2.07. This result is significant on a 97.5% confidence level, suggesting that the quality of our results improves if we drop "atypical" buyouts and outliers.

7. 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 internal rates of return of 133 US buyouts between 1984 and 2004 with the internal rates of return from public market investments with an equal risk profile and duration, we document a significant outperformance of our sample of buyouts, gross of fees. The magnitude of outperformance is sufficiently large to prevail after the deduction of fees normally paid in buyout fund partnerships. It should also be noted that the performance of the benchmark investments is also calculated gross of fees.

Our study builds on and extends existing work on the comparison of the performance of public and private equity in several respects. First, we propose a method for benchmarking the asset class that might become an industry standard.

Second, our study 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, as well as their industry sector and on the capital structures of the investment vehicles at the closing date and at exit, it becomes possible to attribute operating and leverage risk measures to each individual transaction. Thus, we can comprehensively control for the transaction risks in constructing a well-defined mimicking portfolio with an equal risk profile against which the performance of buyout investments can be measured. Our study thus overcomes one of the major challenges of performance assessment in buyouts.

Third, our sensitivity analyses highlight the importance of a comprehensive risk-adjustment that considers both operating and leverage risks for an accurate assessment of buyout performance. This is directly relevant for interpreting findings from prior research where this kind of risk separation has not been possible.

Fourth, 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. It also explicitly analyzes the importance of different assumptions regarding the risk-profile of debt, debt tax shields, credit spreads and transaction operational risks. This analysis confirms the conjecture that buyout investors choose industries with low operating risk, use financial leverage where favorable, and transfer an important portion of the risk to the lenders.

Absent detailed data on the risk characteristics of the entire universe of buyout transactions, any assessment of the relative performance of buyouts has to remain inconclusive as it is impossible to assess the representativeness of our sub-sample of buyouts in this crucial aspect. Hence we cannot assess to what extent our finding of outperformance generalizes the entire asset class despite the efforts we make to correct for the biases we can assess and quantify.

It also remains unclear, how the finding that buyouts seem to outperform public market investments can be explained. One possible explanation could be that the outperformance represents an adequate illiquidity premium. Or, given Jensen's (1986) 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. These efforts range from the implementation of incentive schemes to align interests, all the way to closer monitoring and improved governance. Such initiatives and the burden of debt can lead to superior productivity, hence to higher 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, combined with efforts by the companies' management teams might provide an explanation for the outperformance.[10]

One could also argue that arbitrage opportunities between the quoted and the unquoted market segment exist due to mispricing of equity or debt or both in the unquoted segment. Sophisticated investors collect information to overcome information asymmetries and benefit from these opportunities.

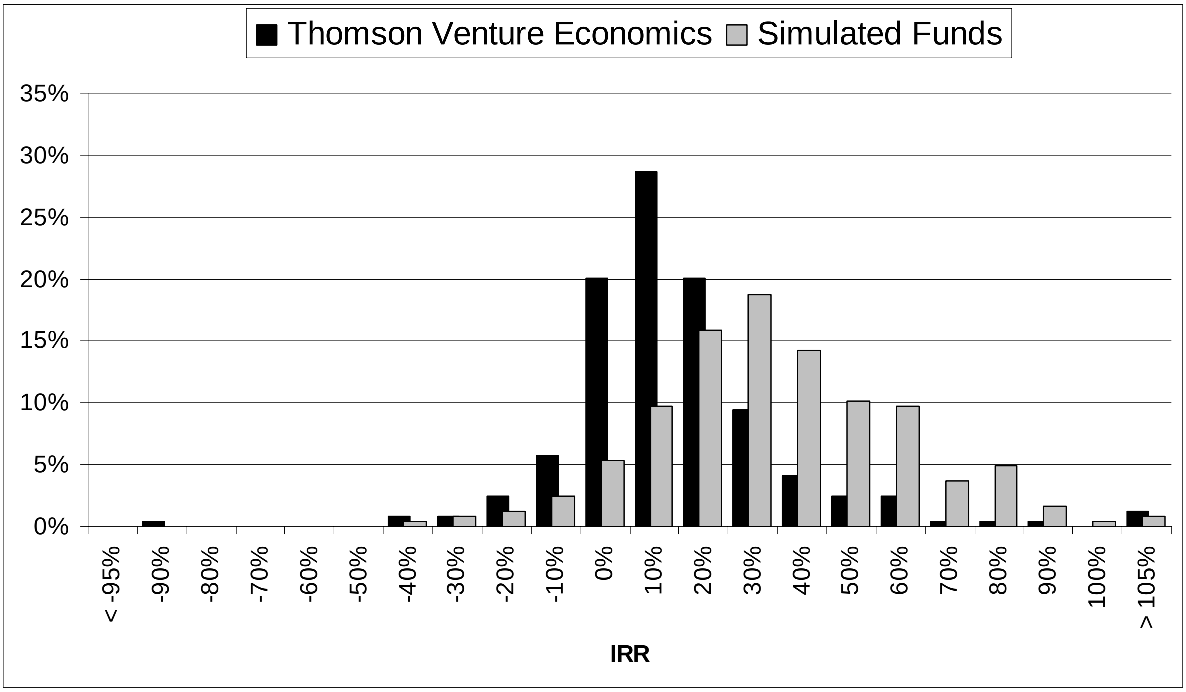
The questions of the origin of buyout outperformance points to interesting areas of future research that we were unable to pursue in this study due to space limitations. For example, it would be insightful to explore to what extent the magnitude of outperformance changes over time, whether it can be explained by transaction size, exit channel, holding period, invested equity amount or percentage of ownership, and most interesting, if the risk levels of the individual transactions can influence the benefits of being held privately.

[10] See the exhaustive literature on the free cash-flow hypothesis and its empirical relevance for buyouts in Jensen (1989a and 1989b), Kaplan (1989a and 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).

Chart and Tables:

Exhibit 1

IRRs Net of Fees of the Thomson Venture Economics US Fund Population and of 244 Simulated Funds



Source: Thomson Venture Economics and bootstrapping simulations of 244 funds. In these, each fund randomly draws 30 transactions from 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]	0.25	15.08	3.75	3.08	2.61
Equity Stake at Closing	8%	100%	76%	86%	25% (pts.)
Equity Stake at Exit	8%	100%	74%	86%	27% (pts.)
Initial Debt/Equity	0	17.05	2.94	2.49	2.75
Exit Debt/Equity	0	14.09	1.28	0.64	1.99
Enterprise Value at Closing [$m]	3.50	almost 9,000	313.52	88.00	870.17
Enterprise Value at Exit [$m]	0.001	almost 13,500	547.90	135.00	1,366.82
Equity Investment [$m]	0.20	almost 1,150	53.39	18.70	115.79
Final Payoff [$m]	0.001	almost 1,800	160.38	63.10	299.05
IRR (p.a.)	-100.00%	472.00%	50.08%	35.70%	91.66% (pts.)

Table 2

Equity Betas for the Baseline Case and Four Scenarios

This table presents the most important descriptive statistics of the equity beta factors at closing and at exit in our base scenario and in different sensitivity analyses.

		Closing				Exit			
#	Scenario	0.05 pct.	0.95 pct.	Mean	Median	0.05 pct.	0.95 pct.	Mean	Median
0	Base Case	0.32	3.88	1.40	0.94	0.32	2.80	1.01	0.71
1	Kaplan/Schoar (2005)	1	1	1	1	1	1	1	1
2	Industry Mix	0.35	1.46	0.78	0.70	0.35	1.46	0.78	0.70
3	Leverage Only	0.93	4.16	2.11	1.92	0.87	2.65	1.40	1.13
4	Phalippou/Zollo (2005)	0.32	4.36	1.50	1.03	0.32	1.70	0.82	0.73

Table 3

Mean IRRs of the Mimicking Portfolios and Regression Results of the Scenarios

This table presents the mean average internal rate of return of the mimicking portfolio and the most important regression results for our base analysis and for different 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	Phalippou/Zollo (2005)	12.5 %	11.8 %	***0.71	0.029	1.597	2.444

*) significant on a 95% -confidence level
**) significant on a 97.5%-confidence level
***) significant on a 99%-confidence level

Table 4

Equity Betas for the Robustness Checks

This table presents the most important descriptive statistics of the equity beta factors at closing and at exit of our robustness checks.

		Closing				Exit			
#	Robustness Check	0.05 pct.	0.95 pct.	Mean	Median	0.05 pct.	0.95 pct.	Mean	Median
1	Increased Operating Betas	0.45	5.87	2.22	1.70	0.43	3.90	1.50	1.09
2	Risk Free Debt	0.69	6.39	2.57	1.99	0.47	3.88	1.53	1.07
3	Increased Risk of Debt	0.32	3.36	1.19	0.72	0.32	2.68	0.92	0.65
4	4% Credit Spread	0.32	3.88	1.40	0.94	0.32	2.80	1.01	0.71
5	Outliers Dropped	0.31	3.89	1.32	0.91	0.31	3.12	1.01	0.70

Table 5

Mean IRRs of the Mimicking Portfolios and Regression Results of Robustness Checks

This table comprises the mean average internal rate of return of the mimicking portfolio and the most important regression results for our 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
5	Outliers Dropped	12.7 %	**12.1 %	***0.70	0.056	2.074	3.116

*) significant on a 95%-confidence level
**) significant on a 97.5%-confidence level
***) significant on a 99%-confidence level

Appendix
Constructing the Mimicking Portfolio

We take the perspective of a well diversified investor 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 that dividends are reinvested, which accurately reflects the fact that during buyout transactions dividends are not usually paid, but free cash flows are used for debt redemption. However, if there is a notable premature disbursement, it is considered. The exact approach to track the 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,[11] 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.[12] 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

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[11] 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 to refute 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.

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

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.

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. Rather, we aim to be as precise as possible assigning peer groups to our 133 sample companies and identifying their 116 different industry sectors. Some of the 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, are 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 buyout transactions is that reasonably 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.[13]

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

[13] 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:[14]

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

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%,[15] 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.[16]

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 lenders. 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.[17] 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.[18] The operating company risk is then borne by the equity and debt investors according to the following relationship:[19]

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

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[14] See Mandelker and Rhee (1984), Equation (3) and Footnote 2.

[15] See Graham (2000).

[16] 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).

[17] See Modigliani and Miller (1963), Footnote 5.

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

[19] 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.[20] 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.[21] 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 about the tax benefits) 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, varying the resulting beta factors.

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.[22] 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, and are called, converted or default more frequently than investment grade bonds.[23] This leads to the problem that on average the duration and hence, the volatility, might be even lower than for investment grade bonds.[24]

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

21 See Shleifer and Vishny (1992), p. 1362 and Kaplan and Stein (1993), p. 333.

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

23 See Altman (1989), p. 913, Asquith, Mullins, and Wolff (1989), p. 928, and Blume, Keim, and Patel (1989), published (1991).

24 See Cornell and Green (1991), p. 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 retrieve weekly gross returns and 2004 year-end market capitalizations for 314 open-end funds investing in investment-grade corporate debt and we retrieve the same data for 101 open-end bond funds investing in low-grade debt securities.[25] Using the S&P 500 Index as a market proxy over a two-year horizon, we calculate the beta factors for each fund. We then determine 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) report 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.[26] 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, where we vary the risk of debt. Also, in a few cases then, 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.

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25 Data was retrieved from Bloomberg.
26 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. 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 (1989a) 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, 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, the equity payoff, 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 breech of covenant takes place.[27]

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 characterized 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 levering 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 us two separate cash flows. The remaining equity following disbursement is retained in the

[27] See *e.g.* EVCA (2003).

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.[28] Add-on investments in the "write off" cases are usually made to prevent the debt providers from claiming bankruptcy. 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.

[28] Premature disbursements in "write-off" transactions were not observed in our sample.

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