DIVERSIFY WITH CARE – EVEN IN PRIVATE EQUITY

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Abstract

This study presents a comprehensive analysis of the relationship between diversification and performance in private equity. It pioneers the view of industry diversification in private equity firms on a firm level rather than on the level of individual funds, providing the first analysis for comparison with traditional multi-business firms. The study not only draws on a broad range of established research methodologies from the strategic management and finance discipline, it also extends them as a weighted least squares regression is applied in order to account for heteroscedasticity. The study employs either methodology in a sample of 100 private equity firms. The empirical results show a highly consistent positive influence of related diversification on performance, indicating a sweet spot of diversification. In addition, the study provides evidence for a positive impact of experience of private equity firms on investment performance.

Keywords

Diversification, performance, portfolio strategy, private equity, relatedness, unrelatedness

INTRODUCTION

The private equity industry has experienced tremendous growth rates in recent years and – despite current woes in the credit market – is still expected to show strong growth rates. With USD 690 billion of deal volume and more than 20 percent of global M&A activity in 2007, private equity has become a major force in the global market for corporate control. While private equity firms appear to invest broadly in unrelated industries, multi-business firms have come under increasing pressure from capital markets to focus their activities. Thus, we have observed the dismantling of several large conglomerates to create more focused companies. These contradicting observations provoke the question how industry diversification in private equity portfolios affects investment performance. Can private equity firms overcome the well documented problems of unrelated diversification or will industry focus pay off?

Scholars have regularly investigated the impact of diversification on performance in multi-business firms, while the same phenomenon in private equity has been given little academic attention, even though private equity has led to substantial changes in the corporate landscape. Some of the world's leading assets are now under private ownership and part of – in many cases – largely unrelated diversified portfolios. The relationship of diversification and performance in traditional multi-business firms has been the subject of intensive academic research, including such seminal contributions as Berger/Ofek (1995), Gort (1962), Lang/Stulz (1994), or Rumelt (1974; 1982). Most findings indicate a positive influence of related diversification on firm valuation and performance (e.g. see Hall and St.John 1994; Lubatkin and Rogers 1989; Palepu 1985). On the private equity side, research has largely focused on the comparison of private

equity returns to public market equivalents and the role of private equity as an asset class (e.g. see Conroy and Harris 2007; Kaplan and Schoar 2004; Ljungqvist and Richardson 2003; Moskowitz and Vissing-Jorgensen 2002; Nielsen 2006; Renneboog et al. 2007). Academic research regarding diversification in private equity is very limited and comprehensive firm-level studies are missing.

This study investigates the influence of industry diversification on performance in private equity firms. Unlike the focus of previous contributions on a fund level (e.g. see Cressy et al. 2007; Lossen 2006; Weidig and Mathonet 2004), this study uses consolidated private equity portfolios across a firm's active funds to determine its firm-wide level of industry diversification. It breaks new ground by making the unit of analysis comparable to traditional multi-business firms, thus providing a suitable basis on which to evaluate findings in the light of prior strategic management and finance research in public corporations. The study furthermore adds new insights to private equity research by distinguishing between related and unrelated diversification. The results of this study therefore shed fresh light on the portfolio strategies and management models of private equity firms, allow a comparison with traditional multi-business firms, and consequently offer the opportunity to draw conclusions for the strategic management discipline. Finally, the study stimulates new research efforts in the phenomenon of diversification in private equity firms and its significance for traditional multi-business firms.

The empirical results of the study indicate a highly consistent performance premium for related diversification. Private equity players with a larger share of related diversified investments tend to outperform those with broad and unrelated diversified portfolios. The study's data shows that private equity firms can find a sweet spot of diversification that provides them with sufficient

diversification to avoid industry cyclicality and to spread risk, while at the same time giving them access to the benefits of related diversification. Related diversification arguably enables firms to reduce asymmetric information and agency costs by improving their monitoring capabilities and at the same time strengthens their ability to add value through active intervention. The study moreover provides evidence of the positive relationship between the professional experience of a private equity firm and its performance.

The rest of this paper is organized as follows. The extant academic literature on the diversification-performance relationship in traditional multi-business firms and in private equity firms is reviewed in section two. Section three outlines the methodology applied in this study, including the characteristics of the sample as well as the performance and diversification measures. In section four, the empirical analysis is presented, followed by a discussion of the study's results in section five. The paper closes with the conclusions drawn from the study and an outlook for further academic research.

LITERATURE REVIEW

Diversification research in multi-business firms and private equity partnerships has been given unequal coverage in academic research. While research in traditional multi-business firms has been an essential part of the strategic management and finance discipline, research on diversification in private equity is sparse.

Literature on traditional multi-business firms

Diversification research in multi-business firms has produced a wide range of contributions. While most empirical studies show a negative influence of diversification on a firm's financial

performance and valuation, some also provide evidence of the positive influence of related diversification. The results have been obtained from two research directions, one investigating the influence of diversification on a firm's financial performance and the other assessing the impact of diversification on market valuation.

Empirical studies regarding the relationship between diversification and financial performance have been undertaken in academic research since the publications of Gort (1962) and Rumelt (1974) and have been intensively explored since then in order to replicate and refine their methods and findings. Measuring performance based on accounting figures such as return on assets, return on investment, return on equity, or return on sales, studies find superior performance by firms with related diversification, while unrelated diversification results in a performance deficit (e.g. see Bettis and Hall 1982; Chakrabarti et al. 2007; Chang and Howard 1989; Lecraw 1984; Markides 1995; Palepu 1985; Rumelt 1982). While these indicators are usually easy to retrieve, these measures make the analysis vulnerable to the effects of extraordinary accounting items and differences in international accounting standards. Many studies in this direction furthermore fail to make adjustments for differences in risk-taking. One set of firms might therefore perform better simply because, being at greater risk, they have to earn higher expected returns for their shareholders (Lang and Stulz 1994). Market-based approaches such as risk-adjusted indicators based on a firm's stock price development (e.g., Sharpe ratio (Sharpe 1964), Treynor ratio (Treynor 1965), or Jensen's Alpha (Jensen 1969)) confirm the finding that diversification in general leads to a decline in performance while related diversification proves favorable for multi-business firms (e.g. see Amit and Livnat 1988; Comment and Jarrell 1995; De 1992; Lubatkin and Rogers 1989; Weston et al. 1972). These

measures were developed in the context of the capital asset pricing model (CAPM) and have found broad acceptance in academic research and with participants in the world's financial markets. They have the advantage of being internationally comparable and being immune to short-term accounting effects. If one accepts the assumption of efficient capital markets, using a firm's stock market performance as indicator is advantageous (Melicher and Rush 1973; Naylor and Tapon 1982; Reimann 1988; K. V. Smith and Schreiner 1969). The finding that related diversified firms outperform focused and unrelated diversified businesses has been largely consistent for different methods of measuring performance as well as diverging ways of assessing diversification. It has furthermore been largely consistent across different periods of time.

The examination of the impact of diversification on a firm's market value gained currency with the two seminal studies by Lang/Stulz (1994) and Berger/Ofek (1995). By assessing a firm's valuation against single business companies – Lang/Stulz use Tobin's q, Berger/Ofek determine excess value via asset and sales multipliers – the authors provide evidence of the negative influence of diversification on market valuation. Both approaches compare the valuation of a multi-business firm with the imputed values for its segments as stand-alone entities. Tobin's q therefore applies a ratio between a firm's capital market valuation and the value of its assets, usually indicated by the its book value (Tobin 1969). The multiplier approach on the other hand uses one of three accounting items – assets, sales, or earnings – to multiply each segment's level of this item with the median ratio of single-business firms representing the firm's industry scope (Berger and Ofek 1995). All consecutive contributions have been based on these two approaches. The majority of the studies, most of which unfortunately use different indicators for

diversification, confirm a diversification discount found in prior studies; in other words, the sum of a firm's business segments is worth less than the aggregate value of comparable single-business firms. This relationship was originally established with data from US firms (e.g. see Denis et al. 2002; Gomes and Livdan 2004; Servaes 1996) but has then been tested and confirmed in a variety of countries including Germany, France, the United Kingdom, and Japan (e.g. see Beckmann 2006; Glaser and Mueller 2006; Lins and Servaes 1999). Interestingly, researchers in recent publications have started to adjust their samples for selection biases, data or methodological issues and have found a neutral or positive impact of diversification on value where negative results were shown before these adjustments (e.g. see Campa and Kedia 2002; Graham et al. 2002; Mansi and Reeb 2002; Villalonga 2003; 2004b; 2004a). One of the major shortcomings of the valuation research stream is the failure to integrate measures that enable the assessment of related and unrelated diversification into their studies. The results provided therefore allow only limited conclusions about how an "optimal" level of diversification might look, although many academics and practitioners claim that related diversification outperforms both focused and unrelated businesses. In addition, the setup of the valuation approach restricts the technique to non-financial firms because valuing financial players requires substantial alterations and thereby limits the comparability of results. Finally, the valuation approach lacks a control mechanism for the different levels of risk inherent in different business models. While valuation studies can make judgments about discounts or premiums relative to comparable peers, it does not allow a comparison across different industries or geographic areas.

Literature on private equity

Research about diversification in private equity is a young discipline and has been driven largely from a finance and portfolio management perspective rather than from the strategic management field. Results pertaining to the influence of diversification on performance are limited and inconsistent. Schmidt (2004) finds in a sample of 3620 US private equity investments that a rising number of portfolio companies reduces the variation of returns of a PE portfolio due to the high risk of total loss associated with individual investments. Weidig and Mathonet (2004) make comparable observations for investments in venture capital portfolios, providing evidence that the probability of loss and total loss declines from direct investments to investments in venture capital funds, and again to funds-of-funds. Both studies however fail to address the industry diversification component of portfolio diversification. While the above studies have focused on the effect of diversification in terms of number of investments on the associated risk of the portfolio, few contributions have considered the effect of diversification across industries. Ljungqvist and Richardson (2003) found, that the performance of investments in 73 venture capital and buyout funds between 1981 and 2001 improved significantly with the overall fund size, albeit documenting a maximum at fund sizes between USD 1.1 billion and USD 1.2 billion. They furthermore show that the average fund in their sample of mainly buyout funds invests close to 40 percent of its capital in a single industry; however, the study provides no evidence that diversification across industries has a significant influence on the fund's internal rate or return. Lossen (2006), studying a sample of 100 PE funds containing information about 2,871 investments, observes that the rate of return increases with diversification across industries, in particular for those funds in the top performance quartile. He moreover shows that fund performance declines with diversification across financing stages but is not impacted by

diversification across countries. Finally, he finds that the rate of return of a PE fund increases with the number of portfolio companies. Lossen therefore argues that private equity firms should apply an opportunistic investment approach, specializing on process know-how independent of specific industries rather than building deep industry know-how. A recent study by Cressy/Munari/Malipiero (2007), on the contrary, supports the argument that industry relatedness impacts positively on performance. In an analysis of 122 UK-based buyouts over the period 1995 to 2002, the study finds substantial improvements in operating profitability for private equity firms specialized by industry. The research reveals that the increase in profitability through industry specialization is with 8.5 percent, almost twice the difference between private equity-based firms and non-PE backed companies at 4.5 percentage points. All of the above studies provide valuable insights into the effects of diversification on PE performance; however, besides being inconsistent, they all fail to view the investment portfolio of a private equity firm on the level of the overall firm rather than on the level of single assets or funds. As most private equity firms run multiple active funds in parallel, the concentration on individual deals or funds is insufficient to draw conclusions about the effect of industry diversification on the performance of a PE firm and to establish a comparison to multi-business firms. Moreover, no consistent methodology has been established for the analysis of diversification in private equity as presented above to determine the influence of diversification on performance in diversified companies, and measures for related and unrelated diversification in private equity firms remain absent.

SAMPLE AND METHODOLOGY

This section introduces the sample under study, including sources of data and selection criteria, as well as the diversification and performance measures chosen for the study's empirical research.

Sample

The performance and firm characteristics of the relevant buyout firms are sourced from Private Equity Intelligence (Preqin), a data provider specialized in the private equity industry. The database 'Preqin Performance Analyst' is one of the most comprehensive collections of PE data available in the market, with performance data for over 3,400 private equity funds and for close to 1,200 private equity firms. It moreover allows the differentiation of various fund types such as buyout, mezzanine or venture capital vehicles. Preqin's data is collected from both general and limited partners, which increases the credibility of the stated PE performance data. As there is no transparency about the detailed composition of the investment portfolios of individual private equity firms available in the market, the study draws on information about the transaction history of individual private equity firms. This data is sourced from Dealogic, one of the leading sources of information for activity on the global capital markets, including a database tracking all mergers and acquisitions taking place in the global market ('M&A Analytics'). This database provides information on elements such as targets, acquirers, prices, or the share acquired during the transaction. To validate the collected information, it is compared to the limited public disclosures available from the private equity firms themselves. All additional information required to support the analysis, such as exchange rates or other indices from financial markets,

are drawn from Thompson Financial's 'Datastream'. This database provides historical, in-depth information for financial indicators on a global level.

In private equity, sample sizes in academic research still remain small. One of the few studies investigating diversification in private equity by Lossen (2006) is based on 51 buyout firms. Similar sample sizes of less than 100 private equity firms can be observed in other studies regarding the performance of PE firms (e.g. see Cumming and Walz 2004; Ick 2005; Kaplan and Schoar 2004; Nielsen 2006). This is mainly due to the fact that there is very limited information about private equity accessible to the public. Most studies are therefore based on the proprietary information provided by funds-of-funds or other limited partners. This approach, on the one hand, provides detailed insights into individual investments; on the other hand, however, these studies fail to give an exhaustive picture of a particular private equity firm and are therefore only able to draw conclusions on the funds offered to the limited partners who provided the data.

Given the shortcomings of prior studies, this study addresses a research sample of 100 private equity firms and investigates private equity partnerships on a firm level rather than on the level of individual funds. After eliminating incomplete data sets from the data population, the sample of 100 firms was selected randomly in accordance with various prior diversification studies (e.g. see Bettis and Mahajan 1985; Markides 1995; Rumelt 1974; 1982). Given the internationality of the private equity landscape, the study is based on a population of US and European firms. It is focused on conglomerate-like structures and therefore concentrates on large private equity players whose total fund values exceed USD 5 billion. The private equity fund value is determined by the value of the firm's investment portfolio which consists of the value of both committed equity and debt.

Diversification measures

Recent academic research efforts have been dominated by two diversification measures which will form the basis of the empirical analysis in this study: comprehensive indices such as the Herfindahl index as a form of continuous measures (e.g. see Gomes and Livdan 2004; Lang and Stulz 1994; Montgomery and Wernerfelt 1988) and the Entropy measure (e.g. see Berry 1975; Chakrabarti et al. 2007; Graham et al. 2002; Jacquemin and Berry 1979; Markides 1995; Palepu 1985). These diversification measures have replaced prior standards such as the categorical measures introduced by Rumelt (1974; 1982) and the more simplistic continuous diversification measures as used by authors like Mansi/Reed (2002), Servaes (1996), or De (1992) owing to their better predictive power (Chatterjee and Blocher 1992).

Both indices used in this study, the Herfindahl and the Entropy measure, are based on SIC codes. The Standard Industry Classification (SIC) system was introduced by the US government as a standardized way for companies to report segmental data about their business activities and has since been adopted as a reporting requirement in most industrialized countries. Every firm hereby reports data relating to its different business segments on a four-digit SIC code level, which can then be aggregated to industry groups, commonly defined as the two-digit SIC code level of the SIC code system. The diversification assessment for the firms in the sample was conducted with data for the year 2006 marking the end of the evaluation period.

The Herfindahl index is a commonly used method for measuring a firm's overall diversification. It can be calculated based on various financial indicators such as sales, assets, or segment valuations. The index is the sum of the squared values of – for example – sales per industry segment as a fraction of total firm sales. If a firm has only one segment, its Herfindahl index is

one; if a firm has ten segments that each contribute ten percent of sales, its Herfindahl index is 0.1 (Lang and Stulz 1994: : 1257). Hence the Herfindahl index falls as the degree of diversification increases, or, in other words, as the firm's concentration on a single industry segment decreases (Comment and Jarrell 1995: : 69-70).

$$\textit{Herfindahl index} \qquad H_{jt} = \sum_{i=1}^{N_{jt}} \left(X_{ijt} / \sum_{i=1}^{N_{jt}} X_{ijt} \right)^2$$

X_{ijt} ... *indicator attributable to a business*
i ... *business i*
j ... *firm j*
t ... *fiscal year t*

The Entropy measure is an alternative index to derive additional information from the data provided in a firm's reporting and is defined as "a weighted average of a firm's diversification within sectors" (Jacquemin and Berry 1979: : 362). Whereas entirely continuous measures allow no conclusion about related or unrelated diversification, the Entropy measure has the advantage of deriving insights into the different levels of diversification prevalent in a firm by assuming that segments within an industry group (two-digit SIC code level) are more related to one another than segments across industry groups (Hall and St.John 1994; Palepu 1985). Related diversification is hereby defined as the diversification within a two-digit SIC code, unrelated diversification as the diversification arising from operating between two-digit SIC codes (Hoskisson et al. 1993: : 222). Thus the Entropy measure allows the decomposition of a firm's total diversity into two additive components – related and unrelated diversity – while at the same time avoiding the problems of subjectivity associated with Rumelt's (1974; 1982) categorical measures (Palepu 1985: : 244).

$$\textit{Entropy index} \qquad DT = DR + DU$$

DT ... *Total diversity*
DR ... *Related diversity*
DU ... *Unrelated diversity*

Total diversity $DT = \sum_{i=1}^{n} P_i * \ln(1/P_i)$

P_i ... *the proportion of a firm's business within the* i^{th} *industry segment*
n ... *number of industry segments which the firm participates in (four-digit SIC code)*

Related diversity $DR = \sum_{j=1}^{M} DR_j * P_j$

DR_j ... *diversity within industry groups*
M ... *the number of industry groups into which the n industry segments aggregate*
P_j ... *the proportion of the firm's business within the* j^{th} *industry group (two-digit SIC code)*

Unrelated diversity $DU = \sum_{j=1}^{M} P_j * \ln(1/P_j)$

M ... *the number of industry groups*
P_j ... *the proportion of the firm's business within the* j^{th} *industry group (two-digit SIC code)*

PE firms typically provide no or only fragmented information about the composition of their investment portfolios. Instead of relying on partial data provided by limited or general partners and thereby only grasping part of the portfolio as seen in most prior research (e.g. see Lossen 2006; Schmidt 2004; Weidig and Mathonet 2004), this study draws on transaction data provided by the data vendor Dealogic. By tracking all transactions, acquisitions and divestitures, the study attempts to reconstruct the actual investment portfolio of the private equity firms in the sample. For this purpose, all transactions occurring within the ten year period between January 1st 1997 and December 31st 2006 have been drawn from the database, including all types of transactions such as mergers, acquisitions, or initial public offerings. Given the limited lifespan of a PE investment fund, the transactions within a ten year timeframe are able to closely represent a

firm's investment portfolio at the end of 2006. The dataset provides information about the acquirer and the divestor as well as relevant information about the target such as the transaction value, the deal type, and the industry as well as SIC code in which the target firm is operating. Building the diversification analysis on this set of data, all acquisitions with subsequent divestitures were removed from the sample. After triangulating the results with the publications of private equity houses and finding high correlations between the statements of PEs and the transaction analysis, the remaining list of acquisitions is then used as a proxy for the current investment portfolio of the PE firms in the sample. After aggregating all acquisitions, the industry structure within the PE investment portfolio can be evaluated. The PE industry diversification is then measured by the Herfindahl and the Entropy index based on the SIC codes and the transaction values are generated from the resulting set of data. The transaction value is the best quality data available for the individual investments in a PE portfolio and therefore used as lead indicator in the diversification analysis.

Performance measures

The study focuses on the relationship between diversification and financial performance rather than on valuation due to data availability and the shortcomings of the valuation approach outlined above. Within this direction of research, there are two general approaches to measure performance as presented above: an accounting-based method and an approach relying on performance to investors, also called market-based approach. This study opts for the market-based approach for three reasons. First, the quality of data available from the private equity side regarding the performance to investors is substantially better than the scarce data retrievable about the accounting-based performance measures of individual portfolio companies or the

private equity investment vehicles. Second, the market-based approach integrates past and future performance elements in one measure as it is a representation of dividend yields and stock price movements indicating expected performance. Accounting-based indicators are purely a representation of past performance and can easily be manipulated. Third, risk adjustments based on market indicators are well established in academic research.

Performance of private equity firms is measured in 'Internal Rate of Return (IRR)'. The IRR is calculated after deduction of the administration and performance fees charged by the private equity firm and is therefore entirely attributable to investors (net IRR). It contains cash flows to investors as well as the current valuation of the investors' private equity investments. The performance data for the individual funds of a PE firm is taken from Private Equity Intelligence's database 'Preqin Performance Analyst' and accumulated to represent performance on the level of the PE firm. This research uses performance measures over a ten-year period.

Internal Rate of Return (IRR) solved from equation

$$I_1 = \sum_{t=1}^{N} C_t / (1 + IRR)^t$$

I_1 ... *initial investment*
C_t ... *cash flow in year t*

Adjusting for differences in risk associated with different kinds of investments can be expressed by various measures. Jensen's Alpha (Jensen 1969) represents the ability of a firm to perform better or worse than a broadly diversified market portfolio (Lubatkin and Rogers 1989: : 459). It can also be described as the risk-adjusted outperformance of an individual asset compared to the relevant market benchmark. The Sharpe measure (Sharpe 1964) divides the excess return on an investment by the overall volatility of returns and thereby provides an alternative indicator to compare risk-adjusted returns between different investments and the market. While Sharpe's

measure takes into account the total risk associated with the investment, the Treynor measure (Treynor 1965) concentrates on the systematic risk of an investment and therefore adjusts for potential differences in market risk associated with different investments. All three indicators appear suitable for the empirical analysis in this study (De 1992).

Jensen's Alpha $\alpha_i = r_i - [r_f + \beta_i (r_m - r_f)] + \varepsilon_i$

Sharpe's Measure $S_i = (r_i - r_f)/\sigma_i$

Treynor's Measure $T_i = (r_i - r_f)/\beta_i$

r_i ... *return of investment*
r_f ... *risk-free rate of return*
r_m ... *return of market portfolio*
β_i ... *beta coefficient measuring the systematic risk of an individual investment; it therefore assesses the volatility of the investment above the volatility of the market portfolio*
σ_i ... *total volatility of investment*
ε_i ... *disruptive factor*

The risk-free rate of return is approximated by the return on three-month US treasury bills, adjusted for varying maturities (Bodie et al. 2005: : 144). Market returns are represented by the return on the relevant stock indices of the different investments. The systematic risk and the total volatility of the share price are represented by a single historic figure in accordance with Cunningham (1973), who observed a high consistency of risk measures for share prices over time. Due to the lack of market data, adjusting PE performance for risk requires some workarounds. According to studies conducted by Rosenberg and Guy (1976; 1995) as well as Braun, Nelson, and Sunier (1995), it can be assumed that a firm's volatility is influenced most strongly by the industry mix of businesses it is invested in and the degree of diversification within its business portfolio. This method is further supported by Jensen's (1989) argument that the risk of default is much lower than generally expected given the interest of all parties to

achieve a successful workout and the support of financial innovations – a view that finds further empirical backing by Kaplan (1989) and Kaplan/Stein (1990). Their studies show that the systematic risk of equity in leveraged buyouts is considerably smaller than that predicted for large levels of financial leverage. Kaplan and Schoar (2004) therefore chose a similar approach when comparing private equity returns to public equity markets. Their influential study controls for "observable differences such as industry composition and stage of investment" (Kaplan and Schoar 2004: : 9) rather than fundamental financial indicators. Based on this concept, the study borrows volatility indicators for private equity firms from public corporations with a comparable business mix and degree of diversification. Therefore, the study uses the average volatility indicators (β_i and σ_i) of the public corporations that match the business portfolio characteristics in terms of industry mix and degree of diversification.

EMPIRICAL RESULTS

The diversification-performance relationship can be addressed on the level of both the individual private equity firm and from a portfolio perspective. For the individual firm level, a regression model is applied including further characteristics obtained for the private equity firms in the study's sample. To establish whether there is a relationship between performance of the portfolio of PE firms and the level and mode of diversification, private equity firms are separated into portfolio groupings according to their level of diversification (De 1992).

Individual firm performance

To determine the relationship between the performance of individual private equity firms and the degree and mode of diversification of their investment portfolio, the study, in a first step,

establishes three basic cross-sectional regression equations which are in line with regression models considered so far in the existing literature. In a second step, the study considers a generalized linear regression approach by relaxing the classical assumption of spherical disturbances. Theoretical details of both classical and generalized linear regression models are given by, for example, Greene (2008).

First, the following three types of regression models are examined:

$$(1)\ (\text{Performance measure})_i = a_0 + a_1(\text{Diversification measure})_j + u$$

$$(2)\ (\text{Performance measure})_i = a_0 + a_1(\text{Diversification measure})_j + a_2(\text{Size}) + u$$

$$(3)\ (\text{Performance measure})_i = a_0 + a_1(\text{Diversification measure})_j + a_2(\text{Size}) + a_3(\text{Funds}) + a_4(\text{Experience}) + u$$

The study uses the private equity performance measures internal rate of return (IRR), Jensen's Alpha (α), the Sharpe measure (S), and the Treynor measure (T) as dependent variables. The diversification measure Herfindahl (H) as well as related diversification (DR) and unrelated diversification (DU) measured by the Entropy index represent independent variables. The additional firm characteristics portfolio size (Size), number of funds (Funds), and firm experience (Experience) are introduced gradually as control variables. In a first step, the size of a PE investment portfolio is included in the model, measured by the equity value of the portfolio. In a second step, the model is augmented by the number of funds, described as all the active funds managed by a private equity firm, and the experience of a PE partnership, evaluated by the years of existence since vintage of the firm's first fund, irrespective of whether the fund is still active or has been liquidated. Following existing empirical research contributions (Berger/Ofek (1995), Lins/Servaes (1999), Chakrabarti/Singh et al. (2007)), the disturbances (u) are assumed

to be homoscedastic and uncorrelated in regression equations (1) – (3), i. e. $Cov(u) = \sigma^2 * I$. Hence, regression coefficients can be estimated by ordinary least squares (OLS). Table 1 outlines the estimated regression coefficients and their significance levels, with estimated standard deviations given in parentheses. Also, Table I states the standard and adjusted coefficients of determination of all regression models.

Insert Table I about here

The presence of diversification measured by the Herfindahl index has a positive or neutral impact on performance, depending on the performance measure. This means that diversification in itself has a positive impact on performance, as diversification is highest when the Herfindahl measure has the lowest values. When distinguishing diversification in related (DR) and unrelated (DU) modes of diversification, one observes a consistently positive influence of related diversification on performance, while the impact of unrelated diversification varies between negative, neutral, and positive along the different measures of performance. Even though highly consistent, the findings for Herfindahl and related diversification are not significant at any conventional significance level.

The impact of adding the size of the portfolio to the analysis increases the explanatory power of the analysis, which is furthermore improved by including the number of funds and the experience of the private equity firm. The experience of the private equity firm is particularly valuable in that it accounts for the varying performance levels among private equity players. Interestingly, when experience is added to the regression model, portfolio size loses significance in most cases and therefore appears to act as a proxy for experience, which is neutralized once the experience variable is included in the model.

With R^2 values reaching up to eleven percent in regression equations (1) – (3), this study achieves values above most comparable, cross-sectional studies in public corporations. Typical cross-sectional studies in this field such as the empirical contributions by Berger/Ofek (1995), Lins/Servaes (1999), or Chakrabarti/Singh et al. (2007) show R^2 values considerably below ten percent.

Low values of the coefficient of determination may indicate that the classical linear regression approach of equations (1) – (3) may not be appropriate. For example, some independent variables may have a non-linear influence on performance. Also, the assumption of homoscedastic disturbances seems questionable, since the scaling behavior of performance measures may vary over different industry groups. Therefore, the following regression model is examined in a second step of our analysis:

$$(4)\ (\text{Performance measure})_i = a_0 + a_1(\text{Diversification measure})_j + a_2(\text{Funds}) + a_3(\text{Experience}) + a_4(\text{IndicatorSize}) + a_5(\text{IndicatorFunds}) + a_6(\text{Funds} * \text{Indicator funds}) + u,$$

$$\text{where IndicatorSize} = \begin{cases} 1, & \text{Size} \leq 5.000.000.000 \\ 0, & \text{Size} > 5.000.000.000 \end{cases}$$

$$\text{and IndicatorFunds} = \begin{cases} 1, & \text{Funds} \leq 5 \\ 0, & \text{Funds} > 5 \end{cases}$$

In comparison with previous regression models, the size of a PE firm is no longer included directly in the regression equation, since its influence has turned out to be rather weak. Still, firm size enters the model as an indicator of whether it is below or above five billion as differentiator between global mega-funds and smaller players with typically regional focus. In a similar way, a second indicator that controls for the number of a firm's funds is added

differentiating the sample above and below five funds to indicate a firm's success in raising multiple funds. The intuition of both indicators is that firms with a larger size and a higher number of funds should perform better than firms with a smaller size and fewer funds, respectively. Hence, the estimated regression coefficients of both indicators should be negative. To further control for non-linear influence of the number of funds, the cross product between the number of funds and its indicator is included in the regression model.

An even more noteworthy change to previous regression models is the assumption of heteroscedastic disturbances in regression equation (4). In particular, it is assumed that the disturbances' variance is constant within a specific industry group, but may vary over different industry groups. Still, disturbances are assumed to be uncorrelated both within and between industry groups, leading to

$$Cov(u) = \begin{pmatrix} \sigma_1^2 & 0 & 0 & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & 0 \\ 0 & \ddots & 0 & \ddots & & & & & & \vdots \\ 0 & 0 & \sigma_1^2 & & \ddots & & & & & \vdots \\ \vdots & \ddots & & \sigma_2^2 & 0 & 0 & & & & \vdots \\ \vdots & & \ddots & 0 & \ddots & 0 & \ddots & & & \vdots \\ \vdots & & & 0 & 0 & \sigma_2^2 & & \ddots & & \vdots \\ \vdots & & & & \ddots & & \ddots & & \ddots & \vdots \\ \vdots & & & & & \ddots & & \sigma_{10}^2 & 0 & 0 \\ \vdots & & & & & & \ddots & 0 & \ddots & 0 \\ 0 & \cdots & \cdots & \cdots & \cdots & \cdots & \cdots & 0 & 0 & \sigma_{10}^2 \end{pmatrix}.$$

As a consequence, the regression coefficients of equation (4) cannot be estimated by OLS anymore. Instead, generalized least squares (GLS) estimation techniques have to be applied. Since disturbances are assumed to be heteroscedastic and uncorrelated, the GLS estimator coincides with a weighted least squares (WLS) estimator with weights given by $w_i = 1/\sigma_i$. Thus,

estimated regression coefficients of equation (4) can be obtained from using feasible WLS. In a first step, the industry group specific variances are estimated by the means of those squared OLS residuals that belong to the specific industry group under consideration. In a second step, the regression coefficients of equation (4) are estimated by the WLS estimator whose weights are given by the inverse values of the estimated industry group specific standard deviations from the first step.

Following this approach, Table II reports the estimated regression coefficients of equation (4), their estimated standard deviations as well as their significance levels. Also, both standard and adjusted coefficients of determination are given.

Insert Table II about here

This variation of the analysis leads to a considerable improvement in R^2 and an advancement in the number of significant variables. Formost, the analysis consistently shows a positive impact of diversification measured by the Herfindahl index and furthermore supports previous findings of a positive impact of related diversification on performance; unrelated diversification continues to show negative coefficients. The indicators size and number of funds both show negative results and are significant on at least a five percent level providing evidence that larger funds as well as continuous success in raising new funds has a positive link with performance; experience again proves to have a positive implication on performance.

However, the inclusion of both indicators and the cross products between the number of funds and its indicator may pose a severe multicollinearity problem in regression equation (4). To check for multicollinearity, Table III states the generalized variance inflation factors (GVIF) of each independent variable of each regression model, see Fox (1997) for a definition thereof.

According to a widely accepted rule, multicollinearity is said to be present in a regression model, if at least one independent variable has a generalized variance inflation factor larger than ten.

Insert Table III about here

The GVIFs of both diversification measures, the number of funds, experience and the firm's size indicator are smaller than five in all regression models considered. Nonetheless, the GVIF of the number of funds indicator is close to ten in seven regression models, thereby slightly exceeding this threshold five times, and even larger than 15 in one regression model. Also, the GVIF of the cross product between the number of funds and its indicator is slightly larger than ten in two regression models and much larger than ten in one regression model. Hence, multicollinearity appears to be a serious problem in only one regression model.

Apart from these minor limitations, allowing for nonlinearities as well as heteroscedastic disturbances by using a generalized rather than a simple linear regression model has substantially improved the modelling of a firm's performance.

Portfolio performance

For the portfolio analysis, the study groups the private equity firms in the sample into four diversification clusters according to the degree of their related diversification (DR) and unrelated diversification (DU) as assessed by the Entropy index. The clusters represent firms with strong related diversification (High DR – Low DU), strong unrelated diversification (Low DR – High DU), both high related and high unrelated diversification (High DR – High DU), and finally comparably focused firms with both low related and low unrelated diversification (Low DR – Low DU). As proposed by De (1992), one can use equal size and equal range portfolios. Equal

size portfolios split the sample into diversification clusters with an equal number of PE firms in each cluster. Equal range portfolios are constructed with identical ranges for diversification measures and can therefore contain different numbers of firms per cluster.

Insert Figure 1 about here

Figure 1 outlines the levels and modes of diversification in each portfolio. Firms in the first quadrant show a relatively high degree of related diversification (0.66 in equal size portfolios/0.74 in equal range portfolios) with at the same time lower unrelated diversification (1.05/0.96). The average number of industry groups (5.00/4.74) is slightly lower than in the overall sample; the number of industry segments (8.74/8.61) remains virtually unchanged from the figure in the overall sample. The second quadrant is marked by firms that have both high related and unrelated diversification. The total level of diversification is the highest among these firms (H 0.12/0.13; DT 2.20/2.17). Firms in the third quadrant have highly unrelated diversification (1.85/1.82) and show only limited signs of relatedness (0.18/0.19). Firms in this part of the sample consequently have an above- average number of industry groups (7.77/7.76) in their portfolios. And finally, the fourth quadrant contains firms with low levels of unrelated and related diversification. They moreover reveal the lowest level of overall diversification (H 0.50/0.51; DT 1.01/1.00).

Insert Figure 2 about here

The performance analysis outlined in Figure 2 reveals that firms with a lower level of unrelated diversification show superior levels of performance across all performance measures. Within the equal size portfolio, firms which focus on limited investments and thereby have low degrees of related and unrelated diversification have the strongest overall performance with 20 percent IRR.

They are followed by the portfolio consisting of related diversifiers with an IRR of 17 percent. In equal range portfolios, PEs with high relatedness and low unrelatedness in their investment portfolios outperform all other modes of diversification with 19 percent IRR as well as a Jensen's Alpha of nine percent. Overall, all portfolio compositions show positive Alpha indicating that they outperformed comparable market investments.

Narrowing the statistical analysis to the two portfolio groupings most relevant for testing the diversification-performance link, Table IV provides – in accordance with the approach chosen by Palepu (1985) – statistical results comparing the portfolio with high relatedness and low unrelatedness (High DR – Low DU) and the portfolio with low relatedness and high unrelatedness (Low DR – High DU). The study uses unpaired t-tests to test the relationship between diversification and individual performance measures. In particular, if the assumption of equal variances within both groups cannot be rejected, the standard t-test is applied. Otherwise, the t-test with a Welch correction is performed. Using standard F-tests, the hypothesis of equal variances within High DR – Low DU and Low DR – High DU portfolios is rejected at a five percent significance level for all equal size portfolios, but cannot be rejected at the same significance level for all equal range portfolios, see Table V.

Insert Table IV and V about here

The comparison of the two diversification portfolios High DR – Low DU and Low DR – High DU again highlights the performance gap between private equity firms with high related and high unrelated diversification. The statistical analysis however cannot bring additional insight into the relationship between diversification and performance in private equity firms. The two-tailed t-tests with a 95 percent confidence interval fail to reject the null hypotheses stating

equality of expected performance across all measures applied in this study ($H_0 : E(Performance_{HighDR\text{-}LowDU}) = E(Performance_{LowDR\text{-}HighDU})$).

DISCUSSION OF RESULTS

The different statistical approaches chosen in this study provide highly consistent evidence of a positive relationship between performance and industry diversification in the investment portfolios of private equity firms. The relationship between diversification and performance highlights that there are portfolio compositions more likely to derive high investment performance than other modes of diversification. Statistical results however reveal that diversification is clearly only one piece in the performance puzzle of private equity.

Diversification and risk/return

The empirical results of the study show that diversification is a key component of the private equity model. Higher levels of diversification improve the risk/return profiles of private equity investments by reducing performance volatility. Schmidt (2004) similarly showed that a private equity firm is able to reduce its diversifiable risk by almost 80 percent when the portfolio increases to 15 investments.

Private equity firms are specifically interested in a strong track record with consistent performance levels. Although inconsistent with the Modigliani/Miller (1958) theorem and West's (1967) transition of the theorem to portfolio diversification, investors in private equity are typically large institutional investors that are looking for stable returns and are unwilling to bet on the success on individual industries. Given the information asymmetry and insufficient

liquidity of private equity investments, risk diversification does not happen on the investor level but on the level of the private equity firm's funds.

Risk reduction through diversification is particularly important for investment models such as private equity, which are built around non-permanent capital. Private equity firms are highly dependent on short-term and medium-term economic trends and on the resulting opportunities to acquire and divest companies. Firms tend to decrease their overall exposure to the cyclicality of particular industries and to minimize correlations within their investment portfolios.

Related diversification

Diversification appears to be a critical success factor for a private equity firm, though the mode of diversification is paramount. Related diversification in a selected set of industries tends to promise the highest rates of return for a private equity partnership and its investors.

The selection and oversight of private companies is characterized by considerable information asymmetries and principal-agent problems (Amit et al. 1998; Chan 1983; Gompers 1995). Specialization in particular industries through related diversification appears to enable private equity firms to overcome some of those obstacles. Exposure to a limited number of industries with substantial scale in those industries can give a private equity firm with related diversification a competitive advantage and the opportunity to improve its selection of acquisition targets, its management of the investment portfolio, and its successful exit from an investment.

During the process of acquiring a new target, information asymmetry exists between the private equity firm as acquirer, the management team, and the vendor of the target company. Private

equity firms generally run an intense, multi-stage selection process to overcome such information asymmetries (Birley et al. 1999; MacMillan et al. 1987; Tyebjee and Bruno 1984). However, knowledge about particular industries enables a private equity manager to further reduce the information gap and improve selection and valuation results. PE players with related diversification are better able to build greater industry expertise and consequently are more likely to make promising acquisitions than firms with unrelated diversification.

After the acquisition, two elements appear to enable related diversifiers to extract greater returns from their portfolio companies: the ability to exercise stronger corporate governance and the opportunity to add value as a parent. On the one hand, agency problems exist between the buyout firm (the principal) and the management team of a portfolio company (the agent). Even though the strong incentive systems implemented in a private equity ownership model help to reduce agency problems (Palepu 1990; Phan and Hill 1995; A. J. Smith 1990a, 1990b; Thompson et al. 1992), the personal interests of managers might continue to differ from those of the PE firm and its investors. According to Gompers' (1995: ; 1465-66) findings in venture capital firms, three likely types of agency costs and asymmetric information in private equity investments exist. First, management might invest in strategies and projects that have high personal returns, such as recognition or further career options, but low expected monetary payoffs to shareholders. Second, given that management equity stakes are essentially call options, a strong incentive exists to pursue high variance strategies. Third, private information might allow a manager to continue projects with negative net present values or to undertake inefficient investments while this information is shielded from the private equity firm. Stronger expertise in particular industries can enable private equity managers to overcome some of the costs associated with

agency problems and asymmetric information. Managers with experience in a number of related investments are more likely to draw on comparable cases to assess management performance and investment decisions. On the other hand, to achieve the returns required by investors, some private equity players have changed their investment model to reflect a more actively involved management style. Buyout specialists play a stronger role in strategic and operational changes to create value and to generate sufficient cash flows to service interest payments (Bruining and Wright 2002; Fox and Marcus 1992; Kaplan 1989; Palepu 1990; Wiersema and Liebeskind 1995). Related diversification can enable private equity professionals to add more value to a portfolio company given their accrued industry experience of strategic and operational questions. Managers of unrelated diversified portfolios are less likely to come across questions and industries that they have addressed before. This argument is closely connected to the resource-based view of diversification in corporate settings. Building on this theory, private equity managers should – as much as corporate managers – attempt to use their set of skills in familiar areas as long as attractive investment opportunities are available in the field (Penrose 1959; Silverman 2002).

Finally, a stronger degree of relatedness in a PE firm's investment portfolio can allow for a stronger position in the exit phase. The amount of information held by the private equity firm and the knowledge of the industry landscape and potential benefits for strategic investors can help a private equity partnership to achieve higher exit prices than an unrelated diversified investor without a strong position in the industry.

Management experience

Closely linked to relatedness is experience, which proved to be the most significant factor explaining performance differences in private equity firms. The time since a private equity firm issued the first fund added substantial power to the performance analysis of the study's private equity sample. On a similar note, Kaplan and Schoar (2004) show a strong persistence in performance across different funds of the same private equity general partnership. In their view, the persistence of results is most likely driven by heterogeneity in the skill set of general partners and the limited scalability of human capital. Persistence of high returns is of particular importance in the private equity world given the non-permanent nature of capital. Private equity professionals have an obligation to return capital to investors after the lifetime of each fund, typically after ten years, and then need to raise fresh capital for new funds. The evaluation process by limited partners is based largely on the performance of prior funds. Lossen's (2006) study similarly shows a positive association of performance with firm experience; his results however are not significant and are based on a fund rather than firm sample.

Time since inception of the first fund embodies a number of variables, including a network and brand that ease access to transactions, the management expertise and network of experienced managers that can be employed in one of the firm's investments, as well as knowledge about potential buyers and standing contacts with investors. All of these can be considered elements brought about by the "experience" of a private equity firm.

For acquisitions, experience allows a firm to build up a network as well as a brand to attract and find available deals in the market. Being in the private equity sphere for a longer period of time provides private equity managers with contacts to search for deals. Furthermore, after having executed a number of successful deals in particular industries, transactions will start to find the

private equity firm in those industries. Moreover, those more established firms will most likely be associated with higher credibility by financiers to raise bridge loans, find co-investors, and access the debt required for the transaction, potentially even at lower cost. A young firm does not have the luxury of being established in the market and will have to put in a higher level of activity to get into the deal flow.

After the initial acquisition, more experienced firms will probably have a higher likelihood of extracting value from an investment through active involvement in strategic decision making. Established firms will moreover have access to a network of executives and advisors, with whom they have worked before and who can be approached if the need for strategic advice arises. A younger player in the market will have to work harder to establish the same level of management expertise and network of competencies. Information about the market is also important when it comes to exits. Established firms will most likely have more information about potential buyers and the advisors most suitable for particular transactions.

Furthermore, established players are able to present a track record to investors and have an established base of investors. Most institutional investors invest in the same firms on a continuing basis, on the strength of trust and the firm's performance record. Positioning a new player in the market without a long-standing performance record and investor network will require a stronger investment case and potentially a risk premium.

Finally, established private equity firms will have most likely gained the ability to read different economic conditions and to understand the implications for the private equity model. Different economic cycles can significantly influence acquisition and divestiture opportunities and thereby affect the depth of involvement and the modes of value creation in PE investments. Experienced

firms may pass on transactions during highly competitive periods and play a more active role on capital markets when they see sound market environments.

Wruck (2007) refers to this phenomenon as the 'routinization' of the private equity's approach to reorganization for value creation. The establishment of a relationship-oriented, organizationally focused business over a PE firm's existence enables the firm to create a competitive advantage over less experienced market participants. Building on Jensen and Meckling's (1992) view, the contribution of private equity experience is a question of specific vs. general knowledge. Whereas general knowledge is inexpensive to transmit among agents, specific knowledge takes time to create and is costly to transfer among agents (Chapman 2007).

Ultimately, the argumentation about the positive influence of experience on private equity performance is closely linked to theories of behavioral learning (e.g. see Bower and Hilgard 1981; Cyert and March 1963; Haleblian and Finkelstein 1999; Mazur 1994) and organizational learning (e.g. see Crossan et al. 1999; Fiol and Lyles 1985; Huber 1991). These theories argue that experience allows firms to establish routines and procedures for managing their investments and thereby achieve higher investment performance. Experienced organizations moreover are better able to reflect on changes in a firm's environment. Haleblian/Finkelstein (1999), for instance, establish a positive relationship between the experience gained by an organization and its performance in corporate mergers by analyzing acquisitions from a behavioral learning point of view. Their study documents that the more similar a firm's acquisition targets are, the better they perform.

Explaining the unexplained

The above performance drivers help in determining what creates more or less successful private equity players. Although results are comparably strong for a cross-sectional analysis, those characteristics of a firm that can be measured through the investment portfolio and data points such as fund size or first year of vintage explain only part of performance differences between private equity players. A substantial part of private equity performance cannot be explained by the firm's investment portfolios or level of experience.

Explaining this unexplained part of private equity performance will require a look into the specific ownership and management models pursued by individual firms as well as an investigation of the set of skills accessible for a private equity firm. As indicated by Lossen (2006: : 36), those as yet unobserved differences in management style between private equity firms are arguably the cause of differences in performance. We are currently investigating the influence of different management models and parenting styles on the performance of private equity firms in a separate research project.

Limitations of research

The study attempts to use the performance and diversification metrics that have had the highest level of acceptance in the academic community and which have been undergoing academic assessments for several decades. However, research limitations arise, in particular given the pioneering work of this study in the private equity field. Limitations mainly include quality issues in the study's data as well as the validity of the applied performance and diversification measures. Finally, the treatment of consortium deals presents a problem unique to the private equity industry.

For private equity firms, access to high quality data is limited. Performance data is based on contributions by general and limited partners to London-based Private Equity Intelligence. Although the mix of general and limited partners should lead to substantial quality improvements, there is still substantial management discretion and a lack of continuous market data in private equity. In addition, the sample reveals survivorship bias, given that only the successful models survived and made it above the sample cutoff criteria. The bias has an effect on the analysis of performance drivers in private equity firms, in particular in terms of experience.

The validity of the measures used in this study, the internal rate of return in combination with its risk-adjusted variations provide a useful basis on which to measure performance while overcoming accounting or measurement problems observed in other performance indicators. One fact however is noteworthy in this context. Private equity firms that have not yet been closed base performance calculations on interim valuations, which might misstate the real value of an investment. Performance figures for not yet liquidated funds might therefore be misstated quite substantially.

The assessment of validity for the study's diversification measures reveals that the lack of regulatory disclosure in the private equity industry requires the construction of a portfolio proxy through the use of transaction data to assess industry diversification. This proxy can differ from the actual PE investment portfolio. In addition, the metrics used to evaluate related and unrelated diversification based on SIC codes have regularly incurred criticism, as such industry classifications are unable to capture a potential resource relatedness of businesses, even though

they are in different SIC industry groups (see Martin and Sayrak 2003: : 49-52 for an useful overview).

Finally, the occurrence of consortium deals can present a limitation to the study's findings. Generally, only the lead firm will be deeply involved in a portfolio company's strategic and operational changes, whereas non-lead firms have only weak incentives for time-consuming activities (Bottazzi et al. 2004). The effect of industry specialization is therefore most relevant for lead firms, while co-investors mostly contribute capital to the transaction or participate for "window-dressing" reasons (Lakonishok et al. 1991) to demonstrate a track record of successful investments to investors (Admati and Pfleiderer 1994; Cressy et al. 2007; Cumming 2005a; 2005b). The dataset is unable to distinguish between lead and non-lead investors.

CONCLUSION AND OUTLOOK

This study pioneers the comprehensive analysis of the diversification-performance analysis in private equity firms. It finds a highly consistent positive influence of industry diversification and related diversification in particular on the performance of private equity firms. The results suggest that on the one hand industry diversification is critical for the success of private equity firms. On the other hand, however, PE firms need to find a sweet spot of diversification and accordingly diversify with care. Concentration on a limited number of industries can provide firms with the advantage of enhanced monitoring capabilities and better qualifications to intervene in the activities of their portfolio companies. The empirical findings confirm the predominant findings of previous academic studies in traditional multi-business firms. In addition, the study finds considerable evidence of the positive influence of a firm's experience on

the performance of private equity portfolios. The 'routinization' of management in private equity firms appears essential for the above-market performance of a PE firm.

The empirical results and research approach of this study provide the basis for additional academic research efforts in the field of portfolio strategies and management models of private equity firms. The statistical results in this study are highly consistent but remain weak as long as the classical linear regression approach is considered. Applying a generalized linear regression model instead and allowing for nonlinearities and heteroscedasticity remarkably strengthens these weak empirical results. Given the current availability of data on private equity, this study was built on a sample of 100 private equity firms, with portfolio proxies based on market transactions as well as third-party performance reporting. Current movements in the industry towards stronger transparency will eventually provide the premises for larger sample studies with potentially higher-quality (panel) data to further test the results for statistical significance. To analyze the influence of industry diversification on returns to investors, the study extended an established research approach from strategic management and finance research. Although it is the authors' belief that the chosen approach is most appropriate to the research question, previous studies in corporate management have experimented with different diversification and performance measures to triangulate the findings of individual studies and to address different angles of the diversification phenomenon. Additional empirical work would therefore be required to test the diversification-performance relationship with different measures. Also, extending the methodology applied in this study even further may add to the understanding of the connection between these two variables. For example, the idea of constant industry group specific variances could be replaced by assuming that variances are, at least partially, influenced

by other covariates such as a firm's size. In addition, estimation techniques which are more robust against multicollinearity than OLS or the adding of instrumental variables may be considered in future research.

If the finding that relatedness also matters in private equity firms is sustained in further academic studies, one has to understand how private equity firms can optimize their portfolio strategies and can create value in related diversified portfolios. Finally, academic research has to answer how the presumable success of private equity firms based on their portfolio strategies and management models can be applied in the management of traditional multi-business firms.

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