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PREDICTIVE CHARACTERISTICS FOR THE CROSS-SECTION OF PRIVATE EQUITY RETURNS

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Abstract

This research applies findings from the field of factor investing to address the question of what drives private equity deal returns. I provide empirical evidence that the most comprehensively documented factor anomalies have explanatory power of cross sectional variations in returns of private equities deals. Consistent with findings from public equities, I find that the value and quality factors are economically and statistically meaningful effects also in private equity markets. I document that the returns differential between top and bottom sorts portfolios are up to five times larger than those observed the public market. The low risk appears to be present as no clear relationship emerges between the amount of risk and returns. The size effect appears to be less pronounced. Results are robust to commonly used methodologies in the field of factor investing.

Keywords: private equity, buyouts, deal performance, predictive characteristics, factor investing

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Introduction

Over the last few years the private equity industry witnessed sizable growth in allocations while positive sentiment is expected to persist going forward. Despite the increased significance of the asset class, there is a persisting lack of consensus on what factors explain returns in private equity deals. Existing literature has primarily focused on dissection of the value generated during the holding period to components such as multiple expansion, leverage and operational enhancement (Achleitner, Braun, & Engel, 2011; Achleitner, Braun, Engel, Figge, & Tappeiner, 2010; Kaserer, 2011; Puche, Braun, & Achleitner, 2015). Some papers go one step further into discussing underlying value generation mechanisms. For instance, a number of studies address the question through studying the effect of certain general partner (henceforth, GP) or target characteristics that are observable prior commitment on deal performance (see, e.g. Loos, 2007; Munari, Cressy, & Malipiero, 2007). Harris, Jenkinson, Kaplan, and Stucke (2014) investigate if persistence is observed across funds of the same partnership. Value generation mechanisms have been researched in detail for funds investing in listed equities (e.g. Carhart, 1997). Next to characteristics of the fund managers, this stream of literature documents that a large portion of the return differences between managers can be attributed to characteristics like size, value, and more recently quality. Interestingly, the predictive power of such factors have not been investigated specifically for non-listed securities like private equity.

Through this paper I address this important gap in the research literature on private equity. In contrast to existing studies in order to explain deal performance I rely on well documented factors from the research stream of factor investing. In essence factor investing argues that along with traditional sources of returns such as exposure to market risk premium and managerial skills, alternative premiums exist beyond the traditional asset class premiums and

through strategically allocating to such factors investors will be able to improve the risk-return profile of their investments in the long term. The most comprehensively studied factors in the academic literature are currently the small cap, value, quality, low-risk effect and momentum (see, e.g., Carhart, 1997; Fama & French, 1992; Fama & French, 2017; Haugen & Heins, 1972; Jegadeesh & Titman, 1993; Novy-Marx, 2013). Interestingly, while these patterns have been documented in public equity markets, and recently also in the corporate bond markets (Israel, Palhares & Richardson, 2015; Houweling & Van Zundert, 2017), to the best of my knowledge no study has investigated if such premiums are also present in the cross-section of returns of private equity deals.

At the heart of my study lies a unique proprietary database consisting of transaction level data of 429 buyouts that took place in Europe over the period 2000-2015. The dataset was compiled from due diligence and reporting materials provided by a Dutch fund of funds (henceforth, FoF) and as such is not subject to discretionary reporting practices typical for public datasets.

Using these data I perform empirical analyses in the spirit of Fama and French (1992) and sort private equity deals into tercile portfolios based on: (i) their enterprise value at entry (henceforth, EV), (ii) their valuation as measured through EBITDA/EV at entry, (iii) their quality as measured through SALES/EV at entry; and (iv) their levels of risk as measured through the amount of leverage (i.e, NET DEBT/EV) at entry. I next evaluate the returns of these tercile portfolios and test if there are significant differences in returns.

I find that four of the well documented anomalies in returns are also present in private equity. For tercile sorts on EV I find less pronounced difference between returns of the small and large portfolios of 4% per annum. For sorts on EBITDA/EV I find a return differential of 29% per annum between the value and growth portfolios; for sorts on SALES/EV I find a return differential of 25% per annum between the quality and junk portfolios; and, finally, for sorts

on NET DEBT/EV I find a return differential of only 3% per annum between the low and high risk portfolios.

In addition to the rank portfolios analyses, I also perform regressions analysis to investigate the marginal impact of private equity deal characteristics on their past returns. The results of these regression analyses are consistent with the rank portfolios analyses. Both EBITDA/EV and SALES/EV are significant in economical and statistical terms in explaining deal returns. For EBITDA/EV I find positive marginal effect of 0.092 standard deviations increase in deal gross return for one standard deviation increase in EBITDA/EV. For SALES/EV I report 0.065 standard deviations increase in deal gross return for one standard deviation increase in SALES/EV. For EV and NET DEBT/EV I confirm that the two deal characteristics have no statistically significant effect for predicting deal performance.

The findings of this study provide empirical evidence that four of the most important factor premiums that have been documented for public equities are also observed in the cross-section of private equity returns. As such the contribution of this research to the extant literature is twofold: first, it adds new insights to the discussion on performance drivers in private equity by evaluating the joint relevance of undocumented private equity premium factors in explaining deal returns. In turn this can be interpreted as a first step in composing an evidence-based framework that enables to evaluate and target certain parts of the private equity market that have the potential to deliver greater returns. Second, by demonstrating the relevance of common factors also in the space of non-public assets, this research helps to assess the robustness of factor patterns and advocates the introduction of factor investing approach towards portfolio structuring. Private equity markets has historically been praised for providing diversification benefits to investors due to the inherent characteristics of private equity investments and relative segmentation of the asset class. As such examining factor relevance in private equity provides a unique opportunity not only to examine cross-sectional variation

of returns in the private asset class but also to reexamine their relation to public markets. As this research indicates returns in private equity and public equities markets are driven by common underlying effects which implies that such factors are fundamentally related to the price setting behavior of investors.

The remainder of the paper is structured as follows: I start this research with a brief overview of the academic literature on private equity and factor investing. I then elaborate on the methodologies that were applied in this research including single sorts analyses, double sorts analyses and regression in the spirit of Fama and French (1973). Next, I describe the dataset used to conduct this study and discuss its limitations. I follow by presenting the main empirical results from a single sorts analyses and subsequently verify the robustness of the results through double sorts and cross-sectional regression analyses. Finally, I conclude with a discussion on the limitations of this study and outline agenda for future research on the topic.

Literature overview

Private equity

Over the last few years the private equity industry has grown enormously in terms of size and significance to investors as well as to the economy in general. From asset management perspective private equity has grown into a meaningful asset class with assets under management standing at the all-time high USD 2.49 trillion as of June 2016. At the same time positive sentiment is expected to persist going forward. As reported in the 2017 Preqin Global Private Equity and Venture Capital Report, 95% of limited partners (henceforth, LPs) believe that the performance of their private equity portfolios has met or exceeded performance expectations, 48% of investors plan to increase their allocations over the long term while 46% intend to maintain their allocation to the asset class. The increased appeal of the private equity

asset class comes as no surprise in the current environment characterized by considerable volatility, historically low interest rate and consolidation opportunities in various markets.

From an economic standpoint private equity is described to drive economic growth and competitiveness through providing capital, supporting innovation and improving productivity and competitiveness of portfolio companies[1]. In a comprehensive study published on behalf of Invest Europe (formally European Venture Capital Association, EVCA), Frontier Economics (2013) evaluates the contribution of the asset class to the economic growth in Europe. The key findings of the report show that private equity accounts for a significant portion (12%) of all industrial innovation despite that private equity-backed companies account for only 6% of the total private sector employment; private equity backing has improved operating performance of the underlying companies from 4.5% to 8.5% during the first three years of ownership; private equity contributes to the creation of 5,600 new businesses in Europe each year.

Despite the recent resurgence of the asset class, surprisingly there is a persisting ambiguity in regards to the performance of private equity investments and the exact determinants of returns. Research in this area is preliminary and inconclusive compared to the body of literature on public asset classes. Central questions such as how to measure returns in private equity, how to benchmark investments to public markets performance and what drives performance of this asset class are still open to considerable debate. The main challenge in studying private equity performance arises due to the limited data availability as private equity managers are largely exempt from public reporting requirements. One alternative to source data is directly from LPs which is typically of sufficient quality as it is used for investment purposes. However, a shortcoming of LPs databases is their short history and limited diversification in terms

[1] Critics argue that private equity managers capture value (rather than creating such themselves) through taking advantage of information asymmetries, tax breaks and mispricing between debt and equity markets, and redistributing wealth from stakeholders to shareholders (Kaplan & Strömberg, 2008; Axelson, Jenkinson, Strömberg, & Weisbach, 2010; Kaplan & Stein, 1993; Ljungqvist, Richardson, & Wolfenzon, 2007).

geographical and sector coverage. Another alternative is to access performance data on private equity through public data providers. In contrast to LPs databases public databases are usually broader in coverage and are sufficiently diversified. However, these are often found to be biased due to selective reporting by private equity managers which in turn poses concerns about the validity of research outcomes. A number of data providers (Cambridge Associates, Venture Economics, Burgiss) have taken significant steps in building a high quality datasets. Nevertheless, it remains a challenge to gather a private equity dataset that defines the investment universe thoroughly and is of sufficient quality.

Aside from data issues, a number of characteristics inherent to the asset class make it hard to measure performance of private equity investments and therefore to draw consistent conclusions. The first complication arises due to the highly illiquid and long term nature of private equity investments and the implications that it has for the observability of returns. Typically investments in the asset class have holding period of 10-13 years during which investors are no longer able to redeem invested amounts. Secondary sales are typically resource intensive and prolonged processes. As a result, there is no active public market for private equity positions leading to lack of pricing and return information on a continuous basis as it is the case for listed equities. Moreover, the true return of a private equity position is observed only after its liquidation which is also a limiting factor considering the young nature of the industry. Another complication in regards to returns in private equity arises due to the irregular timing of cash flows and the implications that it has for measuring performance. Due to the intermediate cash flows typical for private equity time-weighted performance measures used to calculate returns in public market are no longer appropriate to give a true representation of the return of private equity investments. To accommodate this a number of cash flow based performance measures have been adopted. Nevertheless, the broadly accepted performance measures in private equity are not ideal as each of them is characterized by certain weaknesses

(see section Methodology, subsection Measuring performance in private equity for a more extensive overview of the strengths and weaknesses of private equity performance measures). In this regards, Ang and Sorenson (2012) warn that such measures should be interpreted with caution as they are not built upon general financial theories. Finally, performance measures in private equity are not directly comparable with each other or those used for other asset classes making hard to draw consistent inferences on the performance of the asset class in relative and absolute terms.

Research on private equity dates back to 1980 but only recently conclusions are drawn based on more comprehensive datasets that include recent buyout waves and use more precise performance measuring methodologies. In general, two broad literature streams can be distinguished. The first stream of literature deals with the question of computing performance of private equity funds in absolute or relative terms. The main topics discussed by academics include selection of appropriate performance measure, access to high-quality datasets that are sufficiently representative for the private equity universe, differences in performance per subcategories and sensitivity of results to underlying assumptions (e.g. the choice of public market benchmarks, net asset value final value, henceforth NAV, and magnitude of beta). Within this stream of literature a fair share of recent academic contributions converge in their findings of net of fees outperformance of private equity investments to the public market.

For instance, Ljungqvist and Richardson (2003) study the performance of 73 mature funds during the period 1981-1993. Their sample consists of liquidated as well as operating funds invested in 4,300 portfolio companies with more than 900 exits. The primary performance measure used in their research is internal rate of return (IRR) net of carried interest and management fees[2]. The study reports average net IRR of 19.8% and value-weighted net IRR

[2] The authors calculate IRR using only cash events (cash flows into and from portfolio companies and annual management fees) and ignore unrealized capital gains (including stock distributions held in inventory) or capital losses. This methodology differs from those used in

of 18.1%. During the same period the return of S&P500 is reported at 14.1%. Looking at relative performance measured by excess IRR the authors find average (median) outperformance in the range from 8.1% to 5.9% (from 6.0% to 3.9%) relative to S&P 500 and from 6.28% to 2.62% (from 4.01% to 1.51%) relative to Nasdaq Composite. Using profitability index[3] as an alternative performance measure the authors compute mean (median) outperformance of 25.07% (12.18%) relative to S&P 500. Relative to Nasdaq Composite they calculate mean profitability index of 9.96% with even more pronounced difference between mean and median values. On a risk adjusted basis, they find mean ex post profitability index of 24% and ex ante of 32%.

Harris, Jenkinson, and Kaplan (2014) study the performance of 1,400 North American private equity funds formed over the period 1989-2008. To conduct their research the authors use a high quality dataset from Burgiss. In contrast to the dataset used by Ljungqvist and Richardson (2003) which includes funds from a single LP, the dataset of Burgiss covers over 200 institutional investors and as such provides a better coverage of the investment universe. Harris et al. (2014) document significant and positive performance of buyout funds. More specifically the authors show that outperformance relative to S&P 500 ranges between 20% and 27% on average over the life of the fund and is equivalent to over 3% per year. Their conclusion is consistent not only among top quartile funds but also among median funds.

In a subsequent study Harris, Jenkinson, and Kaplan (2015) extend their sample through June 2014 and add 300 European funds. For the entire sample, average IRR is computed at 12.4% while the average multiple is 1.61. Their conclusion in regards to relative performance

Venture Economics and in prior studies as these represent a mixture of growth in net asset value (NAV) for unrealized investments and cash IRRs for realized investments.

[3] Profitability index is defined as the ratio of the ex post net present value (NPV) of investing in a fund over the present value (PV) of the investment. Cash outflows are assumed to be risk free and therefore are discounted at the risk free rate. Cash inflows are discounted at the cost of capital approximated by the annualized return on the S&P 500 or the Nasdaq Composite Index between the date on which the fund was raised and the date on which the fund matured.

is consistent with their previous findings. More specifically, buyouts in both Europe and North America have outperformed the public market with average return premium documented in the range from 3% to 4% per year.

In contrast to studies concluding in favor of the relative outperformance of private equity investments, Phalippou (2013) provides evidence of substantial underperformance. Using a publicly available sample that consists of 392 buyout funds with vintages between 1993 and 2010 he estimates average value-weighted public market equivalent (henceforth, PME) of 1.04 and median PME of 0.99. A significant difference compared to other studies is the choice of benchmark. The author argues that a more appropriate benchmark to match performance of private equity with those on public markets is the small-cap value index, DFA micro-cap index, as the EV of private equity companies is considerably smaller compared to those of listed companies.

Kaplan and Schoar reach to a similar conclusion in their paper from 2005. They study a sample provided by Venture Economics covering 746 venture and buyout deals that occurred during the period 1980-2001. They calculate equal-weighted median and average IRRs to be 12% and 17%, respectively. Median and average IRR are slightly more positive, 12% and 18%, when funds are weighted according to their size. In terms of equal-weighted PMEs median and average funds underperform the S&P 500 index by 26% and 4%, respectively. Average value-weighted PMEs are reported at 0.82 median and 1.05.

In the more recent study of Higson and Stucke (2012) the authors provide more comprehensive evidence on the performance of private equity investments. They study the performance of US private equity funds using one of the most comprehensive datasets with coverage of 85% of the funds raised from 1980 onwards. The results demonstrate outperformance relative to S&P 500 by over 500 basis points per annum. Exclusion of more recent funds from the period 2006-2008 increase returns in excess of the index to 800 basis

points. The results of their research are robust to different performance measures and underlying assumptions on NAV.

Next to the topic of absolute returns in private equity and how investments in the asset class compare to investments in the public market, investors are ultimately interested in what determines private equity returns. This topic marks the second significant stream of literature on performance of private equity. Within this stream existing literature has primarily focused on dissection of deal returns generated during the holding period into three main components. Financial gains in buyouts can be linked to i) improvements in the operating performance of the target which are the result from better profitability, elimination of unproductive assets, more efficient asset use or value-increasing acquisitions; ii) rising market or industry valuations during the holding period leading to increase in the gap between entry multiples and exit multiples and lastly iii) to leverage through its ability to produce large tax shields and improve incentives for cash flow generation.

In a recent work, Achleitner, Braun, and Engel (2011) studied a high quality sample provided by three European FoFs. Their dataset consists of 1980 realized and unrealized transaction that have taken place between 1986 and 2010 in North America and Europe. In regards to operating performance, their findings indicate that both, EBITDA margin improvements and sales growth significantly and positively affect equity IRR. More specifically, they find that sales growth of 10% over the holding period, yields a 1.7 % increase in equity IRR. The effect of the EBITDA/SALES ratio is documented to be way stronger, where 10% increase leads to 25.6 % increase in equity IRR. Depending on the specification of leverage, increase of the ratios NET DEBT/EBITDA and NET DEBT/EQUITY by 10% is found to increase equity IRR by 0.6% and by 1.1% respectively. The multiple effect is computed to account for 2.9% increase in equity IRR for 10% increase in the EV/EBITDA ratio over the deal holding period.

In another study Guo, Hotchkiss, and Song, (2011) study the performance of 94 public to private transactions that occurred between 1990 and 2005 in the US. Their dataset is sourced from SDC database VentureXpert and Dealogic and comprises of larger deals with value of at least USD 100 million. Overall Guo et al. (2011) conclude that buyouts create value on average relative to invested capital. They compute median market and risk adjusted returns to pre-(post) buyout capital invested to be 72.5% (40.9%). In regards to the relative contribution of leverage, operating performance and multiple enhancement to returns the authors find that the three components are nearly equally significant. Industry valuation changes[4] are computed to account for 17.7% (12.0%) of the return to pre (post-) buyout capital for the overall sample. Changes in profitability account for 23% (18.5%) of the pre- (post-) buyout returns. Similar, the leverage effect also drives significant part of returns and is computed to account for 29% of total return. However, results on leverage contribution to returns strongly depend on debt levels maintained post the outcome date.

In another study Kaserer, (2011) studies a unique dataset focused on mid-market transactions in Europe. His dataset covers 332 European fully exited transactions that have occurred during the period 1991 - 2011. The author finds that about two thirds of IRR is due to earnings enhancement while the remaining one third is due to leverage. Sales growth appears to have statistical and economic significant impact on deal returns; increase of revenues between exit and entry by two times results in increase in IRR by 7.9%. Despite that EBITDA margin is recognized to have meaningful economic impact on deal returns, no evidence is provided for its statistical significance. In regards to multiple enhancement no evidence is found that it is a statistically significant value driver while its economic contribution is computed to be negligible.

[4] Industry valuation changes are computed as the difference between total value and a hypothetical return that would have been realized if the industry or market valuation multiple had remained at its pre- or post-buyout level.

Some papers go one step further in explaining private equity returns and discuss underlying value generation mechanisms. For instance, a number of studies address the question through examining the effect of certain General Partner (GP) or target characteristics on deal performance. Achleitner et al. (2011) find that more experienced fund managers are able to generate higher returns through negotiating lower entry prices. Furthermore, they find that more experienced managers are able to pay higher prices for targets as they are able to acquire more debt. Kaplan and Schoar (2005) document that performance increases the greater a fund size and GP's experience is. They find a concave relationship between fund size and returns which implies decreasing returns of scale. In regards to GP experience they find that GP's ability to raise capital is positively related with the track record of the GP. Harris et al. (2014) investigate if persistence is observed across funds of the same partnership – that is that performance of previous funds of a private equity firm predicts the performance of subsequent funds. The underlying logic behind this is that private equity managers that are skilled are able to sustain high performance among funds as a result of accumulated knowledge and network relative to less skilled managers. Their results provide evidence for persistence in the performance of pre-2000 funds. Little evidence is found for funds post 2000. Exception to this are funds in the lower performance spectrum where the authors find that weak performing GPs continue to deliver weak performance. Munari et al. (2007) study the relationship between performance and GP experience measured by the degree of industry and investment stage specialization. According to their findings industry specialized firms are able to deliver consistently greater returns to investors while stage specialization is found to have no impact on returns. In addition, they find that the initial profitability of private equity backed companies has a major role in predicting post-buyout profitability, consistent with the claim that skills in investment selection and financial engineering are important value drivers.

Factor investing

In contrast to private equity, the topic on determinants of returns of public equities has been extensively researched. More recently, the field of factor investing has received special attention as a new systematic way to allocate to certain parts of the market that exhibit greater performance potential than others. In essence factor investing recognizes that certain return drivers, called factors, determine the long-term expected returns within and across asset classes. By weighting strategically portfolio to such factors investors are able to capture factor premiums and improve the risk-return profile of their investments.

Factor investing has grown in popularity in recent years especially after the financial crisis of 2007-2008 when investors questioned the traditional approach to investing that has its foundations in the Capital Asset Pricing Model (CAPM) of Sharpe (1964) and Lintner (1965). According to CAPM returns can be decomposed into two components: a portion stemming from exposure to the market (beta) and a portion that can be attributed to manager's skills (alpha). However, a number of studies dating back to 1970 have provided contradicting evidence by showing that a single factor model is insufficient to explain the relationship between risk and expected return while also showing that other factors are relevant.

More specifically, academics recognized that along to the market risk, stocks have a number of inherent characteristics that determine their returns. For instance in 1972, Heugen and Heins provided evidence of the existence of low volatility effect by showing that low risk stocks produce higher return than high risk stocks. In 1981, Banz examined the empirical relationship between return and market value of common stocks. He found that smaller firms have higher risk adjusted returns on average compared to larger firms where the effect is not linear with market value. In a later paper from 1992, Fama and French, studied the performance of stocks during the period 1963-1990. Their results provided supportive evidence that characteristics such as size and book-to-market value capture cross-sectional variation in

returns. Based on this they demonstrate that stocks with low book-to-market value, also known as value stocks and stocks with small capitalization outperform stocks with high book-to-market value, known as growth stocks, and stocks with high market capitalization. In the more recent period, a relatively new factor has triggered the interest of academics and practitioners. That is the quality factor which describes the effect that high quality companies outperform low quality companies in the long term. The existence of the quality effect has been confirmed in the work of Haugen and Baker, 1996; Sloan, 1996; Fama and French, 2015 where it should be noted that the definitions of the quality factor differ significantly in various research papers[5].

Despite that these insights date back to the 1970s, factor investing increased in relevance after the publication of a report on the performance of one of the largest wealth funds in the world. In 2009 professor Ang, Goetzmann, and Schaefer were given the task to evaluate the role of active management of the Norwegian Government Pension Fund (NGPF) especially after the disappointing results during the financial crisis. Their analysis made a number of important observations regarding the true investment style of the fund portfolios, the true magnitude of returns achieved through active management and sources of those returns. To the surprise of many Ang, Goetzmann, and Schaefer's analysis showed that the fund is not truly actively managed. Active returns, defined as the difference between the performance of the fund and those of the its benchmark constitute only a small fraction of the mean and volatility of the total return. Perhaps the most significant contribution of their work to the field of factor investing is their finding that even the small component of active returns is largely determined by exposure to systematic factors that fared very poorly during the financial crisis. They conclude with the recommendation to implement investment approach that explicitly

[5] For a comprehensive overview of quality factor definitions that are used in the industry and academia, see Kyosev, G., Hanauer, M. X., Huij, J. and Lansdorp, S. (2016).

recognizes the return generating process of the fund, namely the adoption of an explicit top-down allocation approach to proven factors.

Since then the idea of factor investing attracted considerable attention among professional investors that are facing similar challenges in determining portfolio allocations. More recently, increasing number of asset managers and institutional investors are integrating factor investing in their investment portfolios. However, despite the increased interest, evidence on factor investing remains predominately focused on listed equities. Recent progress has been made in regards to assessing the applicability of factor investing in the context of other asset classes such as bonds, real estate or commodities. Nevertheless, research on factors in other asset classes is still rather limited and requires further attention. No exception to this is private equities for which to the best of my knowledge research that explicitly explores factors for private equity does not exist.

Methodology

Methodological approaches

The following section elaborates on the two methodological approaches applied in this research to investigate the relationship between certain deal characteristics (also referred as factors) and deal returns. First and foremost, I examine the individual effect of each deal characteristics on deal returns and thus explicitly ignore any simultaneous effects among the different deal characteristics on returns. I follow the conventional rank portfolio approach of Fama and French (1992). According to the approach deals are ranked into equally weighted and mutually exclusive portfolios based on their exposure to each factor. As such the ranking portfolio approach presents a simple picture of the variance of returns across the range of each factor variable. For instance, the top tercile of value portfolios contains ~33.3% of the deals with the highest exposure to the value factor while the bottom tercile ~33.3% of the deals with

the lowest exposure to the value factor. Similarly factor portfolios are created for (i) EV at entry, (ii) value as measured through their EBITDA/EV at entry (iii) quality as measured through their SALES/EV at entry; and (iv) level of leverage (i.e, NET DEBT/EV) at entry. After sorting the funds into tercile portfolios, I calculate the average return of each portfolio. Based on the above analysis one can conclude that the relevant characteristics have predictive power over deal returns if certain monotonic patterns emerge. While the ranking portfolio approach is praised for its simplicity it should be noted that results are sensitive towards the choice of how observations are weighted. For instance, forming tercile groups by equally weighting each positon might lead to overrepresentation of smaller and mid-sized deals in the extreme terciles as they are higher number within a sample but constitute only a small portion of the total value of the portfolio. A solution to this issue is to take value weighted approach. However, the danger here is that value weighted returns can be dominated by a few big deals also resulting in an unrepresentative picture.

While the ranking methodology is well equipped to test return patterns related to a single characteristic, it ignores potential interaction effects among them and as such is not able to provide direct estimate of the marginal effect of each factor on deal returns. Furthermore, a ranking approach if often not useful in specifying the shape of the relationship between the factor variable and returns. I address these issues through a Fama and MacBeth (1973) regression[6] of deal returns on four deal characteristics. Formula (1) depicts the model used in this study:

$$r_i = \alpha_i + \beta_i EV + \beta_i \text{EBITDA/EV} + \beta_i Sales/EV + \beta_i Net\ Debt/EV \qquad (1)$$

[6] Fama and MacBeth (1973) regression includes the effect of the market (RMF) which represents market returns over duration matched risk free rate. In the case of private equity running this model is only possible when TVPI is used as return measure. Alternatively, the model can be run with PME as performance measure which represents IRR adjusted for the performance of the public market.

Where *r* is return of deal *i*, EV at entry proxies the size effect, EBITDA/EV at entry proxies deal valuation, SALES/EV at entry is the quality factor; and deal levels of risk is measured through the NET DEBT/EV at entry.

Measuring performance in private equity

In line with industry standards and due to limitations imposed by the dataset, for this research I rely on gross IRR as performance measure. IRR is an absolute performance measure and it is defined as the discount rate that equates the net present value of all outflows and inflows related to a specific deal to zero. Among practitioners and academics IRR is deemed as an appropriate performance measure for a number of reasons; first and foremost, IRR takes into account the irregular nature of the cash flows of private equity investment, second, IRR considers the time value of money and finally, IRR is relatively straightforward measure to calculate and interpret.

However, four important remarks should be taken into consideration when using IRR (Phalippou, 2008). First and foremost, IRR assumes that capital distributions that occur prior liquidation can be reinvested at the IRR of the deal. This is often unrealistic assumption that can lead over- or understatement of return in cases where the reinvestment rate does not match the returns delivered by the investment. Second, IRR is a measure sensitive to the timing of the cash flows and as such allows GPs to manipulate returns by strategically reporting residual values and timing cash flows. Third, IRR assumes fund inflows and outflows to be characterized by the same risk. In reality this is not the case as outflows are characterized by lower risk compared to inflows risk. In turn this will lead to overstatement of IRR. Fourth, IRR does not take into account the scale of a specific deal and as a result a direct comparison of IRR between two deals might lead to the misleading conclusion that a smaller deal with higher

IRR is a better investment compared to a larger deal with lower IRR. In reality the comparison of the absolute returns of the two deals might lead to the opposite conclusion.

In this relation, it should be noted that there is an ongoing debate on how to measure performance of private equity investments (Ellis, Pattni and Tailor, 2011; Ang and Sorensen, 2012). A number of commonly used alternative absolute performance measures exist and effectively address some of the limitations imposed by IRR. Nevertheless, it should be recognized that each of the alternative methods has weaknesses[7] and strengths and therefore does not represent a superior method to measure performance in private equity.

For instance, modified internal rate of return (MIRR) tackles the issue that cash flows are reinvested at the same rate of return of the deal during the holding period. Instead MIRR assumes a fixed reinvestment rate of the cash proceeds different from the deal rate of return and therefore it considered to reflect the true profitability of a certain deal. Nevertheless, MIRR introduces additional level of complexity as it requires explicit assumption regarding the return rate of interim cash flows (Phalippou, 2008). Another common method to measure performance in the private equity industry is through the multiple total value to paid-in capital (TVPI), defined as the ratio of the sum of total distributions over the sum of all calls. In contrast to IRR, TVPI is less susceptible to manipulation as it does not take into account the timing of the cash flows for its calculations. Furthermore, TVPI makes the implicit assumption that capital is reinvested at zero rate. Another commonly used multiple is distributions to paid-in capital (DPI), defined as the ratio of the sum of total distributions over the sum of total contributed capital.

[7] Ang and Sorensen (2012) discuss the issues arising with common performance measures in private equity. The authors stress on the substantial variation in results among academic research and attribute this to the discretion that such measures provide to GPs. Finally, they point out that such measures are not derived from the underlying financial theories of risk and return and that has implications for the consistent interpretation of such measures.

While the above measures provide investors with information of the absolute performance of a private equity investment, they do not contain information on a relative basis. The issue is addressed by the performance measure PME which effectively allows for direct comparison between returns in private equity with those on the public market. Variations of the PME performance measure include Long-Nickels PME, Kaplan-Schoar PME, PME+, Modified PME, Direct Alpha. It should be noted that similar to other private equity performance measure PME is not ideal performance measure and is characterized by a number of weaknesses. Some of the main challenges associated with the PME method include its sensitivity towards the choice of index against which comparison is performed; in the case of Long-Nickels PME large distributions yield a negative value in the index theoretical investment; in the case of Kaplan-Schoar's PME is the underlying assumption that calls and distributions are characterized by the same risk while typically capital calls are characterized by a lower level of risk.

Data

To conduct this research I rely on a proprietary deal level database created in close cooperation with a Dutch private equity FoF manager. Information sources used to compile the sample include quarterly, annual reports and track record sheets. Typically, quarterly and annual reports contain information on period specific developments of the underlying portfolio, including qualitative and quantitative records of deal performance and investee company entry characteristics. Similarly, track record sheets contain overview of the past performance of the GP and typically constitute an important piece of information in the due diligence process of prospective investors. All three sources provide high quality information as their content is subject to certain regulatory reporting requirements, external audit in the case of annual reports

or rigorous assessment by LPs during the due diligence process. Nevertheless, entries from the three sources were cross-checked in order to ensure consistent and high-quality records.

Quantitative variables collected for the purpose of this research include gross IRR, EV, NET DEBT, EBITDA and SALES reported at transaction commitment date in million euros. Qualitative variables include fund vintage year, deal entry date, exit date, geographic location, economic sector and reporting currency.

Dataset adjustments

To arrive at the final dataset used in this research I apply a number of adjustments on (i) deal characteristics and (ii) deal returns. In respect to deal characteristics, where applicable variables reported in different currency than euro are converted using the foreign exchange rate between the deal reporting currency and euro from the date of transaction entry. Furthermore, additional adjustments performed on EV, EBITDA/EV, SALES/EV and NET DEBT/EV were made as a standard step taken in relation to the cross-sectional regression analysis. Namely, to make effects comparable and ensure that values of the deal characteristics are zero on average I calculate the normal score of EV, EBITDA/EV, SALES/EV and NET DEBT/EV.

To adjust deal returns, I first narrow the dataset by excluding unrealized transaction. As such I eliminate the problem associated with the uncertainty of the future cash flows. However, by focusing on realized deals exclusively there is a probability of introducing bias towards better performing deals. This might be the case as fund managers tend to avoid selling or writing-off poorer performing investments as it might influence fundraising activity in a negative way (Cumming & Walz, 2010). Alternative approach for unrealized transactions is to use IRR based on NAV as per the last reported date, December 2015. However, NAV is considered an extremely noisy proxy of unrealized cash flows as GPs only adjust it in the case of material changes and does not incorporate interim change in the prospects of a company.

Second, to ensure that results are not driven by the few but large outliers in deal returns, I winsorize deal returns by replacing the 5% highest and 5% lowest values with the 95th percentile and the 5th percentile respectively. Third, to avoid further reduction in the size of the dataset for the remaining transactions with unknown gross IRR, IRR values were approximated according to formula (2):

$$IRR = \left[\frac{Total\ proceeds}{Total\ invested}\right]^{\left(\frac{1}{Holding\ period}\right)} - 1 \qquad (2)$$

with total proceeds defined as the total amount of realized proceeds at the exit of the company, total invested defined as the total amount of capital invested by the GP over total investment period and holding period defined as the total duration of the investment period expressed in years.

A limitation of using the approximation above instead of the extended IRR formula is that it ignores the timing of the cash flows. More specifically it relies on the assumption that investments are made only at beginning of the holding period while proceeds are realized only at exit. As a result IRR values estimated according to the above formula deviate from IRR values calculated using the complete cash flows history of the transaction. This however does not constitute a material change in the final results as the approximation is applied for 14 cases with calculated IRR values in the range -90%-37%.

Summary statistics

In total the adjusted data set comprises of 429 unique realized transactions. Transactions were undertaken by 25 unique fund managers through 47 funds launched during the period 2000-2015. Distribution of deal entries over time is concentrated in the period after 2000 and is characterized by unequal distribution with a sharp decline in entries following the years of

the Financial Crisis (see Appendix A for a distribution of exists and entries over time). The prevailing economic uncertainty combined with the lower amount of available leverage caused decrease in investing and fundraising activity in the subsequent period. In regards to deal exits, similar pattern can be observed with decrease in exits following 2007 and subsequent recovery in the more recent years. The average holding period is 4.5 years (see Appendix B for average holding period per entry year). In regards to regional distribution, transactions were undertaken in 23 different countries, with 88% of the deals concentrated in Europe, slightly below 12% in the US and less than 1% in the Asian-Pacific region (see Appendix C for country concentration statistics).

Table 1 reports summary statistics of the quantitative variables relevant for this research. Performance of the sample is measured in terms of gross IRR with an average of approximately 31% and median of 27%. Average transaction size is EUR 739.5 million which appears to be upward pushed mainly by a number of large and mega transactions. Nevertheless, the most numerous group in the dataset on an equally weighted basis is represented by middle sized transactions with deal value between EUR 50 million and EUR 500 million[8]. Those constitute 53% of all transactions while large transactions comprise 34% and small deals account for less than 14% of the sample.

Average EBITDA/EV ratio is 0.14 with a median value slightly below. Average SALES/EV ratio is 1.2 with a median value significantly below, at 0.8, which is due to some large deals in the dataset. Finally, I report average and median NET DEBT/EV[9] ratio of 0.54 and 0.57 respectively.

[8] Upper and lower limits of the transaction size buckets are defined as per recommendations of Invest Europe, see EVCA (2014).
[9] Net debt reflects the change in the capital structure post investee firm commitment and excludes available cash at deal entry.

Table 1

Summary statistics

	Observations	Mean	Median	Standard deviation
Adjusted Gross IRR	429	30.9%	26.5%	56.1%
EV	429	737.43	234.90	1,637.12
EBITDA/EV	429	0.14	0.13	0.80
SALES/EV	429	1.20	0.83	1.47
NET DEBT/EV	429	0.54	0.57	0.21

Note. The table shows summary statistics of the total adjusted sample. The sample consists of 429 realized deals undertaken during the period 2000-2015. Gross IRR observations are winsorized with values lower than the 5 percentile and higher than the 95 percentile being replaced by -95% and 159% respectively. Characteristics variables are calculated from EBITDA, SALES, NET DEBT and EV values reported in million, EUR. In cases where EBITDA, SALES, NET DEBT and EV were disclosed in deal local currency, values are converted to EUR using the FX rate at the reported transaction entry date.

Dataset quality considerations

The dataset subject to this research is considered unique in regards to several aspects. First, as the database is compiled using high quality information sources provided by an LP, it is not subject to discretionary reporting practices. One of the main limitation of publicly available private equity databases is the bias towards positive performing investments. This is the result as in their fundraising efforts, GPs tend to omit investments with poor returns from their track record on public data sources. Second, along with existing managers our dataset includes emerging managers as well as first time funds. As a result this research is not subject to survivorship bias arising due to exclusion of less successful managers that did not appear on the market with a second fund. Third, with a total number of 25 fund managers invested in 429

unique deals across 23 countries during the period from 2000 to 2015 the dataset is considered to be of sufficient depth and size in order to enable to draw statistically meaningful conclusions.

Having discussed the advantages of the dataset it is important to consider its limitations and the potential implications that these might have for the outcome of my research. First and foremost, I acknowledge that only funds to which the fund manager has made commitments are considered. In other words only funds that fit the investment criteria of the FoF manager that has sourced the dataset are subject to this research. Next to this, one might argue that FoF managers are perceived as private equity investors with superior investment knowledge and skills. So to the extent that indeed this is the case this analysis might be biased towards certain parts of the market that exhibit very specific behavior that is not general to the private equity investment universe. Following the above observations it is important to assess the representativeness of my dataset and therefore confirm if my results are not dataset specific.

In order to address the question in Table 2, I compare the characteristics of the dataset subject to this research to other deal level datasets that were used in more recent academic works and allow for comparison in terms of reported deal characteristics. For instance, Acharya, Gottschlag, Hahn and Kehoe (2013) study a sample of 395 deals closed during the period 1991 to 2007 in Western Europe by 37 large, mature private equity houses. Nikoskelainen and Wright (2007) use dataset sourced from the Centre for Management Buyout Research (CMBOR) and consists of 321 exited buyouts undertaken in the UK during the period 1995 to 2004. Kaserer (2011) uses a dataset that consists of 332 fully exited mid-market transactions in Europe that have occurred during the period from 1991 to 2011. A more extensive dataset is used by Achleitner et al. (2011), consisting of 1980 (1090 realized and 890 unrealized) transactions that have taken place between 1986 and 2010 in North America and Europe. Finally in a more recent study Bonini (2015) uses a more extensive sample of 2911 European leveraged buyouts that have been executed during the period 1998-2008.

At first glass compared to other datasets, my dataset appears to be similar in terms of breath with 429 number of observations. Exception to this are the datasets used by Achleitner et al. (2011) and Bonini (2015) for which the number of observations is substantially higher. However, in the case of Achleitner et al. (2011) their dataset spans over a longer time period while also more than half of the observations are unrealized deals. As shown in previous academic research assumptions on the remaining value significantly can change the analyses outcome. In terms of geographical representation most datasets are focused on Europe, with the studies of Nikoskelainen and Wright (2007) focusing exclusively on British deals and Acharya et al. (2013) focusing on Western Europe. The only study including representation of North America is those of Achleitner et al. (2011) with the number of deals that have occurred in the American region exceeding those in my dataset.

The most notable difference between other datasets and the dataset used in this research appears to be the size of deals. Transactions included in my dataset have considerably greater average and median EV compared to the mean and median EV of other datasets, which leads to the conclusion that larger deals are significantly overrepresented in my dataset. As reported earlier on an equally weighted basis larger deals defined as companies with EV of above EUR 500 million constitute 34% of my dataset. However, using weighting based on EV considerably shifts the dataset composition - large buyouts emerge as the most significant group forming 86% of the dataset. In turn, differences among the above characteristics potentially could explain observed differences in the performance ratios EBITDA/EV and SALES/EV. For instance it is typically the case that the market for larger deals is more competitive compared to the market for smaller deals due to factors such as segmentation and allocation limits. As a result prices are pushed upward and lower multiples are typically observed. Furthermore, net debt for larger companies is typically higher as these are more mature companies with established business model and stable cash flows which enables to bear greater amount of debt.

In contrast, mid-sized and small deals are typically less mature companies with lower EBITDA and sales but are characterized by greater growth potential.

All in all, the comparison between the dataset subject to this research and datasets used in other academic works stresses on a fundamental problem in private equity research. High quality data that is representative of the universe is typically hard to obtain due to the private nature of the industry and mixed incentives[10] of GPs when reporting performance. And if available assessing representativeness of the data is hard to judge when diversity of already available datasets is in general broad.

While the above comparison is insufficient to draw a clear conclusion on whether results from this research are expected to be observed in other datasets, below I address the question in a more qualitative manner. Factor investing literature in the domain of public equities documents that anomalous patterns are more pronounced in certain market size segments. Fama and French (2008) document that anomalies are stronger in the lower end of the market represented by micro stocks than in the large cap market segment with this effect mainly driven by the higher trading costs of stocks of smaller companies. In the context of this research the findings of Fama and French (2008) imply that the degree of diversification of the dataset in terms of deal size could provide helpful insights on the validity of factors premium patterns for private equity in more general terms. More specifically, as it is typically the case that return anomalies are persistent for small transactions due to the associated trading costs and limitations, it is not necessarily the case that factor premiums are also persistent in the larger segment of the universe where trading costs are lower.

[10] Fund managers are repeated players in the private equity activities which together with the significant role of past track record in inferencing future performance creates incentives for selective reporting of results of well performing deals.

Table 2

Comparable datasets characteristics

Dataset	Observations	Source	Number of funds/ fund managers	Status	Period	Geographic focus
Own dataset	429	FoF proprietary database	47 funds 25 fund managers	100% realized	2000 - 2015	88% Europe
Nikoskelainen & Wright (2007)	321	Centre for Management Buyout Research (CMBOR) database	na	100% realized	1995 - 2004	100% United Kingdom
Kaserer (2011)	332	Invest Europe	18 fund managers	100% realized	1990 - 2011	100% Europe
Achleitner, Braun, & Engel (2011)	1980	FoFs proprietary database	98 fund managers	1090 realized 890 unrealized	1986 - 2010	70.3% Europe 29.7% North America
Acharya, Gottschlag, Hahn & Kehoe (2013)	395	large, mature PE houses; McKinsey proprietary database)	48 fund managers	100% realized	1991 - 2007	100% Europe
Bonini (2015)	2911	Mergermarket database	na	100% realized	1998 - 2008	100% Europe

Table 2 (continued)

Comparable datasets characteristics

Dataset	IRR	EV (million)	EBITDA/EV	SALES/EV
Own dataset	31% (mean) 27% (median)	737.4 (mean) 234.9 (median) EUR	0.143 (mean) 0.129 (median)	1.200 (mean) 0.830 (median)
Nikoskelainen & Wright (2007)	22.2%*/70.5%** (mean) -5.3%*/-17.8%** (median)	55.0 (mean) 14.7 (median) GBP	na	na
Kaserer (2011)	40.2% (mean) 29.0% (median)	125.0 (mean) 68.0 (median) EUR	0.130 (mean) 0.147 (median)	0.625 (mean) 0.500 (median)
Achleitner, Braun, & Engel (2011)	31% (mean) 26% (median)	290.6 (mean) 94.1 (median) USD	0.139 (mean) 0.149 (median)	na
Acharya, Gottschlag, Hahn & Kehoe (2013)	56.1% (mean)	430.2 (mean) 141.2 (median) EUR	0.147 (mean) 0.154 (median)	na
Bonini (2015)	na	276.8 (mean) 95.5 (median) USD	0.023 (mean) 0.096 (median)	0.056 (mean) 0.794 (median)

Note. Academic papers included for comparative purposes were selected based on size of the sample, geographic focus and time span. As could be observed from the reported datasets characteristics none of the comparative samples resembles the dataset used for this research. Though very similar reported values exhibit significant deviations on several instances. Those are mainly explained by the more numerous number of large deals and even mega deal in this dataset. * indicates enterprise IRR, ** indicates equity IRR and na is used when data is not available.

As pointed out earlier the majority of the dataset compiled for this research constitutes of middle (53%) and large size (34%) transactions while small deals account for less than 14% of the sample. In contrast, the comparable datasets appear to be less diversified in terms of deal size as seen from their low average and median values. Respectively this implies that in such datasets factor anomalies are likely to be more pronounced while at the same time results are less likely to be representative for the entire private equity deal universe.

Empirical results

In this section I document the results of my empirical analysis. In the first part of my analysis I construct rank portfolios of private equity deals on single metrics and evaluate their post ranking returns to investigate the predictive power of the metrics for the deal performance. I then follow-up and construct rank portfolios based on multiple measures simultaneously to investigate if the predictive power of the variables for private equity returns go beyond that of the other variables that are being investigated. Finally, I perform cross-sectional regressions to investigate the marginal effect of EV, EBITDA/EV, SALES/EV, and NET DEBT/EV in predicting private equity deal returns.

Sorts based on EV, EBITDA/EV, SALES/EV, and NET DEBT/EV

The first set of tests that I perform is the construction of tercile rank portfolios of private equity deals based on (i) their EV at entry (ii) their valuation as measured through their EBITDA/EV at entry, (iii) their quality as measured through their SALES/EV at entry; and (iv) their levels of risk as measured through deal leverage at entry (i.e, NET DEBT/EV). Top rank portfolios contain the top tercile of deals with the highest rank as determined by the characteristic values, and the bottom tercile portfolios contain the deals that were ranked lowest. So, the top tercile of private equity deals for sorts on EV represents the largest private

equity deals, while the bottom tercile contains the smallest private equity deals. Deals included in the top EBITDA/EV tercile contain relatively cheap deals with higher EBITDA at entry relative to the deal price, while the bottom EBITDA/EV tercile contain expensive deal with lower earnings at entry relative to the deal price. The top tercile of SALES/EV is represented by deals of higher quality since such deals generate more sales at entry per unit of price, respectively deals in the bottom SALES/EV are deals of lower quality. Finally, deals in the top NET DEBT/EV tercile are more risky deal as they contain higher amount of debt relative to the deal price paid at transaction entry while the opposite is true for deals included in the lowest NET DEBT/EV tercile. After sorting the private equity deals into tercile rank portfolios, I compute the average returns for each tercile for the different sorts, reported in Figure 1.

I first consider the results for sorts on EV. It appears that the bottom tercile consisting of deals with EV of maximum EUR 119 million and minimum EUR 8.7 million earns only slightly higher returns on average, more than 36% per annum, compared to the top tercile. The top represented by deals with EV range EUR 520 to EUR 21,260 million and middle terciles represented by deals with EV ranging between EUR 119 to EUR 506 million earn returns of 32% and 25% respectively. I hence find that, similarly to public equities, the small cap effect is less pronounced also in the case of private equities.

Next I turn to the results for sorts on the valuation of private equity deals as measured through their EBITDA/EV. The top portfolio now contains private equity deals with a high EBITDA/EV that can be labelled as value buyouts, while the bottom portfolio contains private equity deals with a low EBITDA/EV that can be labelled as growth private equities. Value deals are considered to be cheaper investments as such deals exhibit greater earnings at transaction entry relative to the price paid by investors. On the contrary, growth deals are more expensive deals as investors appear to have paid higher price for each euro of earnings at transaction entry.

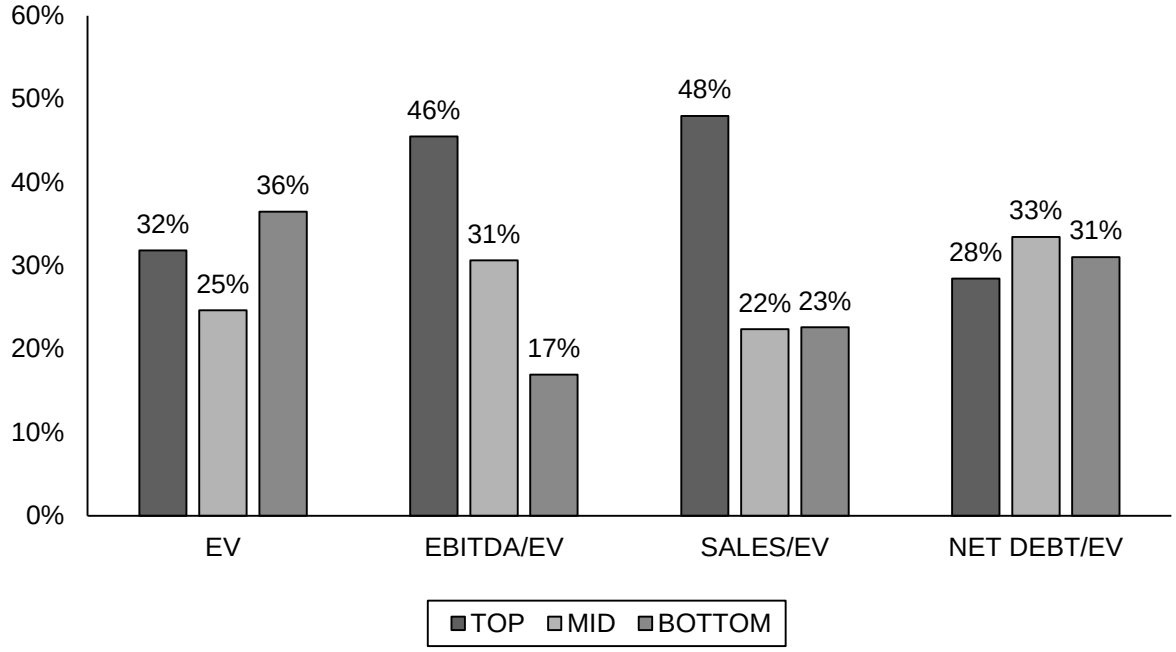

Figure 1. Average returns for sorts portfolios. The figure shows the post-ranking returns of tercile portfolios of private equity deals for sorts on (i) their size as measured by EV at entry (ii) their valuation as measured through their EBITDA/EV at entry (iii) their quality as measured through their SALES/EV at entry; and (iv) their level of leverage (i.e, NET DEBT/EV) at entry. Top top rank portfolios contain the top tercile of deals with the greatest variable values, and the bottom tercile portfolios contain the deals with the lowest values. So, deals included in the top EV tercile are the thirty percent largest deals in the dataset, while deals included in the bottom EV are the bottom thirty percent smallest deals in the dataset. Deals included in the top EBITDA/EV tercile include relatively cheap deals in the sense such deals generate more EBITDA relative to the deal price, EV. Deals included in the top SALES/EV tercile are considered deals of higher quality as such companies generate greater sales per unit of price paid. Deals in the top NET DEBT/EV tercile are more risky deals relative to deals in the bottom NET DEBT/EV tercile as they are more leveraged per unit enterprise value. Extreme return values above the 95th percentile and below the 5^{th} percentile are winsorized to reduce the effect of possible spurious outliers.

When I evaluate the return differences I clearly observe a monotonically declining pattern where value private equities earn significantly higher returns than growth private equities. The value tercile consisting of companies with EBITDA/EV range 0.15 to 0.94 earns a return of 46% per annum. Return per annum for growth buyouts including companies with EBITDA/EV range 0.02 to 0.11 is only 17%. I thus also find strong evidence that the value anomaly that has been documented for public equities can be observed for private equities as well.

Continuing further, I evaluate the return differences between the top and bottom tercile portfolios of private equity deals for sorts on SALES/EV. The top portfolio now contains private equity deals with a high SALES/EV in the range 1.13 to 19.03 and can be labeled as quality private equities, while the bottom portfolio contains private equity deals with a low SALES/EV in the range 0.13 to 0.57 that can be labelled as "junk" private equities. Similar to the results for sorts on EBITDA/EV, we observe a monotonically declining pattern with quality private equity deals earning significantly higher returns than "junk" private equity deals. The returns earned by quality private equities is 48% per annum on average, while the return earned by junk private equities is 23%. This results is consistent with the existence of a quality anomaly in the returns of private equity deals.

Finally, I consider the results for sorts on NET DEBT/EV. The top portfolio now contains the private equity deals with the highest leverage between 0.65 and 1.49, while the bottom tercile contains the deals with the lowest levels of leverage in the range -0.18 and 0.48. It appears that the returns for private equity deals with low levels of leverage are similar to those for private equity deals with high levels of leverage: while the deals with low levels of leverage earn more than 31% per annum, the number is only slightly higher than 28% for the deals with high levels of leverage and lower than for the mid tercile with average returns of 33%. Taking into account the less pronounced returns difference between the top and bottom leverage terciles I can confirm the existence of the low-risk anomaly in private equity.

All in all, through the sorts analysis performed in this section I confirm that four of the most significant return anomalies that have been documented for public equities (i.e., size, value, quality and low-risk anomalies) appear to be present in the returns of private equity deals as well. I find that despite that the size anomaly is present, the effect is less pronounced with only minimal differences in returns of deals in the top and bottom terciles. Value and quality effects appear to be strongly pronounced in the data with double digit difference between returns of deals in the top and bottom sorts portfolios. Finally, deals with lower risk earn similar returns as highly levered deals from which I conclude that the low risk effect is also observed.

Double sorts on EV

The true independent effect of each anomaly variable is difficult to judge without testing for possible interactions where one anomaly largely drives return patters for another anomaly. In fact Fama and French, 1993 show that size and value effect in public equities are strongly correlated with each other. Furthermore, compelling evidence exists that demonstrates stronger anomalous returns for stocks with the lowest market capitalization (micro stocks) (i.e., see Fama and French, 2008). To confirm if this is indeed the case for private equities I perform double sorts analysis where within the initially formed size terciles I introduce a second sorting order on each of the remaining observed anomaly variables. Since the value and quality effects has produced the strongest results for single sorts in this section I only focus on results for sorts on EBITDA/EV and SALES/EV[11]. The results are presented in Figure 2.

[11] Double sorts analysis within EBITDA/EV, SALES/EV and NET DEBT/EV sorts are presented in the Appendix D, E and F, see Figures 5-7.

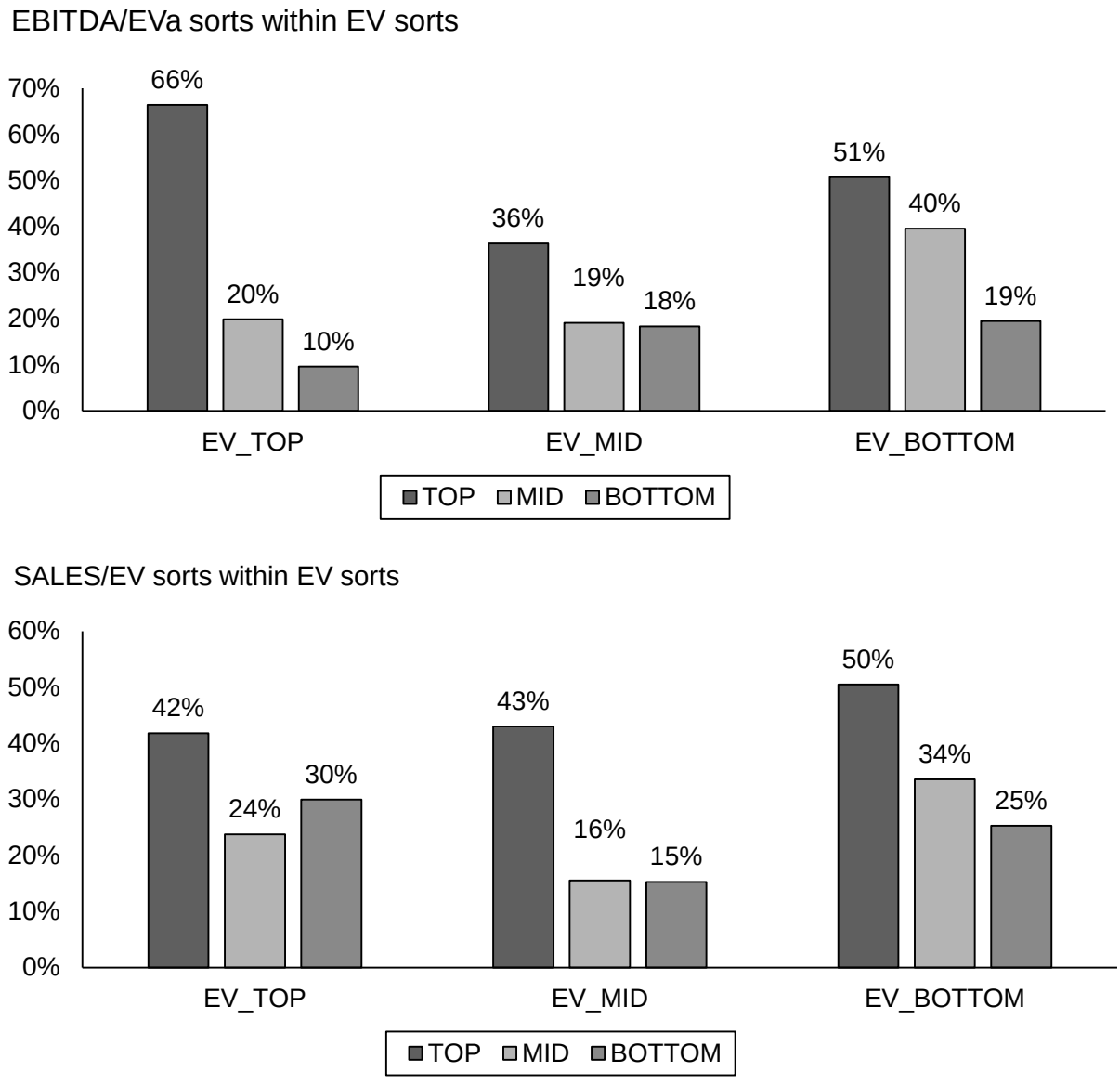

Figure 2. EBITDA/EV and SALES/EV sorts within EV sorts. The figure shows the post-ranking equally weighted returns of tercile portfolios of private equity deals for sorts on (i) their valuation as measured through their EBITDA/EV at entry, (ii) their quality as measured through their SALES/EV at entry within sorts on their size as measured by EV at entry. Top top rank portfolios contain deals with the 33% highest variable values, while the bottom tercile portfolios contain the 33% deals with the lowest variable values. Extreme return values above the 95th percentile and below the 5th percentile are winsorized to reduce the effect of possible spurious outliers.

When I consider the results from double sorts I find consistent patterns with those appearing in the single sorts analysis. More specifically, sorts on EBITDA/EV within EV sorts clearly exhibit monotonically increasing returns the higher the EBITDA/EV ranking becomes confirming that value stocks perform better than growth stocks independently from the size effect. I find that performance on average is highest for deals in the top ranked EBITDA/EV portfolio for each size tercile with average IRR of 66% for largest deals, 36% for mid-sized deals and 51% for small deals. In contrast, deals in the lowest EBITDA/EV terciles return significantly less to investors with IRR of 10% on average for larger deals, 18% for mid-sized deals and 19% for smaller deals.

Turning to results from double sorts on SALES/EV, I document that also the quality effect persists beyond the market cap effect. Top tercile portfolios ranked on SALES/EV continue to outperform the bottom tercile portfolios within all three size portfolios with difference between returns of top and bottom SALES/EV terciles of 12% for the largest deals, 2% to 8% for mid-sized deals and 25% for small deals.

All in all the double sorts analysis[12] performed in this section reconfirms the existence of both value and quality effects in the case for private equity even after accounting for potential correlations with market size. The outcome that both value and quality factors are relevant in predicting returns in private equity nicely fits earlier findings in the academic literature on public equities where both effects have been broadly documented.

However, two puzzling phenomena emerge when I compare my results for private equities to the results that have been documented for public equities. First of all, the economic magnitudes of the return spreads I document are substantially larger than the return spreads that have been documented for public equities. For example, when I take return data on the

[12] Gibbons-Ross-Shanken test is usually applied to formally test difference between terciles from sorts analysis. However, this is beyond scope of this thesis.

value and quality factors from the webpage of Kenneth French and compute average returns per annum over the sample period I use in my study (i.e., 2000 to 2015), I find returns of 5.9%, and 4.4%, respectively. By contrast, the return spreads I documented between tercile portfolios of private equity deals sorted on value and quality are 29% and 25% per annum, respectively. So the private equity returns spread are roughly 5 times larger than the return spreads documented for public equities. Return spreads that have been documented in other studies for public equities over different sample periods (Fama and French, 1993; Fama and French, 1992) are also much smaller than the returns I find for private equities and in similar order of magnitude as the returns I find for the period 2000 to 2015 using the data from the webpage of Kenneth French.

The second notable difference between my results for private equities and the results for public equities regards the double sort analyses on EV. Most studies for public equities find that factor returns like the value and quality premiums are larger in the small cap segment (e.g., see the work of Fama and French, 2008). However, when I consider my double sort results for EV, I do not observe that the return spreads between the top and bottom portfolios for sorts on EBITDA/EV and SALES/EV are larger in the bottom size tercile. On the contrary, in the case of the value anomaly, deals in the top size tercile earn the highest returns and are characterized by the greatest spread between bottom and top EBITDA/EV terciles. In the case of the quality effect, even though I observe a decreasing spread in returns between top and bottom SALES/EV terciles when I move along size terciles the economic effect appears to move inconsistently.

A more careful look on the data underlying this analysis provides a direct answer to these striking differences between public and private equity results. When I consider the size of the deal consisting this dataset relative to the size of the deals from research on public equities, it appears that private equity deals fall into the smallest size bucket defined for public equities.

For instance Fama and French (2008) define the breakpoints separating micro caps from small and small from big to USD 610 million and USD 2.3 billion, respectively. In other words, private equity investments are micro stocks. So while the larger return spreads for private equities are seemingly inconsistent in terms of magnitude compared to the spreads for public equities, this effect appears to be driven by private equity deals being much smaller in terms of market capitalization than the average listed company thereby facilitating higher factor premiums. Also, this effect can explain the second notable observation that return spreads do not increase over market capitalization segments when we move to the micro-cap segment: namely most of the private equity deals are concentrated in this segment, and we have (almost) no deal observations in the large cap segment in which factor premiums are lower.

Cross-sectional regression results

Proceeding further with the analysis, in this section I describe the results of the cross-sectional regressions where I regress deal performance on the normal score[13] of deal characteristics. I first run a single factor regression to deduct the individual predictive power of each factor for deal returns. I also run multifactor regression including all factors together to detect potential interaction effects that might affect the exposure estimates. Both the single and multivariable regressions provide a cross check of results from the sorts analysis in the sense that contradictions in the outcomes might indicate influential observation problem. Finally, to confirm if the potential patterns are not driven by sector, time period and regional effects, I introduce control variables in the form of dummy variables in regression 5. Results are presented in Table 3.

[13] I also run cross-sectional regression using actual values of EBITDA/EV, SALES/EV, NET DEBT/EV and logarithm of EV. since this analysis yields consistent results with the results of cross-sectional regression using normal scores, I do not include them in this section. Nevertheless, I present the output for both regression specifications in the Appendix G and H, see Table 5 and 6.

Table 3

Factor returns and t-statistics from cross-sectional regression

	Regression 1	Regression 2	Regression 3	Regression 4	Regression 5
R sq	-0.1%	3.0%	3.0%	-0.2%	8.9%
EV	-0.019				-0.033
t-stat	-0.719				-1.148
EBITDA/EV		0.101**			0.065*
t-stat		3.779			2.309
SALES/EV			0.101**		0.092**
t-stat			3.776		3.277
NET DEBT/EV				-0.005	-0.017
t-stat				-0.167	-0.611

Note. The table shows factor coefficients estimated using OLS regression using cross-sectional return data for deals completed during the period 2000-2015. The variables used to predict private equity returns (IRR) are the the normal score of enterprise value where enterprise value is measured at transaction entry (EV); value factor measured by the normal score of the ratio of earnings before interest rate depreciation and amortization reported at transaction entry and enterprise value reported at transaction entry as well, (EBITDA/EV); quality factor measured by the normal score of the ratio of sales at deal entry over enterprise value at deal entry; low risk effect measured by the normal score of the ratio of net debt at entry over enterprise value at entry. Regressions 1-4 are individual regressions where deal IRR are regressed on a single deal characteristics. In regression 5 I account for potential interaction effects among the different anomaly variables. Furthermore, in regression 5 I also introduce 12 dummy control variables to account for sector, economic cycle and geographical region effects. Sector controls are based on the classification framework defined by Global Industry Classification Standard (GICS). Geographical region controls distinguish between three regions; Europe, North America and Asia-Pacific. Economic cycle control variables are defined over three periods; from 2000 to 2007, from 2008 to 2011 and from 2012 to 2015. * indicates significance at the 5% level, while ** indicates significance at the 1% level.

When I consider the results in Table 3, regression 1-4, I observe similar results as from the single sorts analysis. Individually both value and quality are significant economically as well as statistically in predicting deal performance. Both significant factors are found to positively influence gross IRR. An increase of 1 standard deviation of the ratio EBITDA/EV and SALES/EV leads to 0.1008 and 0.1007 standard deviations increase in IRR respectively. On the other hand, size and debt are found to be economically relevant but not statistically significant neither at the 5% or 1% level.

Up to this point only the individual effect of value, size, risk and quality on deal returns have been described. In the follow up analysis I also look into their joint effect in a multifactor regression where potential interaction effects between the four characteristics are taken into account as well as certain sector, region and economic cycle effects. Looking at results from regression 5 both EBITDA/EV and SALES/EV remain significant in both economical and statistical terms. However, their marginal effects decrease in magnitude - one standard deviation increase in EBITDA/EV and SALES/EV leads to 0.065 and 0.092 standard deviations increase in deal IRR. The conclusion for both effects of EV and NET DEBT/EV are does not change; I find that the two factors have no statistically significant effect for predicting deal performance.

Concluding comments and follow-up research

The limited evidence on what drives returns in private equity is surprising given the rising significance of the asset class from economic and portfolio management perspective. Academic research on the topic primarily provides insights into attribution of generated returns to three traditional components reflecting the underlying value generation mechanisms in private equity. Alternatively a number of studies take a step further in making the link between the underlying value generation mechanisms and certain manager characteristics that could be

informative about the return potential of a certain fund manager. Nevertheless, empirical evidence remains limited as a result of data restrictions. In contrast, the topic of performance drivers has been extensively researched in the case of public equities. More recently, this stream of literature documents that a large portion of the return differences between managers can be attributed to characteristics like size, value, and quality, also defined as factors along with the traditional premiums. Whether the results carry over to the private market is an important question that to be best of my knowledge is currently unanswered.

In this paper I have addressed this gap. I provide empirical evidence that factor anomalies that are well documented effects for public equities are able to explain returns in private equities deals as well. Namely, I find that value and quality are economically and statistically meaningful effects in private equity markets. The low risk effect appears to be present as no clear relationship emerges between the amount of risk and returns. The size effect appears to be less pronounced which comes as no surprise as similar results are documented for public equities. Using single sorts analysis, I find that value deals earn as high as 46% average return per annum while growth buyouts deliver the significantly lower 17% of average return to investors. Average return for high quality private equity deals is 48% per annum compared to "junk" private equity deals that provide return of 23%. To test the pervasiveness of the anomaly effects I apply multivariable regression as well as double sorts analyses. Both robustness analyses produce strongly consistent results with single sorts analysis even after accounting for potential interaction effects among the four anomalies. Finally, my results remain robust after adjusting for sector, economic cycle and regional effects.

Along with explicitly showing that certain factor premiums exist in the cross-section of private equity returns, I also document two interesting observations that appear to be seemingly inconsistent with what is observed in public equities. First and foremost, I find that the economic magnitudes of the return spreads are substantially larger than the return spreads that

have been documented for public equities. I find that the return spreads I documented between tercile portfolios of private equity deals sorted on value and quality are approximately five times larger compared to average returns per annum for the value and quality factor calculated from return data from the Kenneth French webpage. Compared to results from other studies on public equities results appear to be consistent. Second, anomalies effects are stronger for smaller deals. In contrast, I find that this is not the case of private equity deals with no clear pattern in return spreads emerging along the various size terciles. These phenomena appear to be driven by an obvious difference between private equity deals and listed equities. Namely, private equity being much smaller in terms of market capitalization that the average listed company and thereby facilitating higher factor premiums.

I conclude this research with pointing out some of the most significant implications of my results. First and foremost, academic research on factor anomalies is extensive however it remains mainly limited to the domain of pubic equities. This is the first comprehensive research that demonstrates the relevance of common factor anomaly effects also in the space of the non-public asset class private equity. As such my results confirm the robustness of factor patterns beyond asset classes and advocates the introduction of factor investing approach to portfolio allocation.

Second, I depart from the traditionally tested value drivers in private equity literature to explain returns on a deal level. I provide evidence on the existence of patterns in private equity deal returns associated with specific deal characteristics observable prior commitment. From academic perspective the results provide new insights to the discussion of what drives private equity returns and as such contribute to forming a consensus on the topic. From investment perspective the existence of stable return patterns represent an indication that certain parts of the market deliver better performance than others and those insights could serve as the basis of a new investment strategy.

In this regard, I also acknowledge that a number of questions remain open and require to be addressed in subsequent research. First of all, it is important to extend the current analyses on a more extensive and diverse high quality dataset in order to reassess the robustness of my results. While the dataset used in this research is deemed to be of sufficient quality and breath it remains rather limited compared to databases such as Preqin, Cambridge Associates, Burgiss or Zephyr. Furthermore, by using a more extensive dataset it might be especially interesting to examine how factor effects vary across geographies, sectors and time periods in the case for private equity.

Third, while I provide evidence that specific patterns exist in private equity returns the follow up question how this information can be used for making investment decisions remains unanswered. From portfolio monitoring perspective assessment of exposures to these anomalous effects in the context of an entire portfolio (rather than just public equities portfolio) will lead to a better understanding of the current risk-return profile of the portfolio and facilitate more informed decisions in regards to building future factor exposure. At this point of time no investment framework exist that aims to harvest factor premiums in private equity specifically. At the same time implementing factor investing strategy in private equity might turn out to be more cumbersome compared to following factor investing strategy in public markets. For instance, defining factors in the context of private equity and allocating to those market segments require live data that is also sufficiently representative of the investment universe. Subsequently, in the context of private equity, allocating to factor premiums will be restricted by the quality of the relationship between an LP and an GP which will also determine whether an LP is admitted to the fund of an GP. Similarly, rebalancing of a factor portfolio for private equity will be restrained as is associated with higher costs due to the illiquid nature of the asset class.

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Appendix A

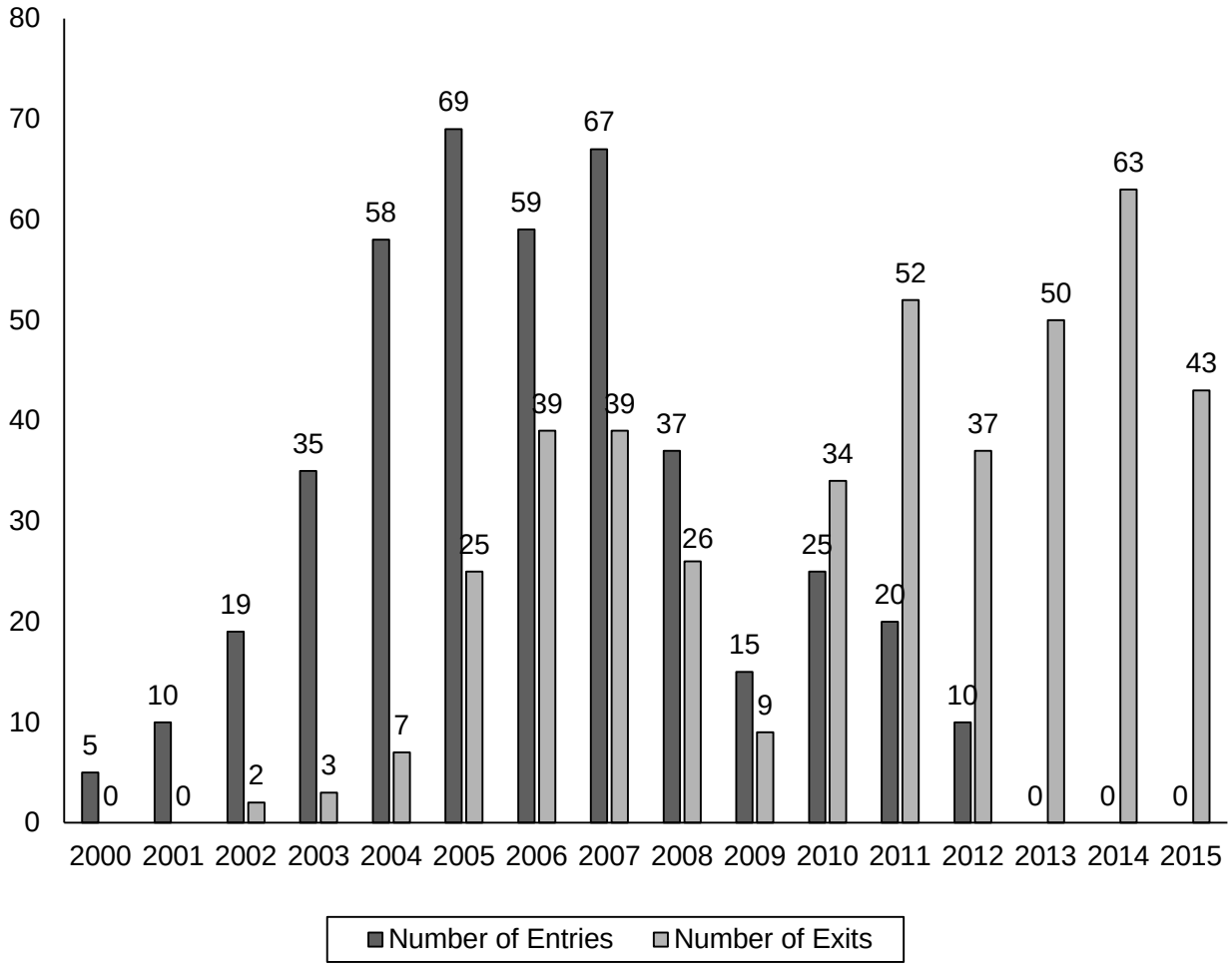

Figure 3. Number of entries and exits per year, 2000 – 2015. The figure shows the number of entry and exit transactions per year undertaken during the period starting in year 2000 and ending in year 2015.

Appendix B

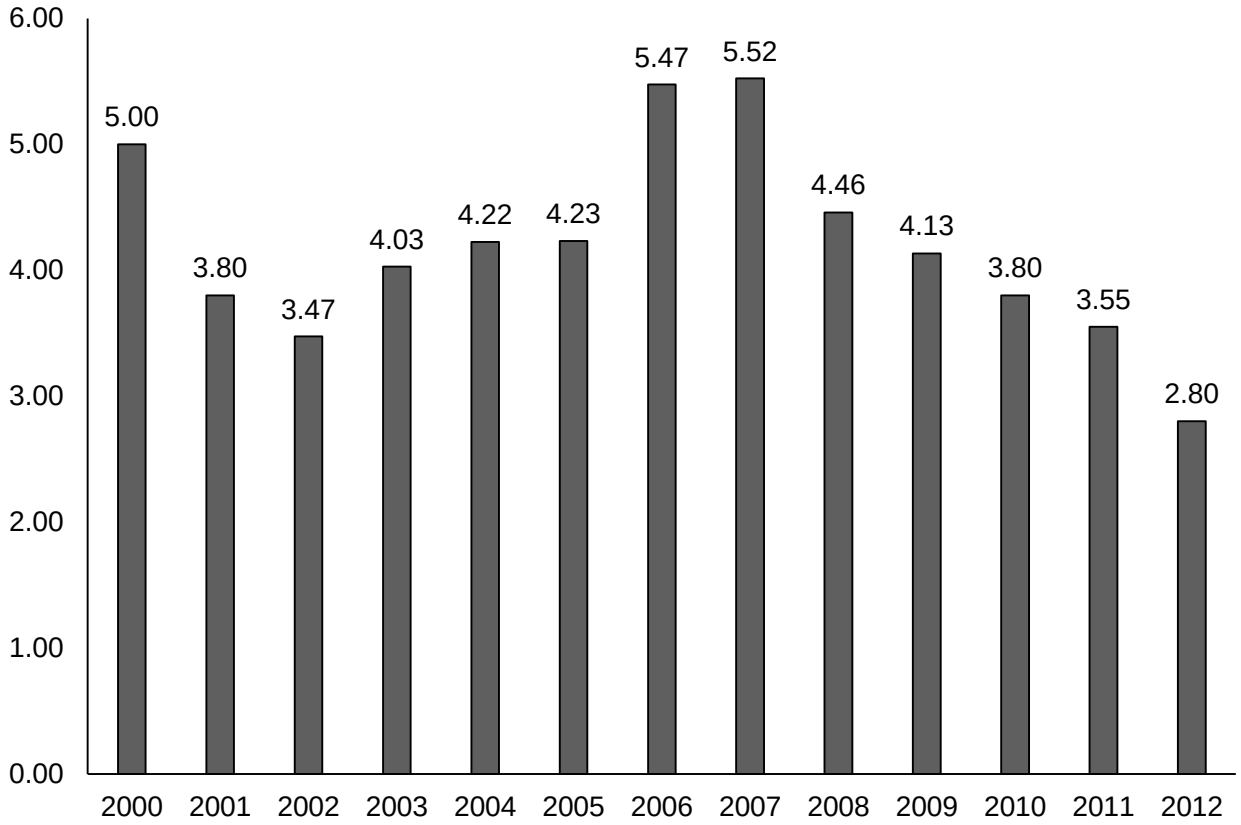

Figure 4. Average holding period. The figure shows average holding period of deals undertaken in the same entry year. Numbers are expressed in years.

Appendix C

Table 4

Dataset concertation per country

	Proportion of total EV	Number of deals
UK	17.05%	102
Germany	14.21%	56
USA	12.23%	35
Sweden	10.88%	46
Italy	8.70%	24
The Netherlands	8.14%	25
France	7.81%	63
Denmark	7.65%	17
Spain	2.43%	13
Belgium	2.27%	11
Australia	1.54%	2
Luxembourg	1.44%	3
Switzerland	1.27%	9
Israel	1.05%	2
Japan	0.78%	1
Norway	0.63%	6
Czech Republic	0.53%	2
Austria	0.52%	2
Hungary	0.36%	1
Finland	0.33%	4
Canada	0.15%	2
Turkey	0.02%	2
Portugal	0.01%	1

Note. The table shows concertation of the dataset per country. Column 2 shows the sum of the EV of deals from a specific country as a percentage of the total EV including all deals. The reported proportions are based on EV values at transaction entry. Where reported in currency different than euro EV values were converted to euro using the FX rate at transaction entry date. Column 3 shows the number of deals undertaken in each country. Only realized transactions are considered.

Appendix D

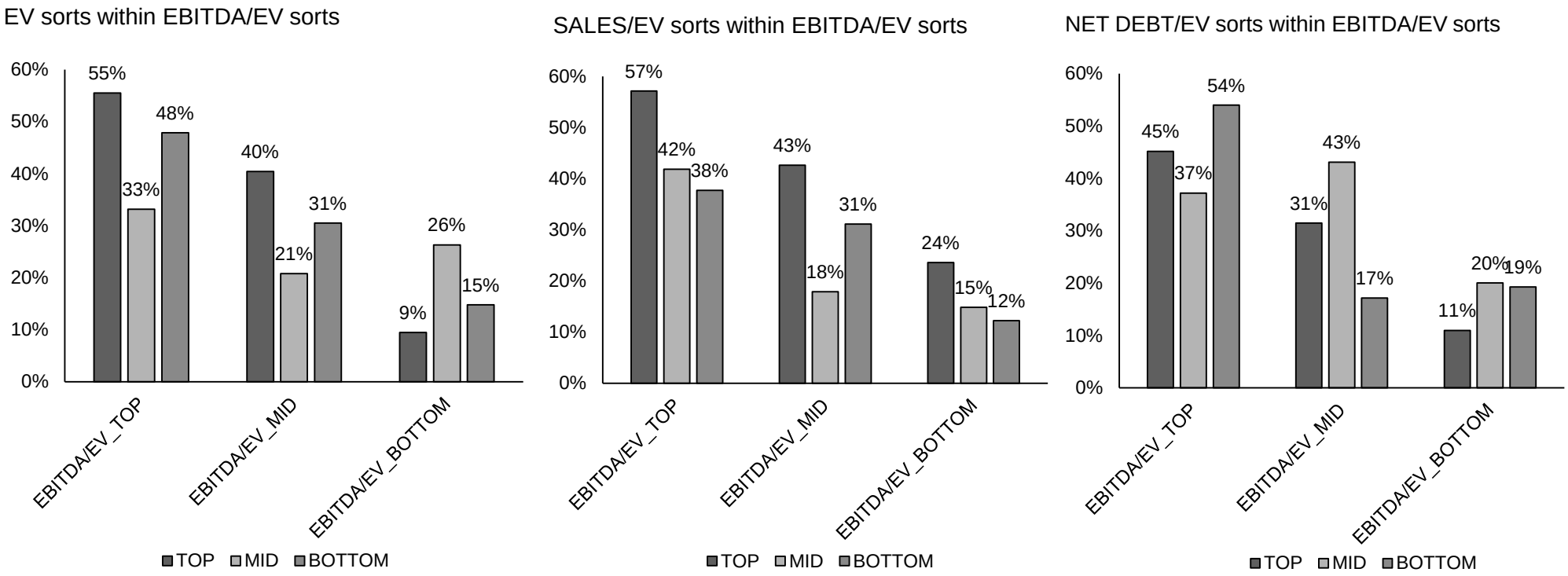

Figure 5. Double sorts on EBITDA/EV. The figure shows the post-ranking equally weighted average returns of tercile portfolios of private equity deals for sorts on (i) their size as measured through their EV at entry, (ii) their quality as measured through their SALES/EV at entry and (iii) their risk as measured by their leverage NET DEBT/EV, within sorts on their valuation as measured by EBITDA/EV at entry. Top rank portfolios contain deals with the 33% highest variable values, while the bottom tercile portfolios contain the 33% deals with the lowest variable values. Extreme return values above the 95th percentile and below the 5th percentile are winsorized to reduce the effect of possible spurious outliers.

Appendix E

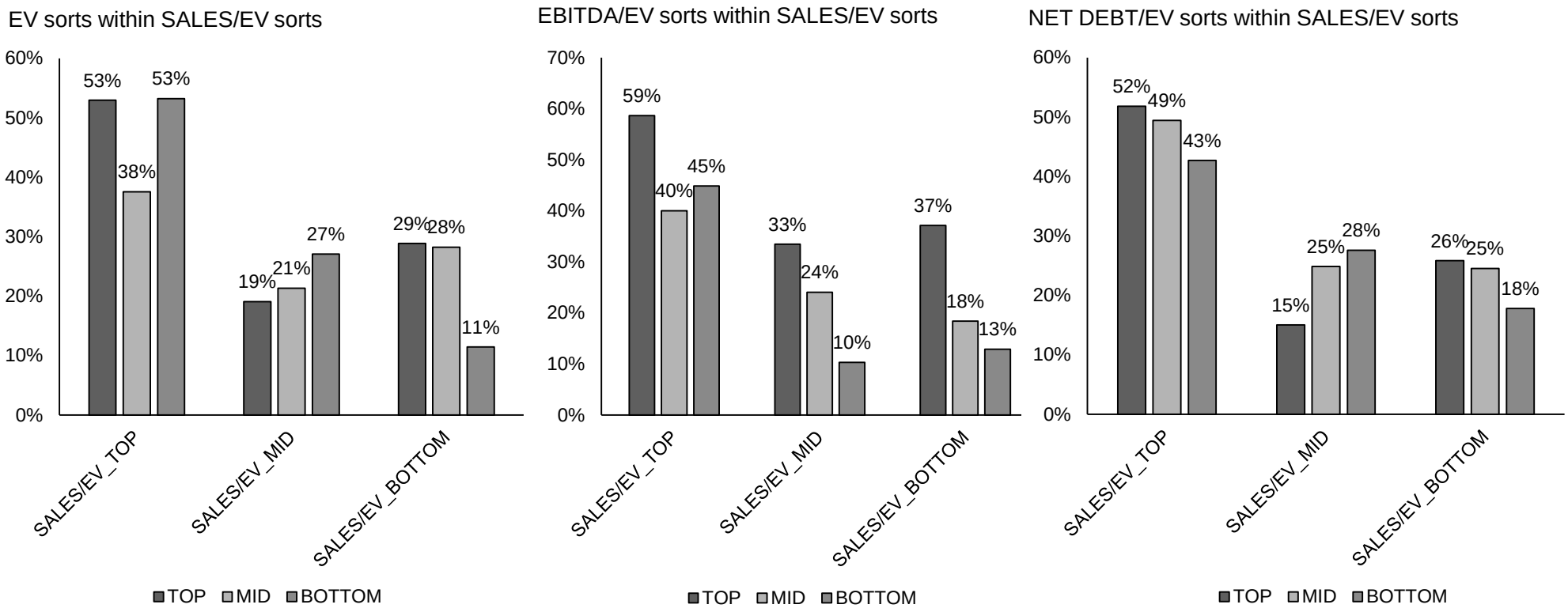

Figure 6. Double sorts on SALES/EV. The figure shows the post-ranking equally weighted average returns of tercile portfolios of private equity deals for sorts on (i) their size as measured through their EV at entry, (ii) their value as measured through their EBITDAEV at entry and (iii) their risk as measured by their leverage NET DEBT/EV, within sorts on their valuation as measured by SALES/EV at entry. Top rank portfolios contain deals with the 33% highest variable values, while the bottom tercile portfolios contain the 33% deals with the lowest variable values. Extreme return values above the 95th percentile and below the 5th percentile are winsorized to reduce the effect of possible spurious outliers.

Appendix F

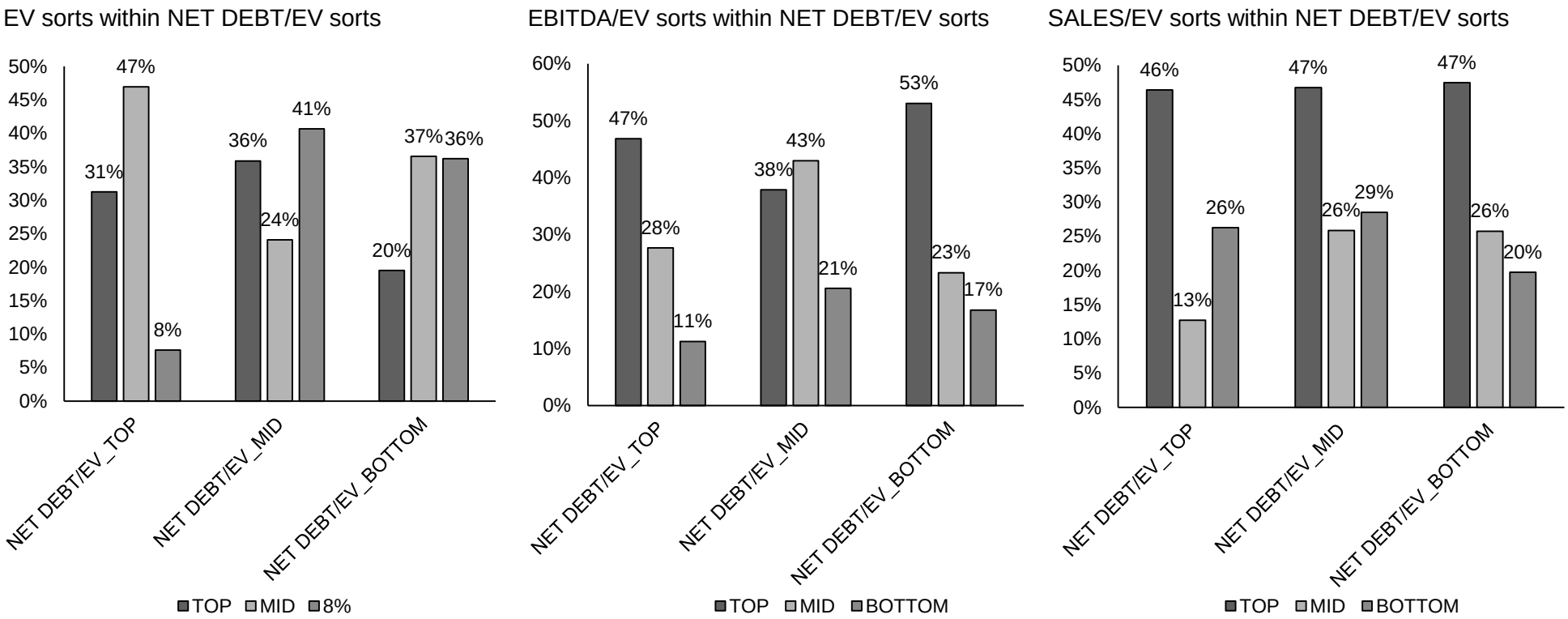

Figure 7. Double sorts on NET DEBT/EV. The figure shows the post-ranking equally weighted average returns of tercile portfolios of private equity deals for sorts on (i) their size as measured through their EV at entry, , (ii) their value as measured through their EBITDAEV at entry and (iii) their quality as measured through their SALES/EV at entry, within sorts on their risk as measured by NET DEBT/EV at entry. Top top rank portfolios contain deals with the 33% highest variable values, while the bottom tercile portfolios contain the 33% deals with the lowest variable values. Extreme return values above the 95th percentile and below the 5th percentile are winsorized to reduce the effect of possible spurious outliers.

Appendix G

Table 5

OLS regression output 1

Regression Statistics	
Multiple R	0.350
R Square	0.123
Adjusted R Square	0.089
Standard Error	0.535
Observations	429.000

ANOVA	*df*	*SS*	*MS*	*F*	*Significance F*
Regression	16	16.518	1.032	3.606	0.000
Residual	412	117.951	0.286		
Total	428	134.469			

	Coefficients	*Error*	*t Stat*	*P-value*	*95%*	*95%*	*95.0%*	*Upper 95.0%*
Intercept	0.487	0.295	1.651	0.099	-0.093	1.067	-0.093	1.067
Z_EV	-0.033	0.028	-1.148	0.252	-0.089	0.023	-0.089	0.023
Z_EBITDA/EV	0.065	0.028	2.309	0.021	0.010	0.121	0.010	0.121
Z_SALES/EV	0.092	0.028	3.277	0.001	0.037	0.147	0.037	0.147
Z_DEBT/EV	-0.017	0.028	-0.611	0.542	-0.072	0.038	-0.072	0.038
Industrials	-0.577	0.151	-3.821	0.000	-0.874	-0.280	-0.874	-0.280
Health Care	-0.472	0.164	-2.873	0.004	-0.796	-0.149	-0.796	-0.149
Consumer Discretionary	-0.552	0.149	-3.702	0.000	-0.845	-0.259	-0.845	-0.259
Financials	-0.474	0.172	-2.754	0.006	-0.812	-0.136	-0.812	-0.136
Materials	-0.699	0.171	-4.091	0.000	-1.034	-0.363	-1.034	-0.363
Information Technology	-0.515	0.183	-2.821	0.005	-0.874	-0.156	-0.874	-0.156
Energy	-0.175	0.236	-0.740	0.460	-0.639	0.290	-0.639	0.290
Consumer Staples	-0.627	0.176	-3.561	0.000	-0.974	-0.281	-0.974	-0.281
Europe	0.331	0.207	1.594	0.112	-0.077	0.738	-0.077	0.738
North America	0.340	0.222	1.531	0.127	-0.096	0.776	-0.096	0.776
2000-2007	0.069	0.176	0.394	0.694	-0.277	0.415	-0.277	0.415
2008-2011	-0.115	0.181	-0.633	0.527	-0.470	0.241	-0.470	0.241

Note. OLS regression output**.** The figure shows factor coefficients estimated using OLS regression. As independent variable is used deal return measured by Gross IRR. As dependent variables are used size factor defined as the normal score of EV at transaction entry (Z_EV); value factor defined as the normal score of the ratio of earnings before interest rate depreciation and amortization reported at transaction entry and enterprise value reported at transaction entry as well (Z_EBITDA/EV); quality factor defined as the normal score of the ratio of sales at deal entry over enterprise value at deal entry (Z_SALES/EV); low risk effect defined as the normal score of the ratio of net debt at entry over enterprise value at entry (Z_NET DEBT/EV). 12 dummy control variables are used to account for sector, economic cycle and geographical region effects. Sector controls are based on the classification framework defined by Global Industry Classification Standard (GICS). Geographical region controls distinguish between three regions; Europe, North America and Asia-Pacific. Economic cycle control variables are defined over three periods; from 2000 to 2007, from 2008 to 2011 and from 2012 to 2015.

Appendix H

Table 6

OLS regression output 2

Regression Statistics	
Multiple R	0.347
R Square	0.120
Adjusted R Square	0.086
Standard Error	0.536
Observations	429

ANOVA					
	df	*SS*	*MS*	*F*	*Significance F*
Regression	16	16.154	1.010	3.516	0.000
Residual	412	118.315	0.287		
Total	428	134.469			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
LN_EV	-0.005	0.021	-0.219	0.827	-0.046	0.037	-0.046	0.037
EBITDA/EV	0.888	0.382	2.324	0.021	0.137	1.639	0.137	1.639
SALES/EV	0.063	0.019	3.305	0.001	0.026	0.101	0.026	0.101
DEBT/EV	-0.093	0.139	-0.672	0.502	-0.367	0.180	-0.367	0.180
Industrials	-0.528	0.148	-3.578	0.000	-0.819	-0.238	-0.819	-0.238
Health Care	-0.425	0.162	-2.622	0.009	-0.743	-0.106	-0.743	-0.106
Consumer Discretionary	-0.506	0.146	-3.478	0.001	-0.792	-0.220	-0.792	-0.220
Financials	-0.425	0.169	-2.518	0.012	-0.757	-0.093	-0.757	-0.093
Materials	-0.648	0.167	-3.877	0.000	-0.976	-0.319	-0.976	-0.319
Information Technology	-0.476	0.181	-2.626	0.009	-0.832	-0.120	-0.832	-0.120
Energy	-0.130	0.234	-0.554	0.580	-0.590	0.330	-0.590	0.330
Consumer Staples	-0.576	0.172	-3.349	0.001	-0.914	-0.238	-0.914	-0.238
Europe	0.342	0.208	1.646	0.101	-0.067	0.751	-0.067	0.751
North America	0.350	0.222	1.579	0.115	-0.086	0.787	-0.086	0.787
2000-2007	0.064	0.176	0.361	0.718	-0.283	0.410	-0.283	0.410
2008-2011	-0.123	0.181	-0.676	0.499	-0.479	0.234	-0.479	0.234

Note. The table shows factor coefficients estimated using OLS regression. As independent variable is used deal return measured by Gross IRR. As dependent variables are used size factor variable defined as the normal score of enterprise value at transaction entry (LN_EV); value factor variable defined as the ratio of earnings before interest rate depreciation and amortization reported at transaction entry and enterprise value reported at transaction entry as well (EBITDA/EV); quality factor variable defined as the ratio of sales at deal entry over enterprise value at deal entry (SALES/EV); low risk effect measured by the ratio of net debt at entry over enterprise value at entry (NET DEBT/EV). 12 dummy control variables are used to account for sector, economic cycle and geographical region effects. Sector controls are based on the classification framework defined by Global Industry Classification Standard (GICS). Geographical region controls distinguish between three regions; Europe, North America and Asia-Pacific. Economic cycle control variables are defined over three periods; from 2000 to 2007, from 2008 to 2011 and from 2012 to 2015.