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How do select characteristics of private equity funds impact their return and how do these returns compare to the performance of the S&P 500?

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ABSTRACT

Keywords: Private equity performance, fund characteristics, historical performance

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This thesis investigates the degree to which private equity fund characteristics impact fund performance and how this performance compares to the S&P 500. The study consists of a regression analysis of a data sample comprising multiple large US institutional investors. The author finds that when comparing other investment strategies to a buyout strategy, performance is mostly not significantly impacted. Further, the paper finds that the performance of private equity funds generally increases when the sector and geographic focus are diversified. Lastly, the aggregate private equity fund performance is found to outperform the S&P 500. Although individual fund characteristics are found to impact the overall fund performance.

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CHAPTER 1 Introduction

Private equity is commonly viewed as a relatively new but profitable way of investing, with Asset Under Management (AUM) showing a Compounded Annual Growth Rate (CAGR) of 15%, for the years 2012 to 2022, according to Bain & Company. Yet, investing into private equity comes at the cost of foregoing other investment opportunities, while paying additional fees to the general partners of private equity funds. High (opportunity) cost in combination with a low degree of reporting regulation for investors and private equity funds increase uncertainty for potential investors when determining their investment strategy. While a large share of literature on private equity performance finds that on average funds outperform the market (e.g., S&P 500), articles like Phalippou & Gottschalg (2009) find that the contrary holds. Their research paper "The performance of private equity funds", concludes that the use of net-of-fees and risk adjusted fund returns underperform the market by 6%, on average. Therefore, accounting for detailed characteristics of private equity funds using publicly reported institutional investor returns as a proxy could add further depth to the existing academic literature in this field.

Currently academics are divided on whether private equity investments are able to outperform the market. Lossen (2006), Bernstein et al. (2016), and Phalippou & Zollo (2005) estimate the performance of private equity funds using publicly reported investor returns as a proxy, and comparing them to common market indices, while analysing individual fund characteristics to estimate whether and how these impact the overall performance of the fund. While Kaplan & Schoar (2003) found in their study that private equity funds performed in line with the S&P 500, which established the base dataset for Phalippou & Gottschalg (2009), Stucke (2011) raised concerns that this data was likely gathered using flawed measurements, as the data sampled was based on voluntary reporting of private equity funds. Focusing on US buyouts, Higson & Stucke (2012) found that while private equity funds outperformed the S&P 500 significantly, this performance was in majority driven by 60 funds, which merely represented the top decile of private equity funds, within their sample. Based on these contradicting results, it is the author's belief that this article will provide further insights on the performance in the private equity fund segment.

Private equity funds face the choice of which (sub-) strategy and focus to pursue when setting up a fund, as different strategies display varying historical performances, as shown by Kaplan & Sensoy (2015). For the purpose of this research, investors are defined as institutional investors. These are exclusively pension / retirement funds for government employees in the US. These investors are obliged to publish information on private equity investments, thus representing a good proxy to gather information on fund performance. The results of this research will then be compared to market performance. To a certain degree this research can also be seen as an extension of Phalippou & Zollo (2005) research which addresses drivers of private equity performance, while additionally focusing on

an extensive list of fund characteristics. The research goals of this thesis can thus be summarized in the following research question:

"How do select characteristics of private equity funds impact their return and how do these returns compare to the performance of the S&P 500?"

The approach followed throughout this thesis to answer this research question is to analyse existing academic literature in combination with the quantitative research performed by the author. Furthermore, as this research aims to estimate the performance of private equity investors, the subsequent study will follow the empirical strategy of Phalippou & Gottschalg (2009).

As the following research is of a quantitative nature, it is important to find accessible and reliable information on private equity fund performance. The main objective of this study is to analyse the historical returns of private equity funds, using institutional investor returns as a proxy. The author will measure key characteristics of the private equity funds in which the sampled institutional investors invested and analyse the impact of these characteristics on overall returns using regression analysis. Utilizing Bloomberg as a secondary data source, for the years 2003 to 2010, the author has gathered key investment information of the respective institutional investors and their investments into private equity funds. Focusing on funds raised between 2003 to 1013 seams adequate as those funds have largely been realized (typically PE funds have a 10 to 12 year life), while also avoiding the distorting effects of the internet bubble in the early 2000's. In extension to the data gathered on Bloomberg, the author will research further fund characteristics on the respective private equity firm websites. Examples of such characteristics include, whether the fund is a follow-on fund, whether there is a geographic focus in the fund, and if the fund focuses on select industries. The gathered information will be summarized in a multi-level data set with 2,075 observations of each of the investor's investments. As the aggregated information will be limited, certain essential assumptions have to be made regarding the distribution and collection of capital, since capital drawdowns are distributed over time. The assumptions regarding the distribution of cash-flows will follow the findings presented by Cohesive Capital Partners in their article "Understanding private equity cash-flows and exposure over multiple fund commitments". To further determine overall investor / fund performance the capital calls and distributions will be discounted to present values, using the risk-free rate. For the purpose of this research the risk-free rate will be estimated using 10-year US government bonds. The author will perform a multi-level regression analysis with investor return as the dependent variable and the following independent variables: ratio capital invested to capital committed, investment (sub-)strategy of the private equity fund, geographic focus of the fund, industry focus of the fund, and whether the fund is a follow-on fund. The researched and analysis of the combination of subjects allows for statistical estimation on the impact of PE fund characteristics on their return.

While the Global Private Equity Report 2023 from Bain & Company shows that private equity funds have performed strongly over recent years, authors of academic literature have differing views on the relative performance of private equity funds. It is the author's expectation that, similar to the findings of Higson & Stucke (2012), there are individual (types of) funds which will drive the overall performance of private equity funds to outperform the market, while other (types of) funds may have difficulties to keep up with market performance. Further, there are certain variables which appear to have an impact on performance, one of which may be whether the type of fund is a follow-on fund (i.e., a second-, third-, fourth- generation fund) which would mean that the fund has a track record of being profitable to investors.

The remainder of this thesis is structured as follows; Chapter 2 provides a background to the PE sector and discusses relevant literature and previous research. Chapter 3 presents the data sample and an introduction to all relevant variables of this research. The methodology and statistical analysis will be provided in Chapter 4. Chapter 5 offers the results, discussion, and limitations section of this paper. Lastly, Chapter 6 provides a final conclusion of the research conducted.

CHAPTER 2 Theoretical Framework

2.1 Private Equity: Background

While the following research will focus on explaining Private Equity (PE) performance, it is important for all readers to understand the fundamental mechanisms of how these companies operate. The relationship between investors and PE firms are mostly facilitated via limited partnership structures (Kaplan & Schoar 2003). Within a limited partnership structure, the PE firm typically acts as the General Partner (GP), while Limited Partners (LPs') form the counterpart. LPs generally consist of insurance companies, endowments, family offices, and high-net-worth individuals and institutional investors, with the latter being by far the largest capital contributors and the focus of this research. Each fund is a limited partnership, where committed capital is pooled. Capital is then drawn and invested during a time that is in accordance with certain conditions defined in the limited partnership agreement, which all partners subscribe to at the beginning of each fund.

Schwass et al. (2011) describe the Bessemer Trust as the first company which, in 1901, started what is now known as a private equity firm. In the beginning and up until the late 1950s these funds mostly invested into early-stage companies. This changed in 1958, with the 'Small Business Act' signed by US president Eisenhower, which enabled privately held venture firms to receive loans from the government to leverage purchases for larger investments. Following this, the 1964 acquisition of Orkin Exterminating Company, became the first 'modern' leveraged buyout in history (Tripathi, 2012). Nevertheless, US government taxation increases on capital gains and the regulations placed on pension funds in the 1970s -- which reduced ability of US pension funds to invest into 'risky investments' -- by the US Congress, initially slowed the rise of PE.

With the 1980s, the ascent of PE investing truly began, as the US reduced the previously imposed taxations and relaxed restrictions on pension funds, which gave rise to some of the largest firms currently active: Bain Capital (1984) , The Blackstone Group (1985), and The Carlyle Group (1987). Although PE rose in popularity amongst investors, literature such as "The Bonfire of the Vanities" (Tom Wolfe, 1987) contributed to the general public's negative perception of the PE market. Following the 1990/1 recession, the boom in the technology sector, once again, gave rise to rapid growth for PE firms. While PE firms had less external capital at hand due to the 1994 bond market crisis (often a main source of their investors earnings), the low share prices for tech companies enabled the firms to drastically increase the number of public-to-private deals in the 1990s (Cheffins & Armour, 2008). This rise is what may have led European investors to enter the private equity market.

In the early 2000s, markets were rattled by the burst of the dot-com bubble. While some firms made considerable losses, others engaged in fire-sales following the market downturn. Nevertheless,

the continuously rising markets, from 2003 onwards, combined with increased regulation of public companies, brought a major shift in popularity from venture to buyouts funds.

The 2007/8 financial crises then again brought down financial markets and with it much of the PE industry. With the levelling of housing prices at the beginning of 2006, adjustable mortgage rates began to increase, while expected values of homes decreased. The resulting drastic increase of loan defaults not only impacted banks and mortgage brokers, but also mortgage lenders who had repackaged their loans into mortgage-backed securities / bonds and experienced falling valuations on those. This eventually resulted in a broader tightening of credit (Chaffins & Armour, 2008), as banks felt the impact of the mortgage defaults and hedge funds were hurt by both the loss in value of bonds and trust from investors. This shortage in available leverage led to the sharp decrease in PE fund exits in the subsequent two to three years. Similar to the rebound following the dot-com bubble, from 2009 onwards the economy as a whole -- and with it PE firms -- recovered and experienced a decade of growth.

2.2 Private Equity: Performance

Definitions of performance, in the context of financial markets, are generally similar: "How successful an investment, company, etc. is and how much profit it makes" (The Cambridge Dictionary[1]). While performance may initially be perceived as a broad topic, performance metrics can be applied to any action with a measurable outcome. For the following research this so called 'action' will be a complete lifecycle of a private equity fund, while the 'measurable metric' will be the returns such a fund earns (i.e., the performance of private equity funds). The rapid global increase in deal value of private equity firms over recent years (Bain & Company[2]) raises the need for unbiased performance measurements, as fund managers may manipulate performance data in their favour (Braun, Jenkinson, and Stoff, 2015). It is important to mention that in this case "manipulation" refers to fund reporting within the boundaries of legal regulations and the rules established in the afore-mentioned limited partnership agreements. This is only possible as valuations of investments may be strongly subjective. Such subjectivity can relate to the valuations of fund investments, which have not yet been sold, as well as to the treatment of fees, credit lines, and other aspects.

Additionally, it is of interest how PE funds add value to their investors, which could explain the relatively large volume of fees collected (Metrick & Yasuda, 2011). Gompers et al. (2016) mention that LPs believe that GPs are generally focused on achieving the highest possible absolute return, while disregarding their relative fund performance. Additionally, the article mentions that PE firms spend considerable time on actively sourcing and evaluating deals, as within their sample only 6 out of 24 initially screened opportunities resulted in signing with the counterparty. These findings are largely in line with those of Metrick & Yasuda (2011), which states that PE funds bridge the gap between

[1] https://dictionary.cambridge.org/dictionary/english/performance
[2] https://www.bain.com/globalassets/noindex/2023/bain_report_global-private-equity-report-2023.pdf

(semi-) uninformed investors and PE firms, who employ industry experts and heavily invest into research. Wright et al. (2008) mentions two additional value creating actions performed by PE firms: value creation via investing in portfolio companies (e.g., through add-on acquisitions) and creating returns by purchasing companies at low multiples.

2.2.1 First Studies

When identifying the first academic literature in the field of private equity performance one has to balance finding the earliest available article without deviating excessively from the topic of interest. Moskowitz & Jørgensen (2002) can be seen as the first study in this field. The authors stated that they chose to study this field as there is only little information on the returns that entrepreneurs receive when investing into equity investments. Their quantitative analysis utilizes the Survey of Consumer Finances[3] (SCF), the Flow of Funds Accounts (FFA), and the National Income and Product accounts (NIPA) to conclude that aggregate returns of PE funds mostly underperform returns achieved in public equity markets.

Shortly following Moskowitz & Jørgensen (2002), Ljungqvist & Richardson (2003) published their working paper titled "*The Cash Flow, Return, and Risk Characteristics of Private Equity*", in which they utilise a dataset from funds raised from 1981 to 2001. Their data set includes detailed cash-flows of investments, distributions to the investors, and management fees. The authors find that competition for deals, the accessibility of investment opportunities, and the timing of cash-flows strongly contribute to the overall performance of PE funds. Additionally, they find that first-time funds outperform follow-on funds, although this relationship is not found to be statistically significant. The impact of portfolio betas[4] is estimated to be positive and significant for buyout funds. The authors determine that higher cash in-flows in the vintage year of a fund lead to a lower performance in succeeding years. Overall, the authors conclude that, on aggregate, buyout funds outperform venture funds. Ljungqvist & Richardson (2003) rationalize these findings by identifying the increased degree of leverage accessible to buyout funds, compared to venture funds. This finding is partially in line with the findings of Harris et al. (2014) who reached the conclusion that, in recent years, buyout funds have outperformed the market, while Venture Capital (VC) funds have underperformed the market. The main goal of Ljungqvist & Richardson (2003) was to shed light on a field which was only lightly researched at the time, and allowed investors, who have little to no control over the cash-flows post-investment, to further understand how returns in PE funds are achieved.

The two most extensive literature overviews of PE performance are Gohil & Vyas (2016) and Harris, Jenkinson, and Kaplan (2014). An article which both of these papers reference is Gompers & Lerner (2000), which discusses the influence of the cash in-flows into venture capital funds on PE

[3] https://www.federalreserve.gov
[4] The beta of a portfolio is a variable which indicates the degree of sensitivity of the portfolio to market movements

valuations. While VC funds do not represent the complete PE sector, they are (besides Buyout) the segment of PE which is studied the most. Further early researchers, such as Chevalier & Ellison (1995), Sirri & Tufano (2002), Berk & Green (2002), Bares et al. (2002), and Brown et al. (1997) research similar relationships, however, differ as they focus on mutual funds, which typically invest in public markets.

2.2.2 Seminal Studies

Kaplan & Schoar (2003) pioneered research in the field of PE performance as it was previously highly untransparent, given that PE firms are largely exempted from disclosure requirements globally. The data set provided by Venture Economics[5] covers voluntarily reported performance metrics of GPs and their respective LPs, which enabled the authors to launch well-founded research. The data set used and analysed by Kaplan and Schoar would then go on and form the base for many further quantitative research articles written in the following years. In order to measure performance, the authors identified three alternatives, namely: Internal Rate of Return (IRR) provided by Venture Economics, IRR calculated based on the funds cash-flows, and the Public Market Equivalent[6] (PME). Kaplan and Schoar concluded that PE performance was largely in line with the performance of the S&P 500 (within their sample time period). They further identified funds raised during an economic boom to be less likely to raise follow-on funds, which did not hold for funds which performed well even in economic downturns.

In contrast to Kaplan & Schoar (2003), Phalippou & Gottschalg (2009) investigated PE performance and found that PE funds generally perform lower than the S&P 500 Index by 3% net-of-fees, while outperforming the index by another 3% gross-of-fees. The authors relied on data provided by Venture Economics, similar to Kaplan & Schoar (2003), but focussed on liquidated funds, which allowed for emphasis on the full performance of a fund. Similar to most academic literature in the field of PE performance, this article aims to further inform readers, including (institutional) investors.

2.2.3 Related Topics & Evolution

In order to compare PE performance, several academic papers (Higson & Stucke 2012, Kaplan & Schoar 2003, and Harris et al. 2014) analyse market indices (S&P 500 and Russel 2000) to identify how PE funds performed against a public alternative. A comparative analysis allows researchers who do not use net-of-fees returns to merely estimate whether PE fund performance would exceed or underperform markets. Nevertheless, academics studying this field substantially differ in their conclusions. While Kaplan & Schoar (2003) find that PE returns are approximately in line with those of the S&P 500, Higson & Stucke (2012) and Harris et al. (2014) conclude that PE returns

[5] https://www.ventureeconomics.com
[6] A performance measurement which adjusts an IRR-like metric to public market returns and irregular cash-flows.

exceed the market by 4.5 and 20–27 percent, respectively. While some variation in findings may be rooted in the differing approach of using gross- and net-of-fees returns, the majority of differences likely arises from the differing sample selection methods, used by the respective authors. This appears to be an essential difference, as performance between individual PE funds varies widely.

2.3 Private Equity: Fund Characteristics

While multiple entities may share individual characteristics, a unique combination of characteristics allows for differentiation. Further, most characteristics are not inherently positive or negative, but they may be perceived more or less favourably by a certain audience, at a specific point in time. For the purpose of this thesis the author will focus on PE fund characteristics. These characteristics include, but are not exclusively, the type of investment (sub-) strategy, and the geographic and industrial foci of the fund. For example, Ljungqvist & Richardson found in 2003 that venture funds tend to invest in a larger number of companies compared to buyout funds, which increases the diversification of such venture funds and thus decreases their systematic risk (Amit & Livnat, 1988).

2.3.1 First Studies

Similarly, to research in the field of general PE performance, Ljungqvist & Richardson pioneered academic literature on PE fund characteristics and their impact on the PE fund performance. Unlike most early studies on PE characteristics, Ljungqvist & Richardson (2003) focused on the risk characteristics of funds and their respective investments. Their data set included cash-flow data, provided by a sizable institutional US investor in private equity, on investments from 1981 to 1993. The authors utilized industry concentration within the fund, the number of companies held, and the portfolio beta as some of their fund characteristics to execute a cross-sectional analysis. In doing so, they found that the overall US Dollar (USD) amount of money flowing into the PE sector and the financial size of the fund itself are the most significant characteristics.

Further early studies include Kaserer & Diller (2004), which, amongst others, studied the extent of the impact fund characteristics have on the performance of the respective funds. Utilizing the dataset provided by Venture Economics and concentrating on European PE funds, they found that vintage year and payback period seem to significantly impact PE fund performance, while fund size (calculated based on committed capital) seems to have an inconclusive impact on performance.

Ljungqvist & Richardson (2004) use risk characteristics to estimate behaviour of PE fund managers. Utilizing the characteristics of fund sequence number (i.e., first-time versus follow-on), fund size, and comparing venture to buyout fund performance. The authors conclude, that while venture funds have a significantly increased investment period compared to buyout funds, they are generally faster in distributing capital to their investors.

2.3.2 Seminal Studies

Metrick & Yasuda (2010) is one of the most referenced academic articles when studying the PE sector. It concentrates on estimating PE fund manager revenues as a function of their investor contracts, while testing for significant differences in manager revenues across differing fund characteristics within the sample. Analysing their sample of 238 funds raised between 1993 and 2006, the authors find that buyout fund managers seem to increase their fund size more rapidly than venture capital fund managers. According to Metrick & Yasuda (2010), their results suggest higher revenues for buyout fund managers and indicate that past results impact the fund size of buyout follow-on funds to a higher extent, when compared to VC funds.

Phalippou & Zollo (2005) study the drivers of PE fund performance to further gain insights on which characteristics differentiate underperforming funds from overperforming ones. The authors analyse relevant literature and performing quantitative research, using characteristics such as fund size, share of portfolio invested outside of the US and whether the fund is a follow-on fund. Firstly, they find that several European funds underperform funds raised in the US, which may be due to institutional differences and the fact that PE firms in Europe are on average younger than in the US, implying less experience to rely on. Secondly, the authors find that the fund's sequence is of statistical significance and of a high positive magnitude. Lastly, they conclude that fund size is positively related with PE fund performance, which may be caused by several factors, such as economics of scale, a steeper learning curve due to a higher deal count, or a higher reputation.

Phalippou & Gottschalg (2009) study the performance of PE funds in comparison with public markets, while identifying key performance drivers and estimating their impact. The authors use the VE data set to perform an Ordinary Least Squares (OLS) regression analysis. Similarly, to Ljungqvist & Richardson (2003), the authors find that fund size impacts performance positively and buyout funds historically outperform venture funds. Nevertheless, their results regarding the impact of the fund sequence contradict Ljungqvist & Richardson (2003), as Ljungqvist & Richardson (2003) conclude that with increasing fund sequence performance typically increases.

Jenner (2011) investigates the effect of a fund's size on its performance. The study's sample data is comprised of 1,222 venture and buyout funds, collected from several data sources, such as Preqin and VE. By means of a regression analysis the authors conclude that larger PE funds produce lower returns than smaller funds. This effect is increased even further when large funds invest into smaller investments. The authors recognise the respective advantages of differently sized funds as the reasoning behind these findings; while the strength of smaller funds lies within the developing of smaller companies, larger funds show an advantage in raising capital.

Kaplan & Schoar (2003)'s working paper investigates the effect of PE funds' past performance on their future performance. The authors use the data set provided by VE to perform a time-series regression of past performance on future performance and individual fund characteristics.

They find that funds which had a strong performance in the past usually raise larger consecutive funds, as their reputation has grown, easing the process of raising capital.

Phalippou & Zollo's previously covered 2005 paper further studies the relationship between PE fund performance and business cycles, as well as public markets. The authors find that PE performance positively co-varies with both business cycles and public markets. According to the authors, these findings may be explained by credit spreads or corporate bond yields, which usually decrease in times of a macroeconomic rise.

Robinson & Sensoy (2013) investigates the relationship between the contract terms of GPs and PE fund performance. They use data provided by LPs on 837 funds spanning the vintage years 1984-2010. Contradicting economic expectations and what is observable for mutual funds, the authors find that higher fees or higher managerial ownership do not significantly correlate with an increased net-of-fee performance of the fund. While the authors mainly focus on analysing the relationship using historical data, they offer an explanation for their findings: "during fundraising booms, percentage management fees increase and GP's compensation shifts towards the fixed component, consistent with greater GP bargaining power and a preference for fixed compensation" (Robinson & Sensoy, 2013).

Fisher and Hartzell (2015) study the effect of strategy (or class) differences in funds on PE fund performance, focusing on real estate funds. The authors utilise the Burgiss data set in their regression analysis. They find that the grouped strategy consisting of value-added and opportunistic funds outperforms core assets funds, for funds with pre-2000s vintage years. This relationship reverses for funds with a vintage year between 2004 and 2008. Further, they find that smaller value-added funds outperformed larger value-added funds for vintage years post-2004. The authors find it likely that this is due to the higher-risk / higher-reward strategy that is usually associated with non-core asset investments.

2.4 Research Expectations

The US represents a viable and interesting geographic location to investigate the performance of PE funds, as it is the largest economy in the world, covering 54% of the AUM of global private markets in 2022 (McKinsey Global Private Markets Review 2023)[7]. Additionally, the US provides a comparatively high reporting standard for LPs, which allows researchers to publicly access data on their investments and respective returns. While North American (and global) numbers of investments and exits have decreased over the past year, these values are still partially above pre-pandemic levels (Bain & Company). Although the commonly used data sets (Preqin, VE, Brugiss, and CA) are not available to the author, this research aims to replicate Phalippou & Gottschalg (2009), while exclusively focusing on US LPs. As there is evidence that buyout funds might outperform VC funds (Ljungqvist & Richardson, 2014 and Harris et al., 2014), the further investigation of additional fund

[7] https://www.mckinsey.com/industries/private-equity-and-principal-investors/our-insights/mckinseys-private-markets-annual-review

(sub-)strategies and their respective impact on PE fund performance is of interest. Using the data sample obtained during this research, this paper will compare US PE fund performance to market indices. Phalippou & Gottschalg (2009) states that their concluded underperformance is largely due to their small selection of European LPs. As those will be entirely excluded from this research, the author expects to find that PE funds outperform the market.

CHAPTER 3 Data

3.1 Sample

The data set utilized for this thesis contains 2,075 investment observations, consisting of investments into 929 distinct PE funds, by 21 large US institutional investors. The author utilized The Bloomberg Terminal[8] (BBG) to gather information on PE funds with vintage years of 2003 – 2013. The selected institutional investors serve as a proxy to estimate PE performance and are located in 14 different states[9] across the US. Institutional investors, in this research, consist of public employee's pension and retirement funds, and their investments. While pension and retirement funds utilize a broad investment portfolio this study focuses purely on their investments into PE funds. The sample has been reduced from c. 6,500 initial investments, in order to only represent investments for which complete data pertaining to all variables of interest is available. The median number of investments institutional investors make over the sample time period into PE funds is 318, with the minimum being 245 and the maximum being 606 investments. Prior to removing any outliers, the data set covers returns with a median IRR of 11%, a minimum IRR of negative 81%[10], and a maximum of 74%[11].

3.2 Variables

Net IRR and *Calc IRR,* both represent the IRR of the specific fund, while *Net IRR* represent the data published by BBG (as do all other variables, unless stated otherwise), *Calc IRR* is the IRR of investments calculated based on estimated fund cash-flows. The following formula is used to calculate the IRR $0 = \sum_{n=0}^{N} \frac{C_n}{(1+IRR)^n}$; where "N" is the total number of periods and "C_n" is the respective cash-flow in that period. The cash-flows for the IRR calculations of the *Calc IRR* have been obtained by discounting the estimated cash-flows of a PE fund, provided by Cohesive Capital Partners, over a 11-year time period. The sample size for all variables is 2,075. As expected, these variables differ from each other, as Bloomberg generally applies net-of-fees figures, as well as inflation adjustments. Both of the IRR will be used as the dependent variable, in the following regression analysis.

The variable *Follow-on Fund* provides information on whether the fund invested in is a first-time fund, or whether it has predecessors. This variable is of interest as previous academic literature is divided on whether later funds increase or decrease in performance.

Vintage Year represents the year in which the initial capital investment is made by the LPs. As the traditional lifetime of a PE fund is around 10 years, this variable is limited to vintage years until

[8] https://www.bloomberg.com/professional/solution/bloomberg-terminal/
[9] Due to differing state regulations with regards to publishing investor performance, the sample is limited to these states. Other states may not require funds located within their state to report complete investment data
[10] Lindsay Goldberg III LP
[11] SAIF Partners IV LP

2013. Otherwise, funds would likely still be realizing investments and distributing capital to their LPs. Thus, any performance metrics provided would not reflect the complete performance of the fund.

CC, CI, and *CD* respectively represent capital committed, capital invested, and capital distributed. *CC* measures the USD amount which the LP committed to the fund, which may be drawn by the GP for investments into portfolio companies or further acquisitions. *CI* represents the actual USD amount of capital invested by the LP into the fund. The median *CI* to *CD* ratio is marginally above one[12], as GPs may request additional funds which exceed the initial capital committed by the LPs. *CD* stands for the capital distributed by the GP to the LP, hence the USD amount returned to the LP. For the purpose of the regression analysis the author will use the *CI* to *CC* ratio, in order to investigate whether the amount withdrawn or additional investments, which exceed the capital committed, increase performance.

The categorical variable *Investment Strategy* represents the major strategies employed by PE funds. These consist of: *Growth, Co-investment, Debt, Fund of Funds, Real Assets, Real Estate, Secondary, Buyout,* and *Venture*. Each of the different strategies represents a distinct investment approach. Growth funds commonly invest in companies with potential renewable and scalable growth, with the aim to exit on a higher multiple. Co-investment funds on the other hand enable investors to invest into distinct companies alongside a GP, which is often done to distribute risks. Debt funds focus on capital investing in lending activities, implying a different position on a company's balance sheet and hence a different risk compared to directly investing into a company . Funds of Funds investments are PE funds acting as LPs for larger PE funds -- in other words raising capital from investors to invest it into several other PE funds. Real Assets funds allow their investors to diversify their usually purely financial assets portfolios to precious metals, commodities, land, and more. Unlike Real Assets, Real Estate funds follow an active investment strategy, while solely focusing on purchasing, developing, and eventually selling real estate projects. Secondary funds (also often referred to as Secondaries), acquire the outstanding commitment of existing LPs, who want to exit their current investment pre-maturely. Finally, there are Buyout and Venture funds (which are the focus of most of the existing academic literature on PE funds). Buyout funds usually make majority investments into mature companies. Venture funds on the other hand, commonly execute smaller minority investments (less than 50%), often into younger technology or biotechnology companies.

While the *Investment Strategy* variable represents the overarching strategy, funds often follow an additional sub-strategy. The categorical variable *Sub-Strategy* consists of the following categories: *Small Cap, Mid Cap, Large Cap, Value Added, Growth, Buyout, Venture, Mezzanine, Debt, Core Plus, Early Stage, Late Stage, Distressed, Special Opportunities,* and *Others*. Certain variables (e.g., *Buyout*) may be found in both *Sub-Strategy* and *Investment Strategy*, such as when PE investors

[12] While usually the capital committed should not exceed the capital invested, in this case the capital invested value further represents any investments made with capital which was realized early into the fund lifecycle and reinvested. This is due to the fact that most US pension funds report in accordance with the Institutional Limited Partners association (ILPA) standards.

engage in a fund of funds strategy for funds which only focus on buyout funds. Small-, Mid-, and Large-Cap funds indicate the investment fund size. Most often, small-cap funds' fund sizes are below USD 2 billion, while mid-cap fund sizes are commonly between 2-10 billion USD. Funds are generally referred to as large-cap if their fund size is above USD 10 billion. It is worth noting that the size definitions of small- / mid- / large-cap funds vary by author, as well as over time. The respective USD value definitions of fund sizes have consistently increased over the past 20 years. Value-added funds are generally funds which invest into medium to high risk / return companies. Mezzanine funds invest in companies using mezzanine debt, a hybrid form of debt and equity financing with relatively flexible repayment terms that is subordinate to pure debt financing, but more senior[13] than equity. While core plus investments are generally associated with fixed income funds, equity investors may also invest in these high-risk / high-return funds. Early- and late-stage funds focus on investments in the respective business stage of the company lifecycle. Distressed fund strategies concentrate on companies which are currently troubled and require restructuring. Finally, special opportunities funds focus on investments which arise during special macroeconomic circumstances.

The categorical variable *Geography*, lists the different regions into which the PE fund invests, covering: *Western Europe, Eastern Europe, North America,* Latin America and Caribbean (*LATAM),* Asia Pacific emerging markets (*APAC emerging*), Asia Pacific developed markets (*APAC developed*), and Middle East & Africa (*MEA*). *North America* is represented the most, with 1,772 observations.

Lastly, this study will consider the categorical variable *Sector*, which describes the different investment sectors the GPs invest into, which are the following: *Technologies, Real Estate, Industrials, Consumer, Healthcare, Energy & Utilities,* and *Materials*. Contrary to the author's initial expectations, the sector real estate did not see a large decrease in number of funds raised post-2008/9.

3.3 Control Variables

In order to control for general trends in the PE and general market, the author will control for *US GDP Growth,* which represents the percentage (%) change in Gross Domestic Product (GDP), compared to the previous year, gathered from Statista[14]. As stated by Phalippou & Zollo (2005), the PE market is highly pro-cyclical. Hence, controlling for GDP growth allows researchers to estimate results which are closer to the true impact of independent variables.

PE dry powder denotes the percentage change in the numerical value of dry powder available in the PE sector. Dry powder is the cash reserves PE funds have from capital committed by investors, which is available to be invested. This variable aims to represent growth in the PE industry, as a positive outlook on PE returns is usually followed by bigger fund raises and a large amount of excess

[13] In investing, seniority describes the order in which investments are returned to investors in the case of a company's liquidation. The more senior a form of financing is, the earlier the investors will receive their initial investment post-liquidation. While junior debt generally yields higher returns, compared to senior debt, it is also less likely to be paid back (in-full).

[14] https://www.statista.com/statistics/996758/rea-gdp-growth-united-states-1930-2019/

capital. Over the sample period the global capital dry powder almost tripled, from USD 500 billion in 2003 to USD 1,4 trillion in 2013[15].

Lastly, *risk-free rate* represents the 10-year US treasury yield rate, summarized yearly by Yahoo Finance[16]. The 10-year US treasury yield rate provides what is considered as the "risk-free rate". An investment which is thought to be without risk nevertheless accounts for opportunity costs, which is the cost of missing out on investing in the next best option. The risk-free rate represents a discount variable, which adjust this investment for the opportunity cost. This variable has been used to partially control PE performance, as it could (partially) explain investor behaviour, due to the indication of future interest rates.

3.4 Descriptive Statistics

The overview of key variables which will be considered for this research can be found below, in Table 1. As demonstrated by the number of observations for each variable, this paper makes use of a complete data set, which allows for the same number of observations (2,075) for each variable. Table 1 further shows that investing into PE funds appears to be profitable at first glance, as the mean and median value of capital distributions is above the capital committed and later invested. Yet, this does not take into account any investing / transaction costs or the time value of money, which will be discussed at a later stage of this research.

Table 1: Overview of key regression variables

Variable	Obs.	Mean	Std.	Min	Max	Median
Net IRR	2,075	0.118	0.103	(0.810)	0.744	0.113
Calc IRR	2,075	0.069	0.128	(0.500)	1.394	0.076
Vintage Year	2,075	2008	2.744	2003	2013	2008
Capital Committed	2,075	101.410	120.790	0.400	1600	75.000
Capital Invested	2,075	106.690	132.210	0.700	1580	70.000
Capital Distributed	2,075	145.330	196.450	0.700	2641	86.900
US GDP Growth	2,075	0.040	0.010	0.020	0.050	0.020
PE dry powder	2,075	0.140	0.170	-0.080	0.500	0.910
Risk-free rate	2,075	0.020	0.010	-0.030	0.040	0.030

Data: Bloomberg. 18.04.2023
Note: negative values are represented as value within parentheses [e.g., -0.810 = (0.810)]

Table A2 provides insights into the raw data of the regression, which provides the most popular investment strategy, sub-strategy, geography, and sector, which appear to be buyout and mid-

[15] This value increased further until 2022 to USD 3.7 trillion (Bain Capital, Global Private Equity Report 2023)
[16] https://finance.yahoo.com/quote/%5ETNX/history/

cap investments into the North American technologies sector. While the regression data, which includes the joint effects of variables used for the actual regression (Table A3 – A5), seems to be mostly in line with the raw data, in terms of popularity, the most popular sectors appear to be a combination of technologies, real estate, industrials, consumers, health care, and financials.

3.5 Comparison to Data Sources used in Existing Literature

To better understand the variation in conclusions of previous articles, it is important to understand the differing data sources used by the authors. Aurdal & Grønsund (2015) summarizes the evolution of the use of the major differing data sets used in popular literature on PE fund performance. The authors define the most common data sets as: Burgiss[17], Cambridge Associates[18] (CA), Preqin[19], and Venture Economics (VE). VE, CA, and Preqin have been available for use in research for a similar period of time, with VE being the data set used most in early academic literature. Meanwhile, Burgiss, a data provider with a focus on private capital, has gained in popularity only in recent years. Further, Harris et al. (2010) finds, that on aggregate, Preqin displays higher performance of PE funds than CA, VE, and Burgiss. Another potential explanation of the variety in findings of different authors, presented by Aurdal & Grønsund (2015), are likely the differing sample time periods chosen by the respective authors. This seems especially relevant, given PE performance behaves in a pro-cyclical manner (Higson & Stucke 2012 and Phalippou & Zollo 2005).

Additional concern about the VE source has been raised by Stucke (2011), whose findings suggest that, while numerous funds remained in the data set, their cash-flows were not updated or extended and their respective Net Asset Values[20] (NAVs) were simply rolled over. This bias causes the IRR of individual funds to decrease with increasing age of the fund. Buyout funds are particularly strongly impacted by this bias, which results in a substantial underperformance in aggregate.

[17] https://www.burgiss.com
[18] https://www.cambridgeassociates.com
[19] https://www.preqin.com
[20] The value of all assets of an entity minus the total value of all liabilities of that entity

CHAPTER 4 Methodology

4.1 Private Equity Fund Performance

To investigate the data, the author will perform an Ordinary Least Squares (OLS) regression. OLS regressions are commonly used, as the output of the regression coefficients are unbiased estimators of the population. Kilmer & Rodríguez (2011) state that OLS regressions are prone to underestimate slopes when the sample gathering process is flawed, due to measurement error (i.e., a significant difference from the estimated or measured value to the true value). Nevertheless, as the main source used in this paper, BBG, is a well renowned data provider regularly updated by financial analysts, the author considers this source as credible, and disregards further concerns of measurement errors.

$$IRR_i = \beta_0 + \beta_1 * CI\ to\ CC\ ratio_i + \beta_2 * Follow\text{-}on\ Fund_i + \beta_3 * Vintage\ Year_i + 4_4 * Calc\ NPV_i + \beta_5 * Investment\ Strategy_i + \beta_6 * Sub\text{-}Strategy_i + \beta_7 * Geography_i + \beta_8 * Sector_i + \beta_9 * \mathbf{risk\text{-}free\ rate_i} + \beta_{10} * \mathbf{US\ GDP\ Growth_i} + \beta_{11} * \mathbf{PE\ dry\ powder_i} + \epsilon_i$$

As part of the regression equation, the variable *IRR* will be exchanged for *Net IRR* or *Calc IRR*, as both of these values will be used as the dependent variable, while all other variables remain the same. This makes possible an analysis of the difference in outcomes from the BBG reported IRR values to the cash-flow calculated IRR value. Variables displayed in a bold font represent the control variables.

As shown in Table 1, some variables show a rather large variation between their minimum and maximum value. While outliers are part of the observation and may also appear in the aggregate or population, they may cause large distortionary effects in relatively small samples. Hence, in order to remove any outliers, the author followed Barbato et al. (2011) and their *Modified IQR method*, which states that an extreme outlier is one which lies outside of the lower / (upper) inner fence. The lower / (upper) inner fence is defined as, $Q_1 - (+)\ 1.5*IQR$[21]$*[1+0.1*log(n/10)],$ where n represents the sample size. This method may be seen as preferable to the simple *Inter Quartile Range* (IQR) *method*, as it considers the sample size when determining outliers, while conserving the benefits of the *IQR method*. Outliers have only been removed for non-binary variables (i.e., *Calc IRR, Net IRR, Calc NPV, CC, CI, CD, and Calc NPV*). This has reduced the total sample size from 2,075 to 1,645.

In order to account for multicollinearity, the author will first execute the regression, followed by calculating and assessing the Variance Inflation Factors (VIFs). A VIF value of above 5 is considered as critical multicollinear (Daoud, 2007). While multicollinearity can pose an issue, this may not always be the case; Kutner (2004) states: "The fact that some or all predictor variables are

[21] Inter Quartile Range (IQR) is the range from the first quartile (Q_1, i.e., 25% of the sample) to the third quartile (Q_3, i.e., 75% of the sample)

correlated among themselves does not, in general, inhibit our ability to obtain a good fit nor does it tend to affect inferences about mean responses or predictions of new observations". This indicates that detected multicollinearity does not necessarily produce inaccurate results. Although the author found multicollinearity in a few variables (e.g., the *risk-free rate* and *vintage year*), this only impacts the coefficient and P-values of these variables and may be explained by the change in US treasury yield rates over the years in the sample period.

To test for heteroskedasticity[22] the author performed a White (White, 1980) and a Breusch-Pagan / Cook-Weisberg test (Breusch & Pagan 1979 and Cook & Weisberg 1983), the results of which can be found in Appendix Table B1. Both these tests resulted in a significant p-value, which indicates that the sample data is indeed heteroskedastic. A popular method to deal with heteroskedasticity is the use of robust standard errors. Robust standard errors, initially introduced by Huber (1967), adjust the regression by deriving unbiased standard errors. The robust standard errors produced further allow for the estimator to be consistent.

Testing, analysing, and adjusting for outliers, multicollinearity, and heteroskedasticity, allows reliable investigation of the regression results in the following section (Chapter 6 – Results). Endogeneity, a variable which is correlated with the respective error term of the model, may further present an issue in the process of investigating causal relationship. Accommodating for endogeneity often poses difficulties, as it is commonly rooted in the omission of explanatory variables. To remove any variables omission, one would need to be sure to include all variables into a regression, which may impact the dependent variable.

In order to perform the regression analysis, the author used four different regression models for the dependent variables (*Net IRR* and *Calc IRR*). Beginning the analysis by regressing the main variables of interest (i.e., *CI to CC ratio, Follow-on Fund, Vintage Year,* and *Calc NPV*) on the respective dependent variables. For the second regression, the categorical variables (*Investment Strategy, Sub-strategy, Sector,* and *Geography)* will be added to the regression equation. The third and fourth models add the control variables, *risk-free rate* & *US GDP Growth* and *PE dry powder,* respectively. Adding the variables *risk-free rate* & *US GDP Growth*, allows the author to control for macro-economic (external factors). Using the variable *PE dry powder,* enables the regression to be controlled for PE sector specific trends.

4.2 Private Equity Fund Performance compared to Market Returns

To address the second part of the thesis (i.e., the comparison of PE fund returns to certain market indices), the author will discuss the metrics used in the following section of the study. Kaplan & Schoar (2005) developed the Kaplan Schoar - Public Market Equivalent (KS-PME) metric to compare the returns of PE funds to public markets. The KS – PME is calculated by "investing (or discounting) all cash outflows of the fund to the total return of the S&P 500 and comparing the

[22] The existence of non-constant standard deviations in a variable

resulting value to the value of cash inflows (all net-of-fees) to the fund invested (or discounted) to the total return of the S&P 500" (Kaplan & Schoar, 2005). If the final KS-PME value is above one, the returns of the fund outperform the market. Thus, while a given IRR might seem relatively large (e.g., 15%) an LP might still face a PME of below one, as the IRR indicates only absolute performance of the fund and not its relative performance.

To calculate the PME the author used the S&P 500 index. Cash-flows (capital calls and capital distributions) have been estimated, utilizing data provided by Cohesive Capital Partners. Hence, cash-flows could only be estimated on a yearly basis. This required the author to use the yearly average of the index price to estimate relative performance (PME). Additionally, the author found that the data provided by BBG is only partially net-of-fees, thus some returns may appear larger than they actually are.

CHAPTER 5 Results & Discussion

5.1 Results & Discussion: Private Equity Fund Performance

The model was estimated using an OLS regression (Table 2), beginning with the independent variables (i.e., *Net IRR* and *Calc IRR*) which are reported in percentages. Hence, all coefficients are interpreted as the absolute increase in that percentage. The *CI to CC ratio*, while positive is found to be without statistical significance in regressions using *Net IRR* or *Calc IRR*. Similar results can be found when analysing the variable *Follow-on Fund,* which, with the exception of one regression, is found to have no statistical significance. Nevertheless, in regression (1) using *Net IRR* as the dependent variable, *Follow-on Fund* is found to be of statistical significance. This variable may be interpreted to indicate, in case the fund is indeed a follow-on fund, the net IRR increases by 0.8%, on average. The regression results for *Calc NPV* are mostly in line with the economic expectations of the author, as an increase in the Net Present Value (NPV) of a fund is estimated to be positively and significantly related with the IRR. While most variables are found to have similar impact on the two dependent variables, this is not the case for *Vintage year.* instead, *Vintage Year* displays a significant and positive relationship with *Net IRR*, which shows in regression (4) that an increase by one year increases the *Net IRR* by 1.1%. A contradicting outcome is found when estimating *Vintage Year* on *Calc IRR*, which implies a significant but negative relationship between the two variables, thus indicating that funds raised in 2003 show larger returns when compared to funds raised in 2013.

The average R-squared of the models using *Net IRR* is 0.505, which indicates that 50.5% of the variance in the BBG reported IRR values may be explained by the variables included in these models. The model which includes only the main variables, yielded a R-squared of 0.385, while models (2) to (4) report an R-squared value of about 0.545. A similar trend can be seen when analysing R-squared for the models using *Calc IRR*, where the average R-squared value lies at 0.604. Model (1) reports an R-squared value of 0.554 which increases in the following models, by up to 0.623 for model (4). While generally only an R-squared value of above 0.7 would be considered to show a high degree of correlation, in finance, the author's reported R-squared values partially exceed the reported R-squared in previous academic studies; Phalippou & Zollo (2005), Higson & Stucke (2012), Kaplan & Schoar (2008), and Gottschalg & Phalippou (2009) report R-squared values of, on average, 10%, 12%, 40%, and 16%, respectively.

From regressions (2) onwards (Table 2), the categorical variables *Investment Strategy, Sub-Strategy, Sector,* and *Geography* are included. These variables are binary variables and use a reference category. The results displayed for the variables of *Investment Strategy* use the strategy *Buyout* as a reference. Thus, the coefficient for a *Secondary* investment strategy, may be interpreted as follows: if a fund switches its strategy from a *Buyout* strategy to a *Secondary* strategy the *Net IRR* will decrease by 2.5% (Table 2, regression (4)). A similar interpretation to the *Secondary* strategy may be made for

the *Debt* strategy, which is statistically significant but of a more negative magnitude. Additionally, the author found that the returns of LPs do not experience a statistically significant impact on the IRR if the PE funds investor changes from *Buyout* to *Venture*.

The variable *Sub-Strategy* allows for multiple sub-strategies to be true for the same fund and hence displays combinations of strategies, using the *Buyout* sub-strategy as a reference variable. Interpreting the results of Table 2 and the extensive regression results in Table C1 the author finds that combining a *Buyout* and a *Venture* sub-strategy increases the IRR significantly, by about 9.2%, on average, across all regressions. A positive impact is further found if the sub-strategy changes to a combination of *Mezzanine* and *Debt*, which can lead to an increase in *Calc IRR* of up to 4.8%. *Sector* and *Geography* may be interpreted similarly to the *Sub-Strategy* variable, using *Communications* and *APAC developed* as the respective reference variables.

Regressions (3) and (4) added the control variables (*US GDP Growth, risk-free rate,* and *PE dry powder*) to the regression models. While these variables are estimated to be statistically insignificant for regressions using *Net IRR*, they do significantly impact regressions using *Calc IRR*. An increase in growth of US GDP or growth of available dry powder in the PE sector is estimated to decrease *Calc IRR*. While the relation between *PE dry powder* and *Calc IRR* seems to be in line with the economic expectations of the author, it appears counterintuitive that an increase in US GDP growth negatively impacts *Calc IRR.* The *risk-free rate* is found to have a positive impact on the *Calc IRR*, which may appear counterintuitive at first, as borrowing money becomes more expensive. Yet, a higher risk-free rate could also work in favour of the funds, as the PE market may be less saturated with capital and hence valuations and bid premiums may decrease, allowing for lower purchase costs.

The author finds that their hypothesis, that PE fund characteristics impact PE fund performance, holds true. While some individual characteristics are estimated to be without statistical significance for the models, a large share of variables remains which show a significant relationship between PE fund characteristics and their performance, within the studied sample.

Figure 1: Development of PE performance, measured by *Net IRR*, over the sample period (2003 – 2013) – Values provided by BBG

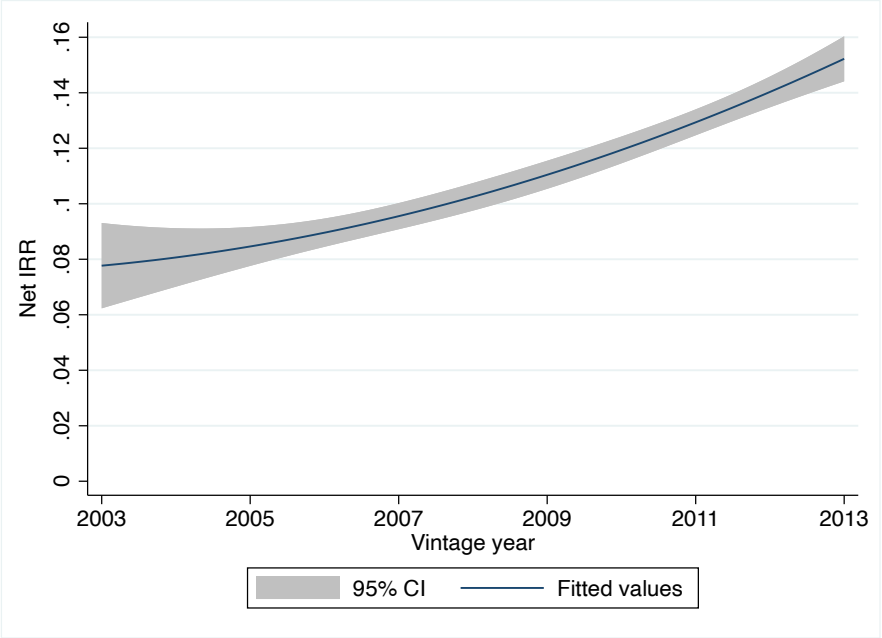

Figure 1 displays the development of the IRR reported by BBG, which is based on net-of-fees cash-flows of the respective fund, while adjusting for inflation. According to the provided IRR, the average is recorded at around 8% IRR in 2003, increasing up to around 16% in 2013. The development of the IRR, shown in Figure 1, is in line with the historical PE development discussed in section 2.1 of this thesis, as it shows an upwards overall trend. Figure C1 shows the development of IRR using the *Calc IRR* variable, which is based on estimated cash-flows of the PE funds. Contrary to Figure 1, Figure 1C shows an increase in PE performance until about 2007, which then drastically decreases until 2013.

Table 2: Extensive overview of regression results – regression (1) for each IRR represents key variables, regression (2) adds the categorical variables *Investment Strategy, Sub-Strategy, Sector,* and *Geography*, regression (3) and (4) add control variables to explain further variation in results

	Dependent variable:							
	Net IRR				*Calc IRR*			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
CI to CC ratio (%)	0.010	0.003	0.003	0.003	0.010	0.006	0.006	0.006
	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.010]	[0.010]	[0.010]
Follow-on Fund	0.008*	0.001	0.001	0.001	0.006	0.001	0.002	0.002
	[0.005]	[0.005]	[0.005]	[0.005]	[0.007]	[0.006]	[0.006]	[0.006]
Vintage year	0.009***	0.010***	0.009***	0.011***	(0.005)***	(0.004)***	(0.003)**	0.000
	[0.001]	[0.000]	[0.001]	[0.001]	[0.001]	[0.000]	[0.001]	[0.002]
Calc NPV	0.002***	0.001***	0.001***	0.001***	0.003***	0.003***	0.002***	0.002***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Investment Strategy ($)								
Debt		(0.046)***	(0.046)***	(0.047)***		(0.013)***	(0.012)***	(0.014)***
		[0.004]	[0.004]	[0.004]		[0.004]	[0.004]	[0.004]
Secondary		(0.024)***	(0.024)***	(0.025)***		(0.008)	(0.008)	(0.009)
		[0.005]	[0.005]	[0.005]		[0.005]	[0.005]	[0.005]
Venture		0.000	0.000	0.000		(0.008)	(0.006)	(0.006)
		[0.006]	[0.006]	[0.006]		[0.009]	[0.009]	[0.009]
Sub-Strategy ($)								
Buyout, Venture		0.095***	0.095***	0.093***		0.083***	0.095***	0.092***
		[0.021]	[0.021]	[0.021]		[0.025]	[0.025]	[0.025]
Growth		(0.074)**	(0.075)**	(0.077)**		(0.054)	(0.038)	(0.043)
		[0.031]	[0.031]	[0.033]		[0.033]	[0.033]	[0.028]
Mezzanine, Debt		0.201***	0.200***	0.200***		0.025	0.045**	0.048**
		[0.014]	[0.014]	[0.014]		[0.019]	[0.020]	[0.020]
Mid Cap, Small Cap		0.024	0.024	0.023		0.072**	0.085***	0.083***
		[0.024]	[0.025]	[0.025]		[0.029]	[0.030]	[0.029]
Sector								
Consumer, Comms, Energy & Utilities, Materials		0.089***	0.090***	0.095***		0.144***	0.141***	0.154***
		[0.019]	[0.020]	[0.020]		[0.017]	[0.018]	[0.018]

Industrials, Health Care, Energy & Utilities		(0.088)*** [0.019]	(0.088)*** [0.019]	(0.086)*** [0.019]		(0.124)*** [0.017]	(0.117)*** [0.017]	(0.112)*** [0.017]
Consumer, Materials		(0.042)*** [0.015]	(0.041)*** [0.015]	(0.037)** [0.016]		0.024** [0.011]	0.022* [0.011]	0.031*** [0.011]
Technologies, Financials		(0.108)*** [0.016]	(0.109)*** [0.016]	(0.108)*** [0.016]		(0.059)*** [0.012]	(0.057)*** [0.012]	(0.053)*** [0.013]
Geography								
APAC emerging		(0.002) [0.046]	(0.003) [0.046]	(0.004) [0.046]		0.028 [0.028]	0.030 [0.027]	0.028 [0.027]
LATAM		0.007 [0.045]	0.007 [0.045]	0.006 [0.045]		0.023 [0.032]	0.026 [0.032]	0.023 [0.032]
North America		(0.007) [0.042]	(0.007) [0.042]	(0.007) [0.042]		0.022 [0.021]	0.022 [0.021]	0.021 [0.022]
Western Europe		0.006 [0.042]	0.006 [0.042]	0.005 [0.042]		0.021 [0.022]	0.021 [0.022]	0.018 [0.022]
Control Variables								
Risk-free rate (%)			(0.147) [0.420]	0.400 [0.628]			0.297 [0.468]	1.806** [0.747]
US GDP Growth (%)			0.012 [0.124]	0.082 [0.136]			(0.442)*** [0.146]	(0.249) [0.165]
PE dry powder (%)				(0.022) [0.017]				(0.061)*** [0.022]
Constant	(19.101)*** [1.183]	(20.386)*** [1.465]	(19.484)*** [3.223]	(22.191)*** [3.990]	9.707*** [1.152]	8.549*** [1.556]	7.519** [3.146]	0.061 [4.311]
Observations	1,645	1,645	1,645	1,645	1,645	1,645	1,645	1,645
R-Squared	0.385	0.545	0.545	0.545	0.554	0.617	0.621	0.623
Akaike Inf. Crit.	(4,595.802)	(4,759.660)	(4,755.866)	(4,751.819)	(4,240.811)	(4,171.149)	(4,178.437)	(4,186.915)

Data: Bloomberg. 18.04.2022

Notes: Significance is reflected by '*', *p < 0.10, **p < 0.05, and *** p < 0.01; Abbreviations have been used for the names of the variables: Tech = Technology, Comms = Communications, HC = Health Care, RE = Real Estate, Fin = Financials, E&U = Energy & Utilities; Negative values are represented as value within parentheses, e.g., -0.8100 = [0.8100]; values in brackets represent the respective standard error of the variable

The regression models (Table C1) show differing effects of PE fund characteristics on their performance. A large section of past literature focuses on performance differences between buyout and venture funds. Yet, the findings of Table 2 suggests that there is no statistically significant impact on the IRR of a fund if it changes its strategy from buyout to venture. This finding differs from the findings of Ljungqvist & Richardson (2002), Phalippou & Gottschalg (2009), and Metrick & Yasuda (2010), who find that buyout funds outperform venture funds. Nevertheless, the data gathered by the authors previously mentioned mainly focuses on vintage years from the 1980s and 1990s, with no vintage year considered being younger than 2006. The author finds it likely that the variation in findings, with regards to buyout versus venture funds, is due to differing sample dates and fund locations.

The results, with respect to the impact of vintage year on fund performance (Figure C1), are partially in line with the findings of Kaserer & Diller (2004) and Phalippou & Zollo (2005), as both authors mention a pro-cyclical relationship between public markets and PE fund returns. Figure C1 indicates that IRR behaves pro-cyclical; while increasing pre-2008, it falls drastically in the years following the '08 financial crisis. Nevertheless, the data BBG gathered on PE fund performance is not in line with prior academic literature, as it displays constant growth in the IRR.

The regression models in Table 2 indicate that the fund sequence (i.e., whether the fund is a first-time or follow-on fund) has no statistically significant effect. This contradicts previous literature. Phalippou & Gottschalg (2009) and Phalippou & Zollo (2005) mention that indeed there is a significant positive relationship, hence a later sequenced fund may indicate increased PE fund performance. On the other hand, Ljungqvist & Richardson (2003) find that, while there is a statistically significant impact of the fund sequence on fund performance, the relationship is estimated to be negative. Hence, first-time funds tend to outperform follow-on funds.

Additionally, the author found that the variable *Geography* displays no individual geographies which seem to increase fund performance in the aggregate, but rather, that a larger diversification increases performance, when compared to exclusively investing into *APAC developed*. While this is not covered, in detail, by previous academic literature, these findings are in line with the author's expectations, as (global) diversification, moderates' market and economic shocks in individual countries.

5.2 Results & Discussion: Private Equity Fund Performance compared to Market Indices

Table 3 displays the results of the KS – PME values, per year of the sample period. The KS–PME values can be interpreted as multiples of the performance of the S&P 500. Hence, using the total PME–KS value of the sample time period (1.443) it indicates that the respective LPs investment into the PE fund cumulatively outperformed the market by 44.3%. While the general outperformance of PE funds is in line with the findings of Higson & Stucke (2012) and Harris et al. (2014), the results of Table 3 indicate a much larger PE fund's outperformance of the market. The variation between the

author's results and the results of other academics are likely due to the only partially net-of-fees values reported by BBG.

Nevertheless, a downside of the KS–PME metric is that it does not risk-adjust the PE investment. Additionally, the metric does not account for the illiquidity of PE investments. While investors into public markets may see a negative trend in their performance early and exit their investment, this is not possible for investments into PE funds. Hence, this should be taken into consideration when interpreting the results presented in Table 3.

Table 3: Kaplan Schoar Public Market Equivalent (KS – PME) development over sample period (2003 – 2013)

The cash-flow assumptions made to calculate the KS – PME are estimated utilizing the data provided by Cohesive Capital Partners, on exemplary cash-flows of a PE fund. To find the KS – PME the capital distributions of each year are divided by the respective 12-month average index price and finally summed up. Similarly, all capital calls of each year are divided by the respective 12-month average index price and totalled. To find the final KS – PME value of each fund the summed and discounted capital distributions are divided by the summed and discounted capital calls.

	Vintage Years											
	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
12-month avg. S&P 500 price	978.13	1,134.22	1,210.18	1,321.78	1,281.72	1,200.37	959.67	1,135.85	1,280.27	1,393.24	1,66.31	1,251.07
KS-PME	2.025	1.715	1.456	1.417	1.502	1.463	1.675	1.545	1.397	1.487	1.142	1.443
No. of Funds	44	46	136	215	306	337	138	116	248	240	249	2,075

Data: Bloomberg. 18.04.2022

5.3 Limitations

An important limitation with this and many other studies is the sample it is based on. In the case of this thesis, the sample represents only a select sample of institutional investors in the US. While able to indicate aggregate behaviour for the global PE market, this research aims to accurately estimate the impact of PE characteristics on US PE fund performance. The sample selection limitation is mainly due to low reporting regulations for PE firms and the limited access to data, as BBG is the only accessible[23] relevant data provider the author could utilize, due to the high cost of further data providers like Prequin and Burgiss. To avoid this limitation as much as possible for future researchers, the author recommends comparing the data provided by BBG to the commonly used data providers (i.e., VE, Prequin, Burgiss, and Cambridge Associates).

A further limitation of this research is the cash-flow assumptions that had to be made to calculate *Calc IRR*. While the assumptions made represent industry standards, they are generalistic and do not account for any extraordinary circumstances. These assumptions likely lead to front-loading cash-flows of PE funds and ignoring underperforming laggers. Additionally, the data gathered on the S&P 500 does not consider possible dividend reinvestments into the market.

[23] The access to BBG has been provided by the Erasmus University of Rotterdam

CHAPTER 6 Conclusion

The author investigated the impact of selected PE fund characteristics on PE fund performance and how this performance compares to returns in the public market. Previous research produced differing results in (the degree of) performance from PE funds, when compared to public markets. In particular this study added to the existing literature by extending the investigated fund goal in studying and utilising a data sample which has not been utilized previously. The author's motivation to study this field is to summarize, analyse, and compare existing literature with the research performed by the author.

To investigate the impact of PE fund characteristics on their performance, the author performed a quantitative study. The data gathered for this study is based on the performance metrics provided by 21 large US institutional investors. The analysis showed that the largest estimated individual impact on PE fund performance is from the variable *vintage year*, which indicates the year in which the first capital was transferred from LPs to the GP. Additionally, the author found that for GPs to change their investment strategy from buyout to a debt or mezzanine strategy significantly decreases the performance of the fund. Furthermore, the study shows that while there are combinations of geographic, sector, or sub-strategies which increase fund performance, it is commonly the case that diversification in the individual characteristics stably increases fund performance.

The study therefore concludes that, while literature is not unified on the impact of PE fund characteristics on fund performance, nor on PE fund performance compared with public markets, the research performed by the author indicates that PE funds outperform the S&P 500. While the degree of outperformance found by the author is likely overstated, adjusting the results for risks and fees will likely still result in PE funds' outperformance of the market. As the access to reliable data sets and the adjustment of values for fees and risk are the major limitations to this study, the author recommends other researchers perform further research on average fund fees and risk-adjustment models, to eliminate or reduce these limitations.

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APPENDIX A Supplementary information on sample data

APPENDIX A provides additional information on the sample data set. Table A1 displays the investor abbreviation, their respective name, and the state in which the investor is located. This provides the reader with a clear overview from which investors the utilized data came from and where these investors are geographically located in the US. Table A2 provides a summary statistics overview of the raw data for variables used for regression. Table A3, A4, and A5 similarly to Table A2 provide a summary statistics overview of the variables used, but for the actual regression, where the tables display information on the sub-strategy, geography, and sector, respectively. This regression investigates the joint estimated effect of categories, as funds may not only invest into e.g., one sector but multiple ones. All tables withing APPENDIX A, provide information on the 'raw' sample data, which has not yet been adjusted for outliers.

Table A1: Overview of Investors (abr.) per US State

	Investor name	State
CalPERS	California Public Employees' Retirement System	California
CalSTRS	California State Teachers' Retirement System	California
CoPPSERS	Commonwealth of Pennsylvania Public School Employees' Retirement System	Pennsylvania
FRS	Florida Retirement System	Florida
MPRIMB	Massachusetts Pension Reserves Investment Management Board	Massachusetts
MSBoI	Minnesota State Board of Investment	Minnesota
MSRaPS	Maryland State Retirement and Pension Systems	Maryland
NJDoI	New Jersey Division of Investment	New Jersey
NYCBoERS	New York City Board of Education Retirement System	New York
NYCERS	New York City Employees' Retirement System	New York
NYCFPF	New York City Fire Pension Fund	New York
NYCPPF	New York City Police Pension Fund	New York
OPERS	Ohio Public Employees Retirement System	Ohio
OrPERS	Oregon Public Employees Retirement System	Oregon
PERSoN	Public Employees' Retirement System of Nevada	Nevada
PSTPaRFoC	Public School Teachers Pension & Retirement Fund of Chicago	Illinois
SoWIB	State of Wisconsin Investment Board	Wisconsin
STRSO	STRS Ohio 80th Inc	Ohio
TRSoNYC	Teachers' Retirement System of the City of New York	New York
TRSoSoI	Teachers' Retirement System of the State of Illinois	Illinois
TRSoT	Teacher Retirement System of Texas	Texas

Data: Bloomberg. 18.04.2023

Table A2: Overview of categorical variables – raw data

	Obs.	Mean	Std.	Min	Max	Median
Investment Strategy						
Growth	2,075	0.0588	0.2353	0	1	0
Co-investment	2,075	0.0164	0.1270	0	1	0
Debt	2,075	0.1243	0.3300	0	1	0
Fund of Funds	2,075	0.0506	0.2192	0	1	0
Real Assets	2,075	0.0453	0.2080	0	1	0
Real Estate	2,075	0.1181	0.3228	0	1	0
Secondary	2,075	0.0424	0.2016	0	1	0
Venture	2,075	0.0945	0.2925	0	1	0
Buyout	2,075	0.4496	0.4976	0	1	0
Sub-strategy						
Small cap	2,075	0.0173	0.1306	0	1	0
Mid cap	2,075	0.2646	0.4412	0	1	0
Large cap	2,075	0.1966	0.3975	0	1	0
Value-added	2,075	0.0357	0.1855	0	1	0
Growth	2,075	0.0116	0.1069	0	1	0
Buyout	2,075	0.0231	0.1504	0	1	0
Venture	2,075	0.0222	0.1473	0	1	0
Mezzanine	2,075	0.0371	0.1891	0	1	0
Debt	2,075	0.0106	0.1024	0	1	0
Core plus	2,075	0.0039	0.0620	0	1	0
Early stage	2,075	0.0684	0.2525	0	1	0
Late stage	2,075	0.0525	0.2231	0	1	0
Distressed	2,075	0.0699	0.2550	0	1	0
Special ops	2,075	0.0154	0.1233	0	1	0
Others	2,075	0.2641	0.4410	0	1	0
Geography						
Western Europe	2,075	0.4631	0.4988	0	1	0
Eastern Europe	2,075	0.2790	0.4486	0	1	0
North America	2,075	0.8540	0.3532	0	1	1
LATAM	2,075	0.2014	0.4012	0	1	0
APAC emerging	2,075	0.2477	0.4318	0	1	0
APAC developed	2,075	0.2511	0.4337	0	1	0
MEA	2,075	0.1571	0.3640	0	1	0

Sector						
Technologies	2,075	0.5586	0.4967	0	1	1
Real estate	2,075	0.4361	0.4960	0	1	0
Industrials	2,075	0.4612	0.4986	0	1	0
Consumer	2,075	0.5908	0.4918	0	1	1
Health Care	2,075	0.4733	0.4994	0	1	0
Energy & Utilities	2,075	0.4395	0.4964	0	1	0
Materials	2,075	0.3605	0.4803	0	1	0
Communications	2,075	0.5161	0.4999	0	1	1
Financials	2,075	0.4255	0.4945	0	1	0

Data: Bloomberg. 18.04.2023

Table A3: Overview of categorical variables – (*Sub-Strategy*)

	Obs.	Mean	Std.	Min	Max	Median
Sub-strategy						
Buyout	2,075	0.0092	0.0953	0	1	0
Buyout, Venture	2,075	0.0014	0.0380	0	1	0
Buyout, Venture, Debt	2,075	0.0014	0.0380	0	1	0
Core Plus	2,075	0.0024	0.0490	0	1	0
Debt	2,075	0.0019	0.0439	0	1	0
Debt, Distressed	2,075	0.0048	0.0693	0	1	0
Debt, Early Stage, Late Stage	2,075	0.0005	0.0220	0	1	0
Distressed	2,075	0.0612	0.2398	0	1	0
Distressed, Special Opportunities	2,075	0.0039	0.0620	0	1	0
Early Stage	2,075	0.0376	0.1902	0	1	0
Early Stage, Late Stage	2,075	0.0328	0.1781	0	1	0
Growth	2,075	0.0010	0.0310	0	1	0
Growth, Buyout	2,075	0.0043	0.0657	0	1	0
Growth, Buyout, Venture	2,075	0.0043	0.0657	0	1	0
Growth, Buyout, Venture, Debt	2,075	0.0029	0.0537	0	1	0
Large Cap	2,075	0.1759	0.3808	0	1	0
Late Stage	2,075	0.0193	0.1375	0	1	0
Mezzanine	2,075	0.0357	0.1855	0	1	0

Mezzanine, Debt	2,075	0.0005	0.0220	0	1	0
Mid Cap	2,075	0.2376	0.4257	0	1	0
Mid Cap, Large Cap	2,075	0.0159	0.1251	0	1	0
Mid Cap, Large Cap, Small Cap	2,075	0.0019	0.0439	0	1	0
Mid Cap, Mezzanine	2,075	0.0005	0.0220	0	1	0
Mid Cap, Small Cap	2,075	0.0053	0.0726	0	1	0
Others	2,075	0.2675	0.4427	0	1	0
Small Cap	2,075	0.0096	0.0977	0	1	0
Special Opportunity	2,075	0.0111	0.1047	0	1	0
Value-Added	2,075	0.0347	0.1831	0	1	0
Value-Added, Core Plus	2,075	0.0019	0.0439	0	1	0
Venture	2,075	0.0130	0.1134	0	1	0

Data: Bloomberg. 18.04.2023

Table A4: Overview of categorical variables – (*Geography*)

	Obs.	Mean	Std.	Min	Max	Median
Geography						
APAC developed	2,075	0.0019	0.0439	0	1	0
APAC emerging	2,075	0.0092	0.0953	0	1	0
APAC emerging, APAC developed	2,075	0.0304	0.1716	0	1	0
APAC emerging, Eastern Europe	2,075	0.0005	0.0220	0	1	0
APAC emerging, Eastern Europe, LATAM	2,075	0.0005	0.0220	0	1	0
APAC emerging, Eastern Europe, LATAM, MEA	2,075	0.0005	0.0220	0	1	0
APAC emerging, Eastern Europe, LATAM, MEA, APAC developed	2,075	0.0010	0.0310	0	1	0
APAC emerging, LATAM, MEA	2,075	0.0005	0.0220	0	1	0
APAC emerging, LATAM, MEA, APAC developed	2,075	0.0010	0.0310	0	1	0
Eastern Europe	2,075	0.0014	0.0380	0	1	0
LATAM	2,075	0.0039	0.0620	0	1	0
MEA	2,075	0.0010	0.0310	0	1	0

North America	2,075	0.4631	0.4988	0	1	0
North America, APAC emerging	2,075	0.0039	0.0620	0	1	0
North America, APAC emerging, APAC developed	2,075	0.0010	0.0310	0	1	0
North America, APAC emerging, Eastern Europe, LATAM, MEA, APAC developed	2,075	0.0058	0.0758	0	1	0
North America, APAC emerging, LATAM, APAC developed	2,075	0.0005	0.0220	0	1	0
North America, APAC emerging, MEA	2,075	0.0019	0.0439	0	1	0
North America, LATAM	2,075	0.0087	0.0928	0	1	0
North America, LATAM, APAC developed	2,075	0.0024	0.0490	0	1	0
North America, MEA	2,075	0.0014	0.0380	0	1	0
Western Europe	2,075	0.0410	0.1983	0	1	0
Western Europe, APAC emerging, LATAM, MEA, APAC developed	2,075	0.0005	0.0220	0	1	0
Western Europe, Eastern Europe	2,075	0.0482	0.2142	0	1	0
Western Europe, Eastern Europe, APAC developed	2,075	0.0005	0.0220	0	1	0
Western Europe, North America	2,075	0.1007	0.3010	0	1	0
Western Europe, North America, APAC developed	2,075	0.0087	0.0928	0	1	0
Western Europe, North America, APAC emerging	2,075	0.0024	0.0490	0	1	0
Western Europe, North America, APAC emerging, APAC developed	2,075	0.0039	0.0620	0	1	0
Western Europe, North America, APAC emerging, Eastern Europe	2,075	0.0010	0.0310	0	1	0
Western Europe, North America, APAC emerging,	2,075	0.0183	0.1341	0	1	0

Eastern Europe, APAC developed						
Western Europe, North America, APAC emerging, Eastern Europe, LATAM, APAC developed	2,075	0.0120	0.1091	0	1	0
Western Europe, North America, APAC emerging, Eastern Europe, LATAM, MEA, APAC developed	2,075	0.1316	0.3381	0	1	0
Western Europe, North America, APAC emerging, LATAM	2,075	0.0092	0.0953	0	1	0
Western Europe, North America, APAC emerging, LATAM, APAC developed	2,075	0.0053	0.0726	0	1	0
Western Europe, North America, APAC emerging, MEA	2,075	0.0029	0.0537	0	1	0
Western Europe, North America, APAC emerging, MEA, APAC developed	2,075	0.0024	0.0490	0	1	0
Western Europe, North America, Eastern Europe	2,075	0.0386	0.1926	0	1	0
Western Europe, North America, Eastern Europe, APAC developed	2,075	0.0106	0.1024	0	1	0
Western Europe, North America, Eastern Europe, LATAM, APAC developed	2,075	0.0039	0.0620	0	1	0
Western Europe, North America, Eastern Europe, LATAM, MEA	2,075	0.0014	0.0380	0	1	0
Western Europe, North America, Eastern Europe, MEA	2,075	0.0014	0.0380	0	1	0
Western Europe, North America, LATAM	2,075	0.0053	0.0726	0	1	0

Western Europe, North America, LATAM, APAC developed	2,075	0.0077	0.0875	0	1	0
Western Europe, North America, MEA	2,075	0.0024	0.0490	0	1	0

Data: Bloomberg. 18.04.2023

Table A5: Overview of categorical variables – (*Sector*)

	Obs.	Mean	Std.	Min	Max	Median
Sector						
Communications	2,075	0.0101	0.1001	0	1	0
Consumer	2,075	0.0096	0.0977	0	1	0
Consumer, Communications	2,075	0.0111	0.1047	0	1	0
Consumer, Communications, Energy & Utilities	2,075	0.0010	0.0310	0	1	0
Consumer, Communications, Energy & Utilities, Materials	2,075	0.0014	0.0380	0	1	0
Consumer, Energy & Utilities	2,075	0.0024	0.0490	0	1	0
Consumer, Energy & Utilities, Materials	2,075	0.0034	0.0580	0	1	0
Consumer, Financials	2,075	0.0048	0.0693	0	1	0
Consumer, Financials, Energy & Utilities	2,075	0.0053	0.0726	0	1	0
Consumer, Financials, Energy & Utilities, Materials	2,075	0.0010	0.0310	0	1	0
Consumer, Health Care	2,075	0.0034	0.0580	0	1	0
Consumer, Health Care, Communications	2,075	0.0010	0.0310	0	1	0
Consumer, Health Care, Communications, Energy & Utilities	2,075	0.0058	0.0758	0	1	0
Consumer, Health Care, Financials	2,075	0.0077	0.0875	0	1	0
Consumer, Health Care, Financials, Communications	2,075	0.0014	0.0380	0	1	0

Consumer, Health Care, Financials, Communications, Materials	2,075	0.0039	0.0620	0	1	0
Consumer, Health Care, Financials, Energy & Utilities	2,075	0.0014	0.0380	0	1	0
Consumer, Health Care, Materials	2,075	0.0014	0.0380	0	1	0
Consumer, Materials	2,075	0.0005	0.0220	0	1	0
Energy & Utilities	2,075	0.0395	0.1949	0	1	0
Energy & Utilities, Materials	2,075	0.0034	0.0580	0	1	0
Financials	2,075	0.0294	0.1690	0	1	0
Financials, Communications, Energy & Utilities	2,075	0.0005	0.0220	0	1	0
Financials, Communications, Materials	2,075	0.0005	0.0220	0	1	0
Financials, Energy & Utilities	2,075	0.0034	0.0580	0	1	0
Health Care	2,075	0.0251	0.1563	0	1	0
Health Care, Financials, Communications, Energy & Utilities	2,075	0.0029	0.0537	0	1	0
Health Care, Financials, Energy & Utilities	2,075	0.0019	0.0439	0	1	0
Health Care, Financials, Materials	2,075	0.0039	0.0620	0	1	0
Health Care, Materials	2,075	0.0043	0.0657	0	1	0
Industrials	2,075	0.0019	0.0439	0	1	0
Industrials, Communications, Energy & Utilities	2,075	0.0135	0.1154	0	1	0
Industrials, Consumer	2,075	0.0034	0.0580	0	1	0
Industrials, Consumer, Communications	2,075	0.0048	0.0693	0	1	0
Industrials, Consumer, Communications, Materials	2,075	0.0096	0.0977	0	1	0
Industrials, Consumer, Energy & Utilities	2,075	0.0024	0.0490	0	1	0

Industrials, Consumer, Energy & Utilities, Materials	2,075	0.0029	0.0537	0	1	0
Industrials, Consumer, Financials	2,075	0.0024	0.0490	0	1	0
Industrials, Consumer, Financials, Communications	2,075	0.0010	0.0310	0	1	0
Industrials, Consumer, Financials, Materials	2,075	0.0058	0.0758	0	1	0
Industrials, Consumer, Health Care	2,075	0.0039	0.0620	0	1	0
Industrials, Consumer, Health Care, Communications	2,075	0.0034	0.0580	0	1	0
Industrials, Consumer, Health Care, Energy & Utilities	2,075	0.0024	0.0490	0	1	0
Industrials, Consumer, Health Care, Energy & Utilities, Materials	2,075	0.0014	0.0380	0	1	0
Industrials, Consumer, Health Care, Financials	2,075	0.0024	0.0490	0	1	0
Industrials, Consumer, Health Care, Financials, Communications	2,075	0.0019	0.0439	0	1	0
Industrials, Consumer, Health Care, Financials, Materials	2,075	0.0029	0.0537	0	1	0
Industrials, Consumer, Health Care, Materials	2,075	0.0039	0.0620	0	1	0
Industrials, Consumer, Materials	2,075	0.0135	0.1154	0	1	0
Industrials, Energy & Utilities	2,075	0.0005	0.0220	0	1	0
Industrials, Financials	2,075	0.0010	0.0310	0	1	0
Industrials, Financials, Communications, Energy & Utilities	2,075	0.0039	0.0620	0	1	0

Industrials, Financials, Energy & Utilities, Materials	2,075	0.0010	0.0310	0	1	0
Industrials, Health Care	2,075	0.0039	0.0620	0	1	0
Industrials, Health Care, Communications, Energy & Utilities	2,075	0.0005	0.0220	0	1	0
Industrials, Health Care, Energy & Utilities	2,075	0.0005	0.0220	0	1	0
Industrials, Health Care, Energy & Utilities, Materials	2,075	0.0029	0.0537	0	1	0
Industrials, Materials	2,075	0.0024	0.0490	0	1	0
Materials	2,075	0.1349	0.3417	0	1	0
Real Estate	2,075	0.0024	0.0490	0	1	0
Real Estate, Consumer	2,075	0.0034	0.0580	0	1	0
Real Estate, Consumer, Communications, Materials	2,075	0.0005	0.0220	0	1	0
Real Estate, Energy & Utilities	2,075	0.0034	0.0580	0	1	0
Real Estate, Financials	2,075	0.0010	0.0310	0	1	0
Real Estate, Industrials, Communications, Energy & Utilities	2,075	0.0014	0.0380	0	1	0
Real Estate, Industrials, Consumer, Health Care, Financials, Communications, Energy & Utilities, Materials	2,075	0.0034	0.0580	0	1	0
Real Estate, Industrials, Financials, Communications, Energy & Utilities	2,075	0.0010	0.0310	0	1	0
Real Estate, Industrials, Financials, Energy & Utilities	2,075	0.0410	0.1983	0	1	0
Technology	2,075	0.0333	0.1793	0	1	0
Technology, Communications	2,075	0.0193	0.1375	0	1	0

Technology, Consumer	2,075	0.0251	0.1563	0	1	0
Technology, Consumer, Communications	2,075	0.0029	0.0537	0	1	0
Technology, Consumer, Communications, Energy & Utilities	2,075	0.0005	0.0220	0	1	0
Technology, Consumer, Communications, Energy & Utilities, Materials	2,075	0.0135	0.1154	0	1	0
Technology, Consumer, Communications, Materials	2,075	0.0019	0.0439	0	1	0
Technology, Consumer, Financials, Communications	2,075	0.0072	0.0847	0	1	0
Technology, Consumer, Health Care	2,075	0.0024	0.0490	0	1	0
Technology, Consumer, Health Care, Communications	2,075	0.0058	0.0758	0	1	0
Technology, Consumer, Health Care, Communications, Energy & Utilities	2,075	0.0024	0.0490	0	1	0
Technology, Consumer, Health Care, Energy & Utilities	2,075	0.0029	0.0537	0	1	0
Technology, Consumer, Health Care, Financials	2,075	0.0063	0.0789	0	1	0
Technology, Consumer, Health Care, Financials, Communications	2,075	0.0005	0.0220	0	1	0
Technology, Consumer, Health Care, Financials, Energy & Utilities, Materials	2,075	0.0005	0.0220	0	1	0
Technology, Consumer, Health Care, Materials	2,075	0.0063	0.0789	0	1	0
Technology, Energy & Utilities	2,075	0.0010	0.0310	0	1	0

Technology, Financials	2,075	0.0096	0.0977	0	1	0
Technology, Health Care	2,075	0.0092	0.0953	0	1	0
Technology, Health Care, Communications	2,075	0.0014	0.0380	0	1	0
Technology, Health Care, Communications, Energy & Utilities	2,075	0.0039	0.0620	0	1	0
Technology, Health Care, Energy & Utilities	2,075	0.0019	0.0439	0	1	0
Technology, Health Care, Financials	2,075	0.0019	0.0439	0	1	0
Technology, Industrials	2,075	0.0005	0.0220	0	1	0
Technology, Industrials, Communications, Energy & Utilities	2,075	0.0005	0.0220	0	1	0
Technology, Industrials, Consumer	2,075	0.0120	0.1091	0	1	0
Technology, Industrials, Consumer, Communications	2,075	0.0024	0.0490	0	1	0
Technology, Industrials, Consumer, Communications, Energy & Utilities	2,075	0.0005	0.0220	0	1	0
Technology, Industrials, Consumer, Energy & Utilities	2,075	0.0019	0.0439	0	1	0
Technology, Industrials, Consumer, Financials	2,075	0.0014	0.0380	0	1	0
Technology, Industrials, Consumer, Financials, Communications	2,075	0.0019	0.0439	0	1	0
Technology, Industrials, Consumer, Financials, Communications, Materials	2,075	0.0039	0.0620	0	1	0

Technology, Industrials, Consumer, Health Care	2,075	0.0072	0.0847	0	1	0
Technology, Industrials, Consumer, Health Care, Communications	2,075	0.0034	0.0580	0	1	0
Technology, Industrials, Consumer, Health Care, Communications, Energy & Utilities	2,075	0.0019	0.0439	0	1	0
Technology, Industrials, Consumer, Health Care, Communications, Materials	2,075	0.0005	0.0220	0	1	0
Technology, Industrials, Consumer, Health Care, Energy & Utilities, Materials	2,075	0.0053	0.0726	0	1	0
Technology, Industrials, Consumer, Health Care, Financials	2,075	0.0067	0.0819	0	1	0
Technology, Industrials, Consumer, Health Care, Financials, Communications	2,075	0.0087	0.0928	0	1	0
Technology, Industrials, Consumer, Health Care, Financials, Communications, Energy & Utilities	2,075	0.0010	0.0310	0	1	0
Technology, Industrials, Consumer, Health Care, Financials, Communications, Energy & Utilities, Materials	2,075	0.0029	0.0537	0	1	0
Technology, Industrials, Consumer, Health Care, Financials, Communications, Materials	2,075	0.0034	0.0580	0	1	0

Technology, Industrials, Consumer, Health Care, Materials	2,075	0.0010	0.0310	0	1	0
Technology, Industrials, Health Care	2,075	0.0014	0.0380	0	1	0
Technology, Industrials, Health Care, Communications, Energy & Utilities	2,075	0.0005	0.0220	0	1	0
Technology, Industrials, Health Care, Financials, Energy & Utilities	2,075	0.0005	0.0220	0	1	0
Technology, Industrials, Materials	2,075	0.0082	0.0902	0	1	0
Technology, Real Estate, Consumer, Financials, Communications	2,075	0.0005	0.0220	0	1	0
Technology, Real Estate, Industrials, Consumer, Health Care, Communications, Energy & Utilities	2,075	0.0005	0.0220	0	1	0
Technology, Real Estate, Industrials, Consumer, Health Care, Financials	2,075	0.2713	0.4448	0	1	0
Technology, Real Estate, Industrials, Consumer, Health Care, Financials, Communications, Energy & Utilities, Materials	2,075	0.0058	0.0758	0	1	0
Technology, Real Estate, Industrials, Consumer, Health Care, Financials, Communications, Materials	2,075	0.0014	0.0380	0	1	0

Data: Bloomberg. 18.04.2023

APPENDIX B Supplementary information on the methodology section

Appendix B provides a detailed overview of the outcomes produced when running a white test on the variables of interest. Table B1 displays the results for selected variables only.

Table B1: White test, for heteroskedasticity, on key variables using *Net IRR* and *Calc IRR*

Variable	*Net IRR* P-value	*Calc IRR* P-value
CC	0.0000***	0.0000***
CI	0.0000***	0.0000***
CD	0.0000***	0.0000***
Vintage year	0.0158**	0.1022
Follow-on Fund	0.3066	0.0232**
Calc NPV	0.0000***	0.0701*
US GDP Growth	0.2806	0.0472**
Dry Powder	0.0269**	0.3628
Risk-free rate	0.0866	0.6346
Sector	0.6648	0.0638*
Geography	0.1712	0.2071
Investment Strategy	0.0000***	0.0000***
Sub-Strategy	0.4202	0.1311

Data: Bloomberg. 18.04.2023
Notes: Significance is reflected by '*', *p<0.10, **p<0.05, and ***p<0.01

APPENDIX C Supplementary information on results

Appendix provides a detailed overview of the regression results. Table C1 displays a detailed overview, to provide readers with extensive information on the results of the individual variables. Figure C1, represents the development of the *Calc IRR*, which is based on estimated cash-flow calculations.

Table C1: Extensive overview of regression results – regression (1) for each IRR represents key variables, regression (2) adds the categorical variables *Investment Strategy, Sub-Strategy, Sector,* and *Geography*, regression (3) and (4) add control variables to explain further variation in results

	Dependent variable:							
	Net IRR				*Calc IRR*			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
CI to CC ratio (%)	0.010	0.003	0.003	0.003	0.010	0.006	0.006	0.006
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)	(0.010)
Follow-on Fund	0.008*	0.001	0.001	0.001	0.006	0.001	0.002	0.002
	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.006)	(0.006)	(0.006)
Vintage year	0.009***	0.010***	0.009***	0.011***	-0.005***	-0.004***	-0.003**	0.000
	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.002)
Calc NPV	0.002***	0.001***	0.001***	0.001***	0.003***	0.003***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Investment Strategy ($)								
Co-investment		-0.015	-0.015	-0.015		0.004	0.005	0.004
		(0.011)	(0.011)	(0.011)		(0.017)	(0.018)	(0.017)
Debt		-0.046***	-0.046***	-0.047***		-0.013***	-0.012***	-0.014***
		(0.004)	(0.004)	(0.004)		(0.004)	(0.004)	(0.004)
Fund of Funds		0.002	0.002	0.002		-0.015	-0.017	-0.017
		(0.007)	(0.007)	(0.007)		(0.010)	(0.010)	(0.010)
Growth		-0.005	-0.005	-0.004		0.019**	0.020**	0.021**
		(0.007)	(0.007)	(0.007)		(0.009)	(0.009)	(0.009)
Real Assets		-0.038***	-0.038***	-0.038***		-0.028***	-0.029***	-0.029***
		(0.007)	(0.007)	(0.007)		(0.007)	(0.007)	(0.007)
Real Estate		-0.029***	-0.029***	-0.029***		-0.016***	-0.017***	-0.017***
		(0.004)	(0.004)	(0.004)		(0.005)	(0.005)	(0.005)

Secondary	-0.024***	-0.024***	-0.025***	-0.008	-0.008	-0.009
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Venture	0.000	0.000	0.000	-0.008	-0.006	-0.006
	(0.006)	(0.006)	(0.006)	(0.009)	(0.009)	(0.009)
Sub-Strategy ($)						
Buyout, Venture	0.095***	0.095***	0.093***	0.083***	0.095***	0.092***
	(0.021)	(0.021)	(0.021)	(0.025)	(0.025)	(0.025)
Buyout, Venture, Debt	0.026	0.025	0.026	-0.003	0.007	0.011
	(0.042)	(0.042)	(0.042)	(0.030)	(0.035)	(0.036)
Core Plus	0.010	0.010	0.008	0.027	0.037	0.033
	(0.032)	(0.032)	(0.032)	(0.068)	(0.066)	(0.066)
Debt	0.019	0.019	0.019	0.057	0.063	0.063
	(0.015)	(0.015)	(0.015)	(0.044)	(0.044)	(0.045)
Debt, Distressed	-0.034	-0.034	-0.035	-0.037	-0.025	-0.030
	(0.023)	(0.024)	(0.024)	(0.040)	(0.040)	(0.040)
Debt, Early Stage, Late Stage	-0.046***	-0.045***	-0.046***	-0.006	-0.015	-0.016
	(0.016)	(0.017)	(0.017)	(0.022)	(0.023)	(0.022)
Distressed	-0.004	-0.004	-0.004	0.002	0.012	0.011
	(0.014)	(0.015)	(0.015)	(0.020)	(0.020)	(0.020)
Distressed, Special opportunities	-0.031	-0.030	-0.028	-0.032	-0.018	-0.010
	(0.024)	(0.024)	(0.024)	(0.026)	(0.027)	(0.026)
Early Stage	0.010	0.010	0.010	0.021	0.032	0.032
	(0.015)	(0.016)	(0.016)	(0.020)	(0.021)	(0.021)
Early Stage, Late Stage	0.006	0.006	0.004	0.006	0.019	0.014
	(0.019)	(0.019)	(0.019)	(0.025)	(0.025)	(0.025)
Growth	-0.074**	-0.075**	-0.077**	-0.054	-0.038	-0.043
	(0.031)	(0.031)	(0.033)	(0.033)	(0.033)	(0.028)
Growth, Buyout	-0.002	-0.002	-0.001	0.005	0.000	0.003
	(0.015)	(0.015)	(0.015)	(0.021)	(0.022)	(0.022)
Growth, Buyout, Venture	-0.018	-0.018	-0.019	-0.080	-0.066	-0.068
	(0.023)	(0.023)	(0.021)	(0.053)	(0.052)	(0.060)
Growth, Buyout, Venture, Debt	0.043	0.042	0.043	0.060	0.075	0.077
	(0.040)	(0.040)	(0.040)	(0.051)	(0.054)	(0.054)
Large Cap	0.005	0.005	0.006	0.005	0.017	0.020
	(0.013)	(0.014)	(0.014)	(0.019)	(0.020)	(0.020)

Late Stage	0.013	0.012	0.013	-0.006	0.007	0.008
	(0.018)	(0.019)	(0.019)	(0.024)	(0.025)	(0.025)
Mezzanine	0.000	0.000	0.000	0.006	0.017	0.017
	(0.015)	(0.015)	(0.015)	(0.021)	(0.022)	(0.022)
Mezzanine, Debt	0.201***	0.200***	0.200***	0.025	0.045**	0.048**
	(0.014)	(0.014)	(0.014)	(0.019)	(0.020)	(0.020)
Mid Cap	0.012	0.012	0.012	0.007	0.019	0.021
	(0.014)	(0.014)	(0.014)	(0.019)	(0.020)	(0.020)
Mid Cap, Large Cap	-0.003	-0.003	0.000	-0.018	-0.011	-0.003
	(0.021)	(0.021)	(0.022)	(0.032)	(0.033)	(0.033)
Mid Cap, Large Cap, Small Cap	0.058*	0.059*	0.057*	0.023	0.030	0.026
	(0.031)	(0.031)	(0.032)	(0.023)	(0.024)	(0.026)
Mid Cap, Mezzanine	-0.007	-0.007	-0.004	0.010(	0.024	0.031
	(0.032)	(0.032)	(0.032)	0.026)	(0.028)	(0.028)
Mid Cap, Small Cap	0.024	0.024	0.023	0.072**	0.085***	0.083***
	(0.024)	(0.025)	(0.025)	(0.029)	(0.030)	(0.029)
Small Cap	0.017	0.017	0.018	0.026	0.037	0.092***
	(0.018)	(0.019)	(0.019)	(0.023)	(0.024)	(0.025)
Special Opportunities	0.003	0.003	0.002	0.000	0.014	0.039*
	(0.021)	(0.022)	(0.022)	(0.024)	(0.025)	(0.023)
Value-Added	0.008	0.008	0.007	-0.005	0.006	0.014
	(0.018)	(0.018)	(0.018)	(0.023)	(0.024)	(0.025)
Value-Added, Core Plus	-0.032	-0.033	-0.033	-0.026	-0.012	0.005
	(0.025)	(0.025)	(0.025)	(0.037)	(0.036)	(0.024)
Venture	0.003	0.002	0.002	0.008	0.019	-0.011
	(0.019)	(0.019)	(0.019)	(0.023)	(0.023)	(0.036)
Others	0.008	0.008	0.008	0.015	0.025	0.025
	(0.013)	(0.013)	(0.013)	(0.019)	(0.020)	(0.019)
Sector						
Consumer	0.005	0.006	0.006	0.018	0.010	0.011
	(0.017)	(0.017)	(0.017)	(0.015)	(0.015)	(0.015)
Consumer, Comms	-0.027	-0.027	-0.026	-0.008	-0.014	-0.011
	(0.020)	(0.020)	(0.020)	(0.018)	(0.018)	(0.019)
Consumer, Comms, E&U, Materials	0.089***	0.090***	0.095***	0.144***	0.141***	0.154***
	(0.019)	(0.020)	(0.020)	(0.017)	(0.018)	(0.018)

Consumer, E&U	-0.013	-0.012	-0.011	-0.004	-0.012	-0.010
	(0.020)	(0.020)	(0.020)	(0.024)	(0.024)	(0.024)
Consumer, E&U, Materials	0.023	0.023	0.023	0.070***	0.059**	0.057**
	(0.025)	(0.025)	(0.025)	(0.024)	(0.024)	(0.024)
Consumer, Fin	0.035	0.036	0.037	0.070*	0.072*	0.076**
	(0.032)	(0.032)	(0.032)	(0.036)	(0.036)	(0.035)
Consumer, Fin, E&U	0.071***	0.072***	0.076***	0.032	0.026	0.037
	(0.023)	(0.024)	(0.024)	(0.029)	(0.028)	(0.028)
Consumer, Fin, E&U, Materials	0.022	0.023	0.023	0.006	-0.004	-0.003
	(0.017)	(0.017)	(0.017)	(0.014)	(0.015)	(0.015)
Consumer, HC	-0.040*	-0.039*	-0.036*	-0.006	-0.016	-0.007
	(0.020)	(0.020)	(0.021)	(0.018)	(0.017)	(0.017)
Consumer, HC, Comms	-0.009	-0.009	-0.007	0.036**	0.026*	0.032**
	(0.038)	(0.038)	(0.039)	(0.015)	(0.015)	(0.015)
Consumer, HC, Comms, E&U	-0.029	-0.029	-0.034	-0.008	-0.006	-0.019
	(0.027)	(0.027)	(0.027)	(0.017)	(0.017)	(0.018)
Consumer, HC, Fin	0.002	0.003	0.004	0.005	-0.002	0.000
	(0.023)	(0.024)	(0.024)	(0.016)	(0.017)	(0.017)
Consumer, HC, Fin, Comms	-0.032	-0.033	-0.031	0.001	0.015	0.018
	(0.025)	(0.025)	(0.025)	(0.032)	(0.032)	(0.032)
Consumer, HC, Fin, Comms, Materials	0.013	0.014	0.016	-0.011	-0.018	-0.011
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
Consumer, HC, Fin, E&U	0.045**	0.046**	0.043**	0.039***	0.033**	0.026*
	(0.017)	(0.017)	(0.017)	(0.014)	(0.015)	(0.014)
Consumer, HC, Materials	-0.025	-0.024	-0.02	-0.040*	-0.058***	-0.054***
	(0.020)	(0.021)	3(0.021)	(0.022)	(0.020)	(0.020)
Consumer, Materials	-0.042***	-0.041***	-0.037**	0.024**	0.022*	0.031***
	(0.015)	(0.015)	(0.016)	(0.011)	(0.011)	(0.011)
E&U	-0.003	-0.003	-0.003	0.018	0.017	0.016
	(0.017)	(0.017)	(0.017)	(0.015)	(0.015)	(0.015)
E&U, Materials	0.016	0.016	0.016	0.018	0.016	0.017
	(0.019)	(0.019)	(0.019)	(0.016)	(0.017)	(0.018)
Fin	0.007	0.007	0.008	0.004	0.000	0.001
	(0.018)	(0.018)	(0.018)	(0.015)	(0.015)	(0.015)
Fin, Comms, Materials	-0.016	-0.015	-0.014	-0.011	-0.017	-0.017

	(0.019)	(0.019)	(0.019)	(0.021)	(0.022)	(0.021)
Fin, E&U	0.035	0.036	0.037	0.040	0.034	0.035
	(0.030)	(0.030)	(0.030)	(0.024)	(0.024)	(0.025)
HC	-0.002	-0.002	-0.001	0.008	0.008	0.010
	(0.018)	(0.018)	(0.018)	(0.016)	(0.016)	(0.016)
HC, Fin, Comms, E&U	0.000	0.000	0.000	0.076***	0.072***	0.068**
	(0.025)	(0.025)	(0.025)	(0.027)	(0.027)	(0.027)
HC, Fin, E&U	-0.084***	-0.083***	-0.082***	-0.073***	-0.090***	-0.088***
	(0.025)	(0.025)	(0.026)	(0.026)	(0.024)	(0.025)
HC, Fin, Materials	0.003	0.003	0.007	0.010	0.010	0.021
	(0.016)	(0.016)	(0.016)	(0.012)	(0.012)	(0.013)
HC, Materials	-0.027	-0.027	-0.028	-0.03*	-0.035*	-0.038**
	(0.025)	(0.025)	(0.025)	(0.018)	(0.018)	(0.018)
Industrials	-0.029	-0.028	-0.029	-0.013	-0.014	-0.015
	(0.020)	(0.020)	(0.020)	(0.017)	(0.017)	(0.018)
Industrials, Comms, E&U	-0.043**	-0.044**	-0.044**	-0.016	-0.012	-0.013
	(0.020)	(0.020)	(0.020)	(0.014)	(0.014)	(0.014)
Industrials, Consumer	-0.015	-0.014	-0.012	-0.004	-0.006	-0.001
	(0.018)	(0.018)	(0.018)	(0.012)	(0.012)	(0.012)
Industrials, Consumer, Comms	-0.016	-0.015	-0.013	0.065	0.064	0.069
	(0.024)	(0.024)	(0.024)	(0.066)	(0.065)	(0.064)
Industrials, Consumer, Comms, Materials	-0.079**	-0.078**	-0.073**	0.000	-0.002	0.009
	(0.035)	(0.035)	(0.035)	(0.045)	(0.046)	(0.046)
Industrials, Consumer, E&U	-0.004	-0.003	-0.003	0.000	-0.008	-0.008
	(0.020)	(0.021)	(0.021)	(0.020)	(0.020)	(0.020)
Industrials, Consumer, E&U, Materials	-0.062***	-0.062***	-0.060***	-0.014	-0.014	-0.009
	(0.021)	(0.021)	(0.020)	(0.033)	(0.032)	(0.029)
Industrials, Consumer, Fin	0.049*	0.050*	0.050*	0.027*	0.018	0.018
	(0.026)	(0.026)	(0.027)	(0.015)	(0.014)	(0.015)
Industrials, Consumer, Fin, Comms	-0.028	-0.028	-0.032	0.080***	0.082***	0.069***
	(0.019)	(0.019)	(0.019)	(0.025)	(0.025)	(0.025)
Industrials, Consumer, Fin, Materials	0.008	0.008	0.009	0.026	0.017	0.018
	(0.022)	(0.023)	(0.023)	(0.035)	(0.036)	(0.036)
Industrials, Consumer, HC	-0.020	-0.019	-0.019	0.005	0.000	0.000
	(0.026)	(0.026)	(0.026)	(0.016)	(0.017)	(0.017)

Industrials, Consumer, HC, Comms	0.051	0.052	0.052	-0.008	-0.018	-0.017
	(0.032)	(0.033)	(0.033)	(0.052)	(0.051)	(0.052)
Industrials, Consumer, HC, E&U	-0.033*	-0.034*	-0.032*	-0.016	-0.011	-0.006
	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Industrials, Consumer, HC, E&U, Materials	-0.020	-0.019	-0.016	-0.017	-0.018	-0.008
	(0.024)	(0.025)	(0.025)	(0.036)	(0.035)	(0.037)
Industrials, Consumer, HC, Fin	-0.034*	-0.034*	-0.039**	0.003	0.006	-0.007
	(0.018)	(0.018)	(0.018)	(0.013)	(0.014)	(0.015)
Industrials, Consumer, HC, Fin, Comms	-0.008	-0.008	-0.010	0.005	0.003	0.000
	(0.016)	(0.016)	(0.016)	(0.017)	(0.017)	(0.015)
Industrials, Consumer, HC, Fin, Materials	-0.068***	-0.067***	-0.069***	-0.034	-0.038	-0.044
	(0.025)	(0.025)	(0.025)	(0.029)	(0.029)	(0.030)
Industrials, Consumer, HC, Materials	-0.037	-0.037	-0.037	-0.014	-0.018	-0.016
	(0.027)	(0.027)	(0.027)	(0.024)	(0.022)	(0.022)
Industrials, Consumer, Materials	-0.064***	-0.065***	-0.064***	-0.015	-0.013	-0.011
	(0.023)	(0.023)	(0.024)	(0.015)	(0.015)	(0.016)
Industrials, E&U	-0.015	-0.014	-0.011	-0.015	-0.018	-0.009
	(0.018)	(0.019)	(0.019)	(0.018)	(0.018)	(0.019)
Industrials, Fin	-0.050**	-0.048**	-0.050**	0.009	0.000	-0.003
	(0.024)	(0.024)	(0.024)	(0.021)	(0.022)	(0.022)
Industrials, Fin, Comms, E&U	-0.029*	-0.029*	-0.028	-0.002	-0.012‘	-0.011
	(0.017)	(0.017)	(0.017)	(0.018)	(0.018)	(0.018)
Industrials, Fin, E&U, Materials	-0.020	-0.020	-0.020	-0.006	-0.010	-0.011
	(0.039)	(0.039)	(0.039)	(0.034)	(0.034)	(0.034)
Industrials, HC	-0.029*	-0.030*	-0.027	-0.001	0.004	0.012
	(0.016)	(0.016)	(0.017)	(0.013)	(0.013)	(0.014)
Industrials, HC, Comms, E&U	-0.067**	-0.066**	-0.060**	-0.002	-0.001	0.015
	(0.027)	(0.027)	(0.028)	(0.041)	(0.041)	(0.041)
Industrials, HC, E&U	-0.088***	-0.088***	-0.086***	-0.124***	-0.117***	-0.112***
	(0.019)	(0.019)	(0.019)	(0.017)	(0.017)	(0.017)
Industrials, HC, E&U, Materials	-0.188***	-0.188***	-0.185***	-0.043*	-0.044*	-0.035
	(0.022)	(0.022)	(0.022)	(0.023)	(0.023)	(0.022)
Industrials, Materials	0.012	0.013	0.015	0.073	0.065	0.071
	(0.043)	(0.044)	(0.043)	(0.076)	(0.067)	(0.067)
Materials	-0.006	-0.006	-0.005	0.040	0.038	0.040

	(0.017)	(0.017)	(0.017)	(0.041)	(0.037)	(0.037)
RE	-0.014	-0.014	-0.012	-0.011	-0.013	-0.007
	(0.016)	(0.016)	(0.016)	(0.012)	(0.012)	(0.012)
RE, Consumer	0.002	0.003	0.003	0.074*	0.073*	0.075**
	(0.019)	(0.019)	(0.019)	(0.040)	(0.039)	(0.037)
RE, Consumer, Comms, Materials	-0.017	-0.016	-0.015	-0.018	-0.040**	-0.038*
	(0.032)	(0.033)	(0.033)	(0.018)	(0.020)	(0.019)
RE, Fin	0.076	0.076	0.078	0.007	0.002	0.007
	(0.049)	(0.049)	(0.049)	(0.015)	(0.017)	(0.017)
RE, Industrials, Comms, E&U	0.015	0.015	0.011	0.051	0.052	0.041
	(0.053)	(0.054)	(0.054)	(0.034)	(0.033)	(0.034)
RE, Industrials, Consumer, HC,	0.017	0.018	0.018	0.106***	0.096***	0.097***
Fin, Comms, E&U, Materials	(0.015)	(0.016)	(0.016)	(0.011)	(0.011)	(0.011)
RE, Industrials, Fin, Comms, E&U	-0.007	-0.006	-0.007	0.023*	0.012	0.009
	(0.017)	(0.017)	(0.017)	(0.013)	(0.014)	(0.014)
RE, Industrials, Fin, E&U	0.020	0.020	0.021	0.076**	0.074*	0.076*
	(0.028)	(0.028)	(0.028)	(0.038)	(0.038)	(0.038)
Tech	0.000	0.000	0.003	-0.002	-0.003	0.002
	(0.017)	(0.017)	(0.017)	(0.013)	(0.013)	(0.013)
Tech, Comms	-0.002	-0.002	-0.001	0.002	0.000	0.002
	(0.017)	(0.017)	(0.017)	(0.014)	(0.014)	(0.014)
Tech, Consumer	-0.018	-0.018	-0.018	-0.003	-0.006	-0.006
	(0.018)	(0.018)	(0.018)	(0.017)	(0.017)	(0.017)
Tech, Consumer, Comms	0.000	0.000	0.000	0.000	-0.004	-0.002
	(0.018)	(0.018)	(0.018)	(0.016)	(0.017)	(0.016)
Tech, Consumer, Comms, E&U	-0.011	-0.010	-0.011	0.010	0.006	0.003
	(0.019)	(0.019)	(0.019)	(0.013)	(0.013)	(0.013)
Tech, Consumer, Comms,	-0.053***	-0.051***	-0.053***	-0.015	-0.020	-0.025
Materials	(0.019)	(0.019)	(0.019)	(0.018)	(0.019)	(0.019)
Tech, Consumer, Fin, Comms	0.027	0.027	0.028	-0.015	-0.025	-0.021
	(0.023)	(0.024)	(0.024)	(0.015)	(0.015)	(0.015)
Tech, Consumer, HC	-0.030	-0.030	-0.028	-0.010	-0.016	-0.011
	(0.021)	(0.022)	(0.022)	(0.019)	(0.018)	(0.018)
Tech, Consumer, HC, Comms	-0.037	-0.037	-0.035	-0.008	-0.016	-0.012
	(0.035)	(0.035)	(0.035)	(0.036)	(0.036)	(0.035)

Tech, Consumer, HC, Comms, E&U	0.011	0.012	0.016	-0.015	-0.019	-0.010
	(0.021)	(0.021)	(0.021)	(0.028)	(0.029)	(0.029)
Tech, Consumer, HC, E&U	-0.027	-0.027	-0.024	-0.029	-0.028	-0.020
	(0.025)	(0.024)	(0.024)	(0.034)	(0.035)	(0.035)
Tech, Consumer, HC, Fin	0.002	0.002	0.004	-0.016	-0.026	-0.021
	(0.048)	(0.048)	(0.048)	(0.023)	(0.025)	(0.024)
Tech, Consumer, HC, Fin, Comms	0.013	0.013	0.014	-0.001	-0.002	0.000
	(0.023)	(0.023)	(0.023)	(0.015)	(0.015)	(0.014)
Tech, Consumer, HC, Fin, E&U, Materials	0.045***	0.046***	0.050***	0.059***	0.057***	0.069***
	(0.017)	(0.017)	(0.017)	(0.014)	(0.014)	(0.015)
Tech, Consumer, HC, Materials	-0.046***	-0.045***	-0.041**	0.014	0.011	0.023*
	(0.016)	(0.016)	(0.016)	(0.011)	(0.011)	(0.012)
Tech, E&U	-0.018	-0.017	-0.014	0.007	0.004	0.013
	(0.018)	(0.018)	(0.019)	(0.018)	(0.019)	(0.020)
Tech, Fin	-0.108***	-0.109***	-0.108***	-0.059***	-0.057***	-0.053***
	(0.016)	(0.016)	(0.016)	(0.012)	(0.012)	(0.013)
Tech, HC	-0.034	-0.034	-0.033	-0.049**	-0.052**	-0.049**
	(0.024)	(0.024)	(0.024)	(0.021)	(0.021)	(0.022)
Tech, HC, Comms	-0.034	-0.033	-0.031	-0.026	-0.033*	-0.026
	(0.022)	(0.022)	(0.022)	(0.019)	(0.019)	(0.019)
Tech, HC, Comms, E&U	-0.019	-0.018	-0.014	-0.026**	-0.025*	-0.014
	(0.017)	(0.017)	(0.018)	(0.013)	(0.013)	(0.013)
Tech, HC, E&U	-0.036**	-0.035**	-0.035**	-0.007	-0.010	-0.010
	(0.018)	(0.018)	(0.018)	(0.023)	(0.022)	(0.024)
Tech, HC, Fin	-0.075***	-0.074***	-0.074***	-0.060*	-0.060*	-0.061**
	(0.017)	(0.017)	(0.016)	(0.034)	(0.036)	(0.028)
Tech, Industrials	-0.043	-0.042	-0.044	-0.078*	-0.082*	-0.086**
	(0.032)	(0.032)	(0.032)	(0.044)	(0.044)	(0.043)
Tech, Industrials, Comms, E&U	-0.047**	-0.046*	-0.044*	0.007	0.001	0.006
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Tech, Industrials, Consumer	-0.061***	-0.062***	-0.060***	0.000	0.002	0.007
	(0.018)	(0.018)	(0.018)	(0.016)	(0.016)	(0.016)
Tech, Industrials, Consumer, Comms	0.001	0.002	0.004	0.004	0.000	0.004
	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)	(0.019)
Tech, Industrials, Consumer,	-0.061*	-0.061*	-0.061*	-0.045	-0.048	-0.048

Comms, E&U	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)	(0.032)
Tech, Industrials, Consumer, E&U	0.072***	0.072***	0.072***	0.040**	0.034**	0.033**
	(0.018)	(0.018)	(0.018)	(0.015)	(0.016)	(0.015)
Tech, Industrials, Consumer, Fin	-0.047*	-0.047*	-0.054**	0.003	0.010	-0.008
	(0.024)	(0.024)	(0.025)	(0.029)	(0.030)	(0.030)
Tech, Industrials, Consumer, Fin, Comms	-0.065***	-0.066***	-0.063**	-0.091**	-0.084**	-0.077*
	(0.025)	(0.025)	(0.025)	(0.039)	(0.038)	(0.039)
Tech, Industrials, Consumer, Fin, Comms, Materials	0.022	0.023	0.024	-0.060**	-0.064**	-0.062**
	(0.020)	(0.020)	(0.020)	(0.027)	(0.026)	(0.026)
Tech, Industrials, Consumer, HC	-0.019	-0.020	-0.019	0.007	0.011	0.013
	(0.023)	(0.023)	(0.023)	(0.016)	(0.016)	(0.016)
Tech, Industrials, Consumer, HC, Comms	-0.027	-0.025	-0.025	-0.001	-0.006	-0.004
	(0.019)	(0.019)	(0.019)	(0.022)	(0.021)	(0.021)
Tech, Industrials, Consumer, HC, Comms, E&U	0.000	-0.001	0.000	0.040	0.041	0.042
	(0.025)	(0.025)	(0.025)	(0.047)	(0.046)	(0.046)
Tech, Industrials, Consumer, HC, Comms, Materials	-0.055***	-0.055***	-0.053***	-0.065***	-0.060**	-0.054**
	(0.019)	(0.019)	(0.019)	(0.023)	(0.023)	(0.023)
Tech, Industrials, Consumer, HC, E&U, Materials	-0.005	-0.004	-0.004	0.044*	0.037	0.038
	(0.020)	(0.020)	(0.020)	(0.024)	(0.024)	(0.024)
Tech, Industrials, Consumer, HC, Fin	-0.010	-0.010	-0.011	0.003	0.000	0.000
	(0.024)	(0.024)	(0.024)	(0.029)	(0.029)	(0.028)
Tech, Industrials, Consumer, HC, Fin, Comms	0.078***	0.078***	0.079***	-0.008	-0.007	-0.003
	(0.029)	(0.030)	(0.03)	(0.023)	(0.023)	(0.023)
Geography						
APAC emerging	-0.002	-0.003	-0.004	0.028	0.030	0.028
	(0.046)	(0.046)	(0.046)	(0.028)	(0.027)	(0.027)
APAC emerging, APAC developed	-0.030	-0.030	-0.030	0.000	0.001	0.001
	(0.043)	(0.043)	(0.043)	(0.023)	(0.024)	(0.024)
APAC emerging, Eastern Europe	-0.042	-0.041	-0.038	0.025	0.028	0.036
	(0.042)	(0.042)	(0.042)	(0.022)	(0.022)	(0.023)
APAC emerging, Eastern Europe, LATAM	0.019	0.019	0.018	0.036	0.029	0.025
	(0.042)	(0.042)	(0.042)	(0.022)	(0.022)	(0.022)
APAC emerging, Eastern Europe, LATAM, MEA	0.083*	0.081*	0.082*	0.112***	0.119***	0.122***
	(0.042)	(0.043)	(0.043)	(0.022)	(0.022)	(0.023)

APAC emerging, Eastern Europe, LATAM, MEA, APAC developed	-0.068	-0.068	-0.071	-0.099	-0.103	-0.112
	(0.049)	(0.049)	(0.049)	(0.104)	(0.102)	(0.100)
APAC emerging, LATAM, MEA	-0.077*	-0.077*	-0.075*	0.030	0.033	0.039*
	(0.043)	(0.043)	(0.043)	(0.023)	(0.023)	(0.023)
APAC emerging, LATAM, MEA, APAC developed	0.080*	0.078*	0.079*	-0.010	0.005	0.006
	(0.044)	(0.044)	(0.044)	(0.022)	(0.022)	(0.022)
Eastern Europe	-0.023	-0.024	-0.026	0.008	0.015	0.010
	(0.045)	(0.045)	(0.045)	(0.037)	(0.039)	(0.037)
LATAM	0.007	0.007	0.006	0.023	0.026	0.023
	(0.045)	(0.045)	(0.045)	(0.032)	(0.032)	(0.032)
MEA	-0.005	-0.005	-0.006	0.018	0.019	0.016
	(0.048)	(0.048)	(0.048)	(0.039)	(0.039)	(0.039)
North America	-0.007	-0.007	-0.007	0.022	0.022	0.021
	(0.042)	(0.042)	(0.042)	(0.021)	(0.021)	(0.022)
North America, APAC emerging	-0.050	-0.050	-0.051	-0.014	-0.019	-0.021
	(0.044)	(0.044)	(0.044)	(0.026)	(0.026)	(0.026)
North America, APAC emerging, APAC developed	-0.010	-0.009	-0.012	-0.036	-0.036	-0.043*
	(0.054)	(0.054)	(0.055)	(0.022)	(0.022)	(0.023)
North America, APAC emerging, Eastern Europe, LATAM, MEA, APAC developed	-0.009	-0.009	-0.007	0.051*	0.052*	0.057**
	(0.044)	(0.044)	(0.044)	(0.026)	(0.027)	(0.026)
North America, APAC emerging, LATAM, APAC developed	0.009	0.009	0.010	0.053**	0.038	0.041
	(0.043)	(0.043)	(0.043)	(0.025)	(0.026)	(0.026)
North America, APAC emerging, MEA	-0.096*	-0.096*	-0.100*	-0.079*	-0.084**	-0.095**
	(0.051)	(0.051)	(0.052)	(0.041)	(0.042)	(0.041)
North America, LATAM	0.003	0.003	0.003	0.047**	0.048**	0.048**
	(0.043)	(0.043)	(0.043)	(0.022)	(0.022)	(0.022)
North America, LATAM, APAC developed	0.033	0.033	0.030	0.077***	0.074***	0.066***
	(0.049)	(0.049)	(0.049)	(0.024)	(0.024)	(0.025)
North America, MEA	-0.022	-0.023	-0.022	0.020	0.025	0.026
	(0.051)	(0.051)	(0.051)	(0.026)	(0.026)	(0.026)
Western Europe	0.006	0.006	0.005	0.021	0.021	0.018
	(0.042)	(0.042)	(0.042)	(0.022)	(0.022)	(0.022)
Western Europe, APAC emerging, LATAM, MEA, APAC developed	-0.036	-0.036	-0.037	-0.010	-0.013	-0.016
	(0.044)	(0.044)	(0.044)	(0.027)	(0.027)	(0.028)

Western Europe, Eastern Europe	-0.014	-0.014	-0.014	0.026	0.027	0.028
	(0.042)	(0.042)	(0.042)	(0.021)	(0.021)	(0.021)
Western Europe, Eastern Europe, APAC developed	0.080*	0.078*	0.079*	0.105***	0.112***	0.115***
	(0.042)	(0.043)	(0.043)	(0.022)	(0.022)	(0.023)
Western Europe, North America	-0.002	-0.003	-0.004	0.034	0.033	0.030
	(0.042)	(0.042)	(0.042)	(0.022)	(0.022)	(0.022)
Western Europe, North America, APAC developed	-0.043	-0.043	-0.043	0.019	0.020	0.019
	(0.043)	(0.043)	(0.043)	(0.024)	(0.024)	(0.024)
Western Europe, North America, APAC emerging, APAC developed	0.005	0.005	0.004	0.010	0.004	0.002
	(0.048)	(0.048)	(0.048)	(0.031)	(0.031)	(0.032)
Western Europe, North America, APAC emerging, Eastern Europe	-0.009	-0.010	-0.011	-0.004	0.003	0.000
	(0.043)	(0.043)	(0.043)	(0.023)	(0.023)	(0.023)
Western Europe, North America, APAC emerging, Eastern Europe, APAC developed	0.025	0.025	0.023	0.090**	0.091**	0.084*
	(0.046)	(0.046)	(0.046)	(0.043)	(0.043)	(0.044)
Western Europe, North America, APAC emerging, Eastern Europe, LATAM, APAC developed	-0.026	-0.026	-0.029	0.031	0.035	0.027
	(0.043)	(0.043)	(0.043)	(0.026)	(0.026)	(0.026)
Western Europe, North America, APAC emerging, LATAM	0.002	0.002	0.002	0.007	0.000	-0.002
	(0.045)	(0.046)	(0.046)	(0.040)	(0.040)	(0.040)
Western Europe, North America, APAC emerging, LATAM, APAC developed	-0.044	-0.044	-0.048	0.037	0.038	0.028
	(0.045)	(0.045)	(0.045)	(0.034)	(0.034)	(0.035)
Western Europe, North America, APAC emerging, MEA	-0.003	-0.002	-0.003	0.049	0.033	0.031
	(0.056)	(0.056)	(0.056)	(0.042)	(0.044)	(0.042)
Western Europe, North America, Eastern Europe	-0.010	-0.010	-0.011	0.035	0.034	0.030
	(0.042)	(0.042)	(0.042)	(0.023)	(0.023)	(0.023)
Western Europe, North America, Eastern Europe, APAC developed	-0.026	-0.026	-0.026	0.031	0.035	0.033
	(0.043)	(0.043)	(0.044)	(0.028)	(0.027)	(0.027)
Western Europe, North America, Eastern Europe, LATAM, APAC developed	0.011	0.010	0.007	0.026	0.035	0.026
	(0.046)	(0.046)	(0.046)	(0.027)	(0.027)	(0.028)
Western Europe, North America, Eastern Europe, MEA	0.024	0.024	0.026	0.023	0.024	0.030
	(0.045)	(0.045)	(0.045)	(0.025)	(0.026)	(0.027)
Western Europe, North America,	0.016	0.016	0.017	0.016	0.018	0.020

LATAM		(0.046)	(0.046)	(0.046)		(0.024)	(0.025)	(0.025)
Western Europe, North America, LATAM, APAC developed		-0.039 (0.043)	-0.039 (0.043)	-0.040 (0.043)		0.027 (0.028)	0.024 (0.028)	0.019 (0.028)
Western Europe, North America, MEA		-0.034 (0.044)	-0.033 (0.044)	-0.030 (0.044)		0.060* (0.032)	0.062* (0.033)	0.070** (0.033)
Western Europe, North America, APAC emerging, Eastern Europe, LATAM, MEA, APAC developed		0.000 (0.042)	0.000 (0.042)	0.000 (0.042)		0.032 (0.021)	0.033 (0.021)	0.032 (0.022)
Control Variables								
Risk-free rate (%)			-0.147 (0.420)	0.400 (0.628)			0.297 (0.468)	1.806** (0.747)
US GDP Growth (%)			0.012 (0.124)	0.082 (0.136)			-0.442*** (0.146)	-0.249 (0.165)
PE dry powder (%)				-0.022 (0.017)				-0.061*** (0.022)
Constant	-19.101*** (1.183)	-20.386*** (1.465)	-19.484*** (3.223)	-22.191*** (3.990)	9.707*** (1.152)	8.549*** (1.556)	7.519** (3.146)	0.061 (4.311)
Observations	1,645	1,645	1,645	1,645	1,645	1,645	1,645	1,645
R-Squared	0.385	0.545	0.545	0.545	0.554	0.617	0.621	0.623
Akaike Inf. Crit.	-4,595.802	-4,759.660	-4,755.866	-4,751.819	-4,240.811	-4,171.149	-4,178.437	-4,186.915

Data: Bloomberg. 18.04.2022

Notes: Significance is reflected by '*', *p < 0.10, **p < 0.05, and *** p < 0.01; Abbreviations have been used for the names of the variables: Tech = Technology, Comms = Communications, HC = Health Care, RE = Real Estate, Fin = Financials, E&U = Energy & Utilities; Values in brackets represent the standard error of the respective variable

Figure C1: Development of PE performance, measured by *Calc IRR*, over the sample period (2003 – 2013) – Values based on estimated cash-flows of the respective funds