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Master Thesis

Thesis Master of Science

The Performance of Private Equity Funds - An empirical study on the performance of private equity funds with European managers, private equity firm expertise, and the impact of macroeconomic crises

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Start: 15.01.2021 09.00

Finish: 01.07.2021 12.00

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An empirical study on the performance of private equity funds with European managers, private equity firm expertise, and the impact of macroeconomic crises

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by

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Submission Date: July 1, 2021

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Study Programme:

Master of Science in Business with Major in Finance

Acknowledgments

Our sincere gratitude goes to Janis Berzins, our supervisor, for his consistent support, feedback, and inspiration during this year. Without his encouragement and valuable advice, the completion of this thesis would not have been possible. We also want to thank Kim Wahl for sharing his insights on the field of Private Equity. Lastly, our friends and family deserve great thanks for their thoughtful counsel, patience, and kindhearted encouragement. Our graduating year at BI was challenged by the Coronavirus pandemic, and without the support of friends and family we would not have been able to complete this thesis.

Abstract

This thesis studies the absolute and relative performance of European private equity funds, using a data set of 417 buyout funds raised between 1999 and 2016. The average European private equity fund provides annual returns of near 18% (net of fees and carry) and outperforms public markets by a minimum of 12% over the life of the fund. Performance patterns are cyclical, yet relative performance less cyclically sensitive than absolute performance. Human capital encourages value-creation in private equity, as factors proxied for expertise by private equity firms drive performance. These results indicate that the average European private equity fund delivers premium returns over time. We acknowledge that sample selection bias and zombie funds can influence our results but conclude that such issues are improbable to do so.

Key words: private equity funds, performance, public markets, cyclicality, leveraged buyout, PME, IRR, global financial crisis, oil price crash

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List of abbreviations

Assets under management	AUM
Billion	bn
Conservative minus aggressive	CMA
Distribution to paid-in ratio	DPI
Environmental, social and governance	ESG
Fund manager	FM
General partner	GP
Global financial crisis	GFC
High minus low	HML
Internal rate of return	IRR
Kaplan and Schoar	KS
Lagrange multiplier	LM
Leveraged buyout	LBO
Limited partner	LP
Net asset value	NAV
Net present value	NPV
Ordinary least squares	OLS
Private equity	PE
Profitability index	PI
Public market equivalent	PME
Remaining value to paid-in ratio	RVPI
Robust minus weak	RMW
Small minus big	SMB
Standard and Poor's 500	S&P 500
The center for research in security pricing	CRSP
Total value to paid-in ratio	TVPI
Venture capital	VC

1. Introduction and motivation

The Private Equity (PE) industry´s rapid expansion makes it a dominant asset class in the financial market. Jensen (1989) describes this as a noticeable organizational change of economics. Global PE assets under management (AUM) will likely account in excess of $5.8 trillion by 2025 (Henry et al., 2020). PE is defined as risk capital offered separate from public markets, in which private contrasts with the publicly quoted markets (Gilligan and Wright, 2020). It is principally divided between venture capital (VC) and leveraged buyout (LBO) investments. Limited partnerships with PE firms as fund general partners (GPs) and limited partners (LPs) as outside investors is the set up. We focus on the buyout segment of PE, wherein an LBO, PE firms acquire a company using a small share of equity and a large share of debt financing (Kaplan & Strömberg, 2009). Worldwide domination of LBOs has grown after its appearance in the 1980s. The first European PE firms emerged in line with the high-technology boom throughout the 1990s and is now an essential investor group of the European region (Kaserer & Diller, 2004).

Previous research argues an inherent commitment risk of PE investing following illiquidity and high levels of debt. Due to this, as well as GPs skills and expertise, PE fund performance averages undamaged by macroeconomic crises. Existing literature mentions how independently of external market conditions, average PE buyout funds clearly outclasses public markets over the previous decades. Despite an increasing availability of research on PE investments, historical performance of PE funds still cause dispute. Essentially, PE is private, indicating information and data historically is withheld by different actors of the PE industry. With legislative changes, access to reliable quality data is presently available.

This thesis builds on and contributes to existing literature by assessing PE fund performance of 417 European buyout funds with vintage years from 1999 to 2016[1]. We use high-quality cash flow data sourced by Preqin database. Research focuses on buyout funds raised by European-located fund managers (hereinafter referred to as European PE funds) in specific, whereas the geographic investment focus of each individual fund can be global. We focus on Europe due to limited previous research on the European PE segment, as the American PE market is generally investigated.

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[1] See Attachment 1 for Python-code used throughout this thesis.

Thus, with a twofold objective and methodology, this research investigates the absolute and relative performance of European PE funds during the period of interest. First, we investigate absolute performance based on the net investment multiple (TVPI) and net internal rate of return (IRR)[2]. Second, in the same framework we investigate the performance of PE funds relative to public markets, in which we apply the public market equivalent (PME) method to examine whether PE outperforms public equity. Within the relative investigation, we provide an extensive comparison of private and public equity performance, in which three distinctive public benchmarks are included, explicitly the S&P 500, the Russell 2000, and the MSCI Europe Standard. We also examine how macroeconomic crises affect performance, focusing on the 2008 global financial crisis (GFC). In addition, we evaluate the effects of the 2014 oil price crash to examine the different outcomes of the two respective crises. Moreover, we assess the difference between top- and bottom-quartile ranked funds in terms of fund performance, as well as the impact of expertise provided by PE firms. The variables examined in this thesis are generally managed by the GPs, and thus proxies for expertise within the PE fund segment. The following factors are used as proxies for expertise: fund size, fund number, industrial diversification, and geographic focus.

The motivation behind this study relates to present conclusions of relevant research, and an intrinsic curiosity and interest in the topic of PE. In addition, the desire to explore the European PE sector is greatly enhanced after interviewing one of the "founders" of the Scandinavian PE segment, Kim Wahl, who has unrivaled insights and experience on the topic[3]. The current climate of the PE sector is intricate. On the one hand, PE is perceived with enthusiasm and opportunism due to the recent positive performance of the industry. On the other hand, PE is influenced by geopolitical uncertainty, climate change, and shifting expectations. The recent pandemic is an example of such uncertainty, but this crisis is deemed too recent to explore in this study. Considering the devastating effects of the current Coronavirus pandemic, as well as the aftermaths of the 2008 GFC and the 2014 oil price crash, we find it vital to discover how PE funds perform given different macroeconomic conditions, and whether strategic choices of GPs contribute to greater performance. The reason to examine these two crises in specific is to determine whether an

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[2] For the remainder of this paper, TVPI and IRR refers to net TVPI and net IRR, respectively.
[3] The summary of this interview can be found in Appendix G

industry-specific crisis, as the oil price crash, differs from a global financial crisis in how it affects fund performance.

Despite the extensive growth observed within the PE industry over the latest years, the major results of this thesis mirror those of previous research. In brief, the funds of our sample, regardless of benchmark, significantly outperform public markets for almost all vintage years from 1999 to 2016, with an average outperformance ranging from 12% to 43%. We find cyclical performance patterns for both absolute and relative performance over time, in which funds raised in 2007, on average, slightly underperform. These results suggest that European PE fund performance was affected by the outcomes of the 2008 GFC. We show that 1st quartile ranked funds perform considerably better than 2nd, 3rd, and 4th ranked funds, as is expected, both in absolute measures and relative to public markets. Regression results show that the strategic choices of GPs influence PE fund performance, as fund number, a European geographical focus, and industrial diversification, are drivers of performance. Moreover, the TVPI (by construction) and capital called significantly predict performance in terms of IRR, and crisis times[4] significantly affect PE fund performance adversely. In addition, TVPI, IRR (by construction), and capital called have a significant relation with PE fund outperformance, as measured by the PME. We investigate whether selection bias or zombie funds influence the results of this study and conclude that such issues are improbable to do so. Lastly, we undertake the Fama French five-factor asset pricing model to examine the systematic market risk of European PE funds, and, with the limitations of our data set, find that neither of the five factors significantly influence the returns of the average fund of our sample.

We build on the methodologies of Kaplan and Schoar (2005), Harris et al. (2014), and Robinson and Sensoy (2015), who all study absolute and relative PE fund performance applying IRR, TVPI, and PME valuation methods. Our approach adds value to these papers by differing in various aspects. In specific, an investigation of absolute and relative European PE fund performance, with a particular attention to the performance-effects of both macroeconomic crises and GP expertise, is different from what exists. In contrast to present research on the European PE

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[4] Crisis times are in this context proxied by the years 2006-2008, i.e., the build-up to the GFC.

market, we recognize the importance of GP expertise, as the relative performance-effect of macroeconomic crises is less than the absolute performance-effect. Therefore, this thesis contributes to existing research by examining a concept not previously explored in the European region. Moreover, we intend to provide PE corporations with valuable information regarding how to adapt to uncertain times through specific strategic decisions. This study continues with a review of relevant literature, a representation of the theory and methodology, and a description of data and preliminary results. Lastly, the main results and analysis are presented, before the paper ends with a discussion of limitations and recommendations, and a conclusion.

2. Literature review and theory

Jensen (1989) outlines the conflict between managers and owners regarding the control and practice of corporate resources as a major weakness of the public corporation. In contrast to his doubts about the public corporation, he esteems the economic benefits following LBO organizations, which today are known as PE backed buyouts. Considering Jensen´s theory and work, this research examines key activity observed in the European PE buyout segment from 1999 onwards. To properly examine this, it is crucial to explore relevant and prominent theories within the entire concept of PE. Thus, by investigating theories and research from previous and relevant literature, the following section presents major concepts of the research question at hand. First, we provide a theoretical discussion of PE and buyout funds. Further, we present and describe the main drivers of PE fund performance, as well as the impact of expertise on PE fund performance. Thereafter, we discuss PE performance in times of financial distress, before the section concludes by contemplating key findings, methodological appropriateness, and the existence of a knowledge gap in the literature available.

2.1 Private equity and buyouts

As mentioned above, Jensen (1989) esteems the organizational and economic benefits of LBO organizations. In fact, he early forecasted these organizations to become the leading commercial organizational arrangement. The logic behind his optimism and proposition is linked to his observations of typical public corporations, with low leverage, inefficient capital allocation, and unstable

corporate governance with agency conflicts. Hence, he forecasted how new organizational forms could resolve these major limitations of public corporations using high leverage, more efficient capital allocation, better employee productivity, and the creation of shareholder value.

Despite Jensen's predictions and the following rise of the PE market in the 1980s, the LBO market activity was relatively low during the 1990s and early 2000s. LBO activity remained low until mid-2000s, before a second boom occurred. In line with an increasing focus on the PE industry, Kaplan and Strömberg (2009) examine important concepts regarding LBOs and PE. The authors define a PE firm as a leveraged buyout investment firm. The PE firm raises equity capital within a PE fund, and in a leveraged buyout the PE firm creates a new entity by acquiring an existing or mature company using a small share of equity and large share of debt financing. The authors refer to a buyout as a PE transaction, in which, in contrast to venture capital firms, the PE firm normally obtains principal control over the firm acquired.

They explain that the term *leveraged buyout* stems from the fact that a buyout is normally financed through 60-90% debt. This portion of debt is typically divided between senior and secure debt settled by an investment bank or bank, and an unsecured percentage of junior debt backed by high-yield bonds or debt that is subordinated to the senior debt (mezzanine debt). However, the remaining percentage of capital needed for the buyout to be completed is normally obtained by pooling money from PE investors and a management team (Siegel et al., 2011). Hence, the PE firm operates as the GP, while the institutional investors and prosperous individuals who provide the largest percentage of capital are known as the LPs (Kaplan & Schoar, 2005). Meuleman et al. (2009) explains that PE firms obtain principal control as they become active investors through taking board seats and deciding on prescribed boundaries related to for instance the acts of management and reporting requirements.

In line with this theory, Cendrowski et al. (2012) outline that when looking for potential buyout objects, GPs are interested in companies with convincing and established cash flow statements, low debt-to-equity ratios when compared to similar companies, and a well-established management team. The typical fund has a fixed life of about ten years but is often prolonged for up to three additional years.

The five first years are usually set as a boundary for investment of the capital committed, while the remaining five to eight years are set to return the capital to its respective investors (Kaplan & Strömberg, 2009). Metrick and Yasuda (2010) explains that prosperous PE firms continue running by establishing a new fund every three to five years.

2.2 Private equity fund performance

The drivers of PE performance have been extensively researched throughout the years. Most studies focus on aggregate trends observed within the PE industry, or on PE deal-level performance and value-creation models within this perception. However, in line with better access to information and data on PE funds during the last 20 years, major contributions have enriched the literature on PE fund level performance and returns. PE fund performance is in absolute terms normally measured by fund IRR and investment multiples (TVPI, capital called, DPI, RVPI), and in relative terms measured by PME methods[5]. We now discuss the results and arguments of previous literature on these subjects to evaluate their relevance to our research, including both necessary connections and observed differences.

Based on a sample of 746 US PE funds obtained from Venture Economics, Kaplan and Schoar (2005) suggest that LBO fund returns approximately equals the returns of the S&P 500, with an average PME of 0.97. The main results obtained by the authors is based on IRR, TVPI, DPI, and PME analyzes, with an average IRR of about 19%. Likewise, based on a sample from Thomson Venture Economics, Phalippou and Gottschalg (2009) conclude that PE funds perform poorer than the S&P 500, by 3% annually. These PME results are not in line with the results of our study. However, the findings are highly relevant, as we use the same performance metrics.

Using a Burgiss data set, Harris et al. (2014) study the performance of 1400 US-located LBO and VC funds. The authors investigate absolute and relative PE fund performance by applying IRR and investment multiples, and Kaplan and Schoar's PME, respectively. In contrast to the results obtained by Kaplan and Schoar (2005) and Phalippou and Gottschalg (2009), the authors find that PE buyout funds

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[5] See section 4.5.1 and 5.2 for extended definitions of TVPI and capital called, respectively. See Appendix A for extended definitions of DPI and RVPI. See section 4.5.2 for extended definition of the PME.

outperform the S&P 500 by an average of 20% to 27% over the life of a fund. In support of this result, the authors find evidence to claim that this outperformance is persistent regardless of benchmark comparison. This extraordinary performance does not only include the top quartile funds, but also the median and average funds. Also, the results outline that both absolute and relative performance are negatively related to cumulative capital commitments. This finding is consistent with results obtained by Kaplan and Strömberg (2009). Based on these findings, it is to be expected that also European PE funds persistently outperform public markets, despite benchmark comparison and quartile rank.

Robinson and Sensoy (2015) study the liquidity properties of PE cash flows using a data set of 837 LBO and VC funds. Consistent with the results of Harris et al. (2014), the authors find that due to the liquidity premium arising from calling capital in hard times, PE funds with a high propensity to do so perform better in both relative and absolute terms. In the paper, funding liquidity is described as the typical contractual agreement between LPs and GPs in a PE setting. In similarity with both Kaplan and Schoar (2005) and Harris et al. (2014), PE fund performance is also estimated by using the PME method. In dissimilarity with the results of Kaplan and Schoar (2005), but in line with the results of Harris et al. (2014), a PE fund outperformance of 18% above the S&P 500 is reported. Moreover, cross-sectional statistics on IRR and TVPI show that PE funds perform better both in absolute and relative terms. These results are also consistent with US findings obtained by Higson and Stucke (2012), which with the use of a data set of 1169 US buyout funds conclude that buyout funds have significantly outperformed the S&P 500 for nearly all vintage years since 1980. Likewise, results presented by Phalippou (2014) show that the average buyout fund outperforms the S&P 500 by approximately 5.7% per year. In similarity with our research and the papers discussed above, the results of the two last-mentioned studies are also based on PME estimations.

As the information and data from the PE sector are generally secretive, both currently and historically, some literature suggests that PE analyses and evaluations might be biased. Phalippou and Gottschalg (2009) imply that the performance of PE funds is overstated, as a large part of said performance is driven by inflated accounting valuations of ongoing investments. The authors find that funds that have reached their "normal" liquidation age still report considerable accounting

valuations for current investments, which overstates the average fund performance by 7% in terms of the profitability index (PI). Furthermore, the authors find that standard aggregation choices result in a 2% upward bias in terms of the PI. These findings are important for our analysis.

2.3 The impact of expertise on private equity performance

Even though investment multiples, IRR, and the PME allow for comprehensive analysis of PE fund performance, an important aspect of this research is to also investigate the impacts of human expertise on PE fund performance. The following section seeks to identify residual factors related to operational expertise within PE houses. The methodologies applied in most of the following papers differ from that of ours, as they are solely developed to examine diversification and special skill characteristics of PE houses or partners. Yet, to capture the impact of expertise on PE performance in our analysis, several components of the following research papers are included in our methodological setup. Such components comprise the effects of industrial diversification, geographic focus, fund number, and fund size.

Kaplan and Strömberg (2009) state that, on average, LBOs by PE firms create economic value. The authors argue that PE firms create changes in the firms they invest in by applying financial, governance, and operational engineering. This relates to the fact that PE managers have "skin in the game", in which illiquid equity reduces the motivations of management to bias short-term performance, and leverage creates pressure on managers to perform well, as principal and interest payments must be paid. Moreover, PE investors are actively involved in governance, and industrial and operating expertise is often applied to add value to PE investments. Jordaan (2018) and Harris et al. (2015) refer to the illiquidity of PE investments as the inherent commitment risk existing in private equity investments, as there is no distinction between committed and invested capital for the LPs. This theory is highly relevant to our line of research, as, in comparison to public markets, the expertise of the management teams should have a considerable impact on the performance of PE funds.

Uing a data set of 395 PE buyout deals, Acharya et al. (2013) present indications to state that LBOs create value by drastically enhancing the performance of the acquired firms, and by disposing capital via high debt payments. The authors investigate how much of the excess returns generated by PE firms come from

financial leverage, and how much comes from pure financial improvements. To capture the impact of financial improvements, the authors include factors such as deal partner background and PE strategy in their regressions. The results of their analyses indicate that about 34% of average deal IRR comes from operational expertise added by PE houses. Although deal-level data are used in this study, the methodology and results are highly relevant for us, as the economic intuition behind their hypotheses is like that of ours.

UK evidence provided by Cressy et al. (2007), states that PE ownership creates substantial gains to the operating profitability of PE-backed buyouts during the first three years after the buyout takes place. Huss and Steger (2020) study the connection between PE fund performance and diversification. The authors find evidence to argue that diversification within, but not across, industries is associated with higher buyout fund performance. However, the results provided in the paper do not support a significant relation between PE fund performance and geographical diversification. Likewise, based on a sample of 1000 European PE buyouts from 2000-2006, Brigl et al. (2008) argue that neither industrial nor geographical diversification predict PE buyout fund performance in terms of PE fund IRR. Consistent with these results, Ljungqvist and Richardson (2003) find no significant positive relation between diversification and fund performance. In contrast, a study conducted by Humphery-Jenner (2013) reports significant relations between both geographical and industrial diversification and PE fund performance. By using a sample of 1505 PE funds, the author argues that knowledge-sharing and learning are likely to increase PE fund performance. All these results provide strong support for the abnormal returns acquired by PE funds, and we expect GP expertise and skills to have a meaningful relation with the performance of PE funds.

In the same way as Brigl et al. (2008) and Ljungqvist and Richardson (2003), Aigner et al. (2008) find no significant relations between industrial or geographical diversification with either PME or IRR. However, based on their sample of 358 PE funds, they find a positive relation between GP experience and fund performance, a positive relation between fund length and fund performance, a negative relation between fund size and fund performance, and a positive relation between the number of deals within a fund and fund performance, in terms of PME. Lopez-de-Silanes et al. (2015) find no significant relation between fund size and fund

performance in terms of PME. In difference, Jordaan (2018) finds a positive relation between fund size and fund performance.

Braun et al. (2017) analyze the performance persistence of PE buyout fund managers. The authors find a positive relation between returns on current and previous deals from the same GP. Likewise, Gianfrate and Loewenthal (2015) find a positive connection between experience and PE fund performance. The authors moreover present how average PME values above 1.00 are driven by many years of extraordinary returns. Similarly, Kaplan and Schoar (2005) show that both GP experience and fund size are positively related to fund performance. Using a data set of 777 European PE funds provided by Thomson Venture Economics, Diller and Kaserer (2009) find statistically significant evidence of persistent fund returns. Based on the evidence presented in the two latter paragraphs, we expect that fund performance is driven by GP skills and strategic decisions related to diversification.

2.4 Financial distress and private equity fund performance

In times of financial distress and economic crises, many businesses fear and experience extensive challenges. Correspondingly, the outbreak of the 2008 GFC resulted in a dramatic fall in deal value across the world, in which debt markets froze, and private equity firms had to change strategies to save highly leveraged and struggling portfolio companies (Siegel et al., 2011). Harris et al. (2014) show that PE-backed buyout funds that started investing in the years before the 2008 GFC, on average, have lower IRR values, and TVPIs near one. Also, according to a study by Fazekas and Becsky-Nagy (2015), US buyout funds lost 25% of their value in 2008 because of the GFC outbreak. Despite this, the authors state that, on average, buyout funds outperformed the public market portfolio substantially in the period from 2000-2010. We partly confirm these results, as the funds of our sample with vintage years 2006 and 2007, on average, have lower IRR values, but not significantly lower average TVPIs, nor substantial value losses in terms of fund size figures.

Evidence from the UK provided by Wilson et al. (2012) argues that in contrast to comparable companies, PE-backed buyouts managed not only to survive the 2008 GFC, but to realize excellent performance in the period before and throughout the recession. The methodology and data applied in this research differ from that of ours. Despite this, the results obtained are important and relevant for our study. In essence, the results show that PE-backed buyouts obtained higher growth,

productivity, profitability, and improved working capital management when compared to comparable firms. One major reason for this superior performance is, according to the authors, due to how PE firms strategically decide to invest in stable sectors with robust cash flows and in companies with good potential for functioning and production enhancement. Additionally, constant observing and well-timed interference done by PE investors to handle financial difficulties also support the upholding of stable and good performance by PE companies. Moreover, evidence presented in the research states that employment and revenue growth for PE-backed companies showed a positive trend during the sample period leading up to and during the 2008 GFC. Also, due to cost reduction strategies and control mechanisms, PE-backed buyouts are more likely to uphold margins, productivity, and value-added in times of distress, when compared to non-buyouts. Relatedly, Bernstein and Sheen (2016) state that by taking an active role in their portfolio companies by applying industry proficiency and knowledge, PE firms manage to improve management practices also during times of difficulty.

Bernstein et al. (2018) indicate that in comparison to their peers, PE-backed firms reduced investments less, experienced more equity and debt inflows, higher asset progression, and improved market share, during the 2008 GFC. Among several findings presented in this paper, the authors argue that by being robust and resilient against downturns, PE firms have a stabilizing role during recessions. According to the authors, one reason for this is due to the relation between PE firms and the banking industry, as banks may provide PE firms with access to capital during distressed periods. Another reason relates to the fact that PE firms raise funds that are invested over many years. Additionally, Siegel et al. (2011) argue that due to specialist governance skills of PE firms, financial distress is by these firms often perceived as an opportunity for value-creation rather than as a difficulty.

Using a Preqin fund-level data set with vintages from 2000-2007, Jordaan (2018) investigates the performance of 249 European and North American buyout funds during the GFC. In similarity with us, the author applies absolute performance measures such as the IRR and TVPI, and the relative PME performance metric. A mean IRR of 12% and a TVPI of 1.68 are reported. Moreover, a PME of 1.11 for North American buyout funds and 1.10 for European buyout funds is calculated, indicating consistent outperformance of public markets. Within the period between 2002 and 2007, the author observes a significant downward trend in PME.

Gianfrate and Loewenthal (2015) study the performance of PE funds during the 2008 GFC, using a Preqin data set of 358 PE funds. The authors measure absolute performance by the IRR, DPI, RVPI, and TVPI, and relative performance by applying the PME method. The results imply a substantial PE fund outperformance, a mean buyout fund IRR of 12%, and a TVPI of 1.56. Moreover, the authors find that due to the PE industry's low correlation with market swings, as well as its strict focus on operating growth, PE funds are proven to handle financial crises with success. However, they also discovered that bigger and more experienced funds performed better than average funds during the GFC. Based on the same database and performance metrics used in the two last mentioned studies, we confirm their results on both PME, IRR, and the TVPI.

2.5 Key findings

Based on the conclusions of the above-discussed literature, we recognize certain key findings relevant for our paper. Considering the absolute and relative performance results observed, broadly measured by the IRR and PME, respectively, we emphasize the following: Kaplan and Schoar (2005) find a mean IRR of approximately 19% and a mean PME of 0.97 over the sample years of their study. Harris et al. (2014) report figures of 14% and 1.22 for the mean IRR and mean PME, respectively. In like manner, Robinson and Sensoy (2015) show that over the years investigated in their study, the average PE fund provides a mean IRR of 9% and a mean PME of 1.19. These results indicate that, on average, PE funds deliver strong returns in terms of IRR, as well as performance in line with or above public markets, as indicated by the PME ratios observed. Regarding the effect of macroeconomic crises on PE fund performance, we recognize the results of Harris et al. (2014) and Jordaan (2018), both observing a negative performance trend for PE funds raised in the years prior to the GFC. Also, concerning the impact of expertise on the performance of PE funds, we find the conclusions of Gianfrate and Loewenthal (2015) and Humphery-Jenner (2013) as particularly relevant. The former paper states that experience is positively related to fund performance, and the latter shows that diversification across industries is associated with higher PE fund performance.

2.6 Methodological differences and similarities

The methodology of our research is mainly based on the methodologies of Kaplan and Schoar (2005), Harris et al. (2014), and Robinson and Sensoy (2015). By establishing a methodological framework based on these sources, accompanied by components from section 2.3, we can estimate PE fund performance (in normal and bad times) in both absolute and relative terms. The data sets used in these studies contrast from each other and that of ours, as the sources, sample years, and fund manager locations used are different. Kaplan and Schoar (2005) base their analyses on realized returns at the end of a fund's lifetime, in the same way as we do. They also apply the same performance measures as we do, but find slightly negative results for LBO outperformance, with an average PME of 0.97. Our methodology closely resembles that of Harris et al. (2014). Like us, they divide the methodology into two main sections, separating the analyses of absolute (IRR and TVPI) and relative (PME) performance. The methodical setting used by Robinson and Sensoy (2015) relates to our methodology as the IRR, TVPI, and PME are used to estimate PE fund performance. The focus of this research is, however, different from ours, as their principal purpose is to study the liquidity properties of PE cash flows.

2.7 Knowledge gap

Despite the broad range of information presented by previous research, there is still a knowledge gap between the presented literature and our research. This gap mainly relates to two areas of investigation. First, we identify a limited existence of research conducted on fund-level data on the European region, as most previous literature focus on the US market for PE. Due to restricted previous research, our results are not easily comparable to existing results from the same region, and any comparisons are therefore mainly done with the US market. Moreover, we find little previous evidence related to the strategic choices undertaken by European located GPs, and consequently whether there exist specific investment trends within the European PE segment. Second, we find scarce research considering the 2014 oil price crash, both in general and in the context of the European PE market. As a result, we have little prior information on how the European PE market was, and is, affected by this crisis. Therefore, as we aim to examine the absolute and relative performance of European PE funds, and how macroeconomic crises and GP expertise influence this performance, we expect our results to somehow differ from

existing research. We consider this knowledge gap by focusing on relevant factors and cyclicality in our analysis, in which we hope to provide results and evidence that contributes to a better understanding of the European PE sector.

3. Historical movements

This section provides an understanding of the underlying background and historical setting of the discussions, analyses, and results of this study. The European PE segment has been subject to record growth during the last two decades, with assets managed by PE firms being more than doubled from the time the 2008 GFC hit the worldwide economy. Thus, with an inductive purpose, this section highlights the main historical trends observed within the European PE market over the years of interest for this study.

Figure 1 displays the number and value of PE buyout deals undertaken in the European region during the period from 1999 to 2016. As predicted by the graph, the number and aggregate value of deals have fluctuated quite substantially during this period, which includes both the years of the 2008 GFC and the oil price crash in 2014.
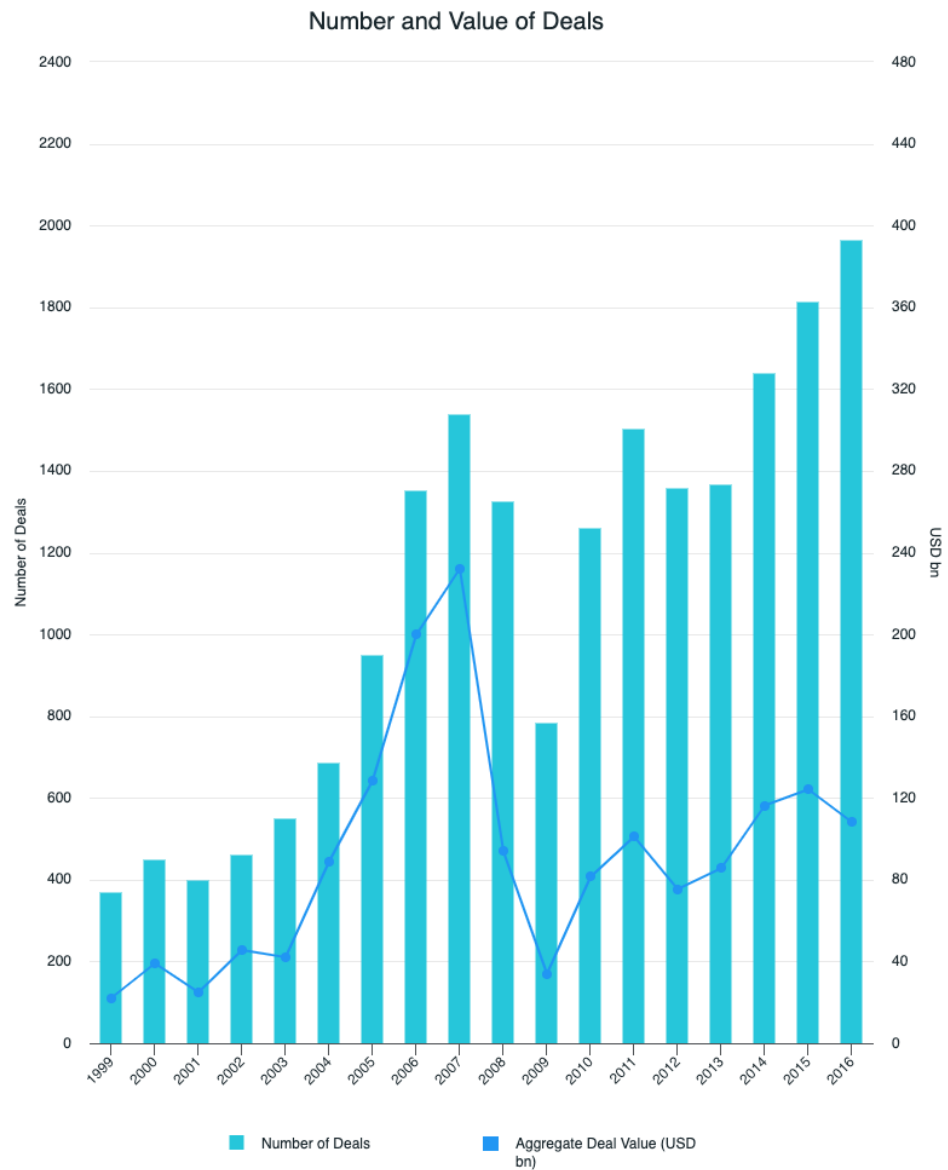
Number and Value of Deals

Figure 1: Number and value of European PE deals from 1999-2016

As the graph displays, there was a clear fall in both the number and value of buyout deals from 2007 to 2009 – during the outbreak of the GFC. This behavior clearly shows how the downturn relocated traditional rules and expectations of the PE industry. The trend observed during these years are not surprising, and the reasons behind it are many. First, the world experienced a major absence of existing bank financing in 2008-2009, causing huge bank covenant concerns for PE firms. Second, due to the insecurity observed in the market at the time of this crisis, PE firms became almost impossible to value correctly (Pwc, 2010). However, the GFC resulted in a colossal downturn throughout the entire economy of the world, including all markets and industries within it. Notwithstanding this enormous crash,

the graph evidently illustrates how the PE industry managed to quickly recover from 2009 to 2010.

Despite the worsening macroeconomic conditions experienced by the markets in line with the dramatic decline in the global oil prices in 2014, the graph shows an overall strong deal activity in the period from 2014 to 2016. According to Pwc (2015), there are several reasons for this trend. One reason is that PE firms were more willing to pay premia during 2014 than they had been before. Another major reason is that PE firms in 2014 had a large amount of dry powder available for allocation. Also, the pattern observed in this period indicates that PE firms had learned from the great recession in the sense of being prepared and ready to respond to a downturn. Evidence outlined in a Pwc (2016) report states that, as a response to the 2008 GFC, PE firms started to analyze all aspects of an investment case more critically before deciding on any deals.

One could argue that the diverse macroeconomic conditions experienced during the two crises differently affects the number and value of buyout deals. The 2008 GFC was a global banking crisis; hence all markets and industries, including the PE industry, were affected by the downturn at the same time. The combination of the PE sector being an already illiquid asset class, combined with arguably overvalued deals across the sector, resulted in a substantial decrease in both the number and the value of deals in 2008 and 2009. Likewise, the oil price crash of 2014 hit parts of the public market substantially, however, it can be argued that this crisis was more industry-specific and did not bring along the liquidity problems previously seen during the GFC, at least not to the same extent. As a result, the PE sector experienced a period of growth from 2014 to 2016, with an increasing number of deals each year, while the aggregate deal value remained roughly the same. These results could imply that the sector had gained valuable knowledge from the previous crisis, as the aggregate deal value did not grow in an unproportionate manner compared to the number of deals completed.

4. Methodology

The methodology of this study originates from that of Kaplan and Schoar (2005), Harris et al. (2014), and Robinson and Sensoy (2015). These studies apply the main metrics of our analysis: the Kaplan Schoar PME (KS-PME) metric, first introduced

in the 2005 paper conducted by Kaplan and Schoar, as well as the IRR and the TVPI. Today, most PE fund performance is reported in terms of IRR and TVPI by both funds and investors, indicating a rising significance and comprehension of these metrics. The following section presents the methodology of this study, including explanations of the abovementioned metrics and the relevant theories related to the hypotheses to be formally tested. For the empirical estimation, we apply ordinary least squares (OLS) regressions as the estimation procedure for the econometric models. This estimation creates a line of best fit that minimizes the sum of squared residuals (Wooldridge, 2014).

4.1 Economic arguments

To get a true grasp on how value-creation and performance are measured in PE funds, it is crucial to look beyond accounting and pure quantitative dimensions, to get an understanding of the underlying economic reality of the industry. We identify three main sources of value creation in PE, namely the return on a public market comparable (measured by the PME), the impact of leverage, and a residual. The former addresses whether an investor did better from investing in PE than in the stock market, and this is thoroughly described in section 4.5.2. The latter comprises a variety of factors related to value-creation raising from GP expertise. The different variables of expertise are outlined in section 5.2. However, the effects of illiquidity and leverage on PE investments are also essential underlying factors of PE fund performance. Due to the lack of available data on specific debt levels of each fund, as well as the difficulty of measuring an exact impact of illiquidity, the economic intuitions behind these two factors are outlined below.

Illiquidity

In comparison to quoted equities, PE investments are illiquid, as investors agree to lock their cash up for up to 10 years (KPMG, 2016). Due to this illiquidity, investors typically require a premium relative to public market investing (Harris et al., 2014). This illiquid equity means that the management cannot easily sell off equity, such that their incentives to influence short-term performance are not very present within the framework of the PE industry (Kaplan & Strömberg, 2009). This inexact timing of capital calls and distributions explains why the illiquidity of PE investments is referred to as the commitment risk of the LPs, which is not present in public markets (Harris et al., 2015). In relation to the economics of PE, one can argue that the

commitment risk of investing in PE functions as an underlying factor of solid performance, indicating that PE managers have "skin in the game", and high-power incentives to perform as well as possible. Moreover, the reputational effect of PE investments is big, meaning that due to the finite life of PE funds, GPs are depending on a good reputation to attract new investors and raise new funds.

Leverage

The impact of leverage is also a source of value-creation in PE. In terms of PE, Kaplan and Strömberg (2009) define leverage as the borrowing done to undertake a PE transaction. Jensen (1989) underscores that the intensive use of debt in an LBO leads to efficiency, value creation, and powerful ownership incentives. Similarly, with high leverage follows a pressure on PE managers to perform, as principal and interest payments are due in the future (Wilson et al., 2012). In like manner, there is no cross-subsidization between the portfolio firms of a PE fund. Therefore, GPs cannot, in general, use profits from one successful deal to drive profits in another deal within the same fund. Thus, we expect this, as well as the high levels of debt, to have a disciplining effect on fund managers, which forces efficiency and strong monetary incentives.

The data used in this research do not include specific information regarding the amount of debt acquired by each fund of the samples. However, Axelson et al. (2013) show an average buyout fund investment leverage of 69%. Thus, even though we are not able to capture the factual impact of leverage on the performance of each of the funds included in this study, we are highly aware of the economic importance of leverage in PE fund performance. Accordingly, by treating debt as given, we aim to capture the effects of illiquidity and leverage on PE performance by the expertise of GPs to undertake specific strategic choices.

4.2 Hypotheses and research question

The methodological design of this thesis is divided into the two streams of investigation: A and B, including different hypotheses to be tested in each section. The hypotheses listed below aim to clarify the overall research question *"Which factors drive the absolute and relative performance of European private equity funds, and is performance affected by macroeconomic crises?"*

4.2.1 Section A - absolute performance

Backed by extensive previous research on the topic, we believe that expertise of GPs drives PE fund performance. With expertise, we refer to the strategic choices undertaken by the GPs. Aigner et al. (2008) argue that experienced and skilled GPs tend to persistently have the capacity to raise new funds and continually outperform their peers. Thus, GPs that have such extraordinary skills should, on average, remain in the market and achieve abnormal returns. Also, in line with evidence outlined by Kaplan and Schoar (2005), we believe that larger PE funds can benefit from economies of scale and the larger amount of capital under management, in terms of higher returns, and thus stronger PE fund performance as measured by IRR. In line with this, we predict to observe a positive relation between both fund number and fund size with PE fund performance:

Hypothesis A1: Higher PE fund numbers have a positive relation with PE fund performance

Hypothesis A2: PE fund size has a positive relation with PE fund performance

Kim Wahl (Appendix G) describes active ownership as a cornerstone underlying successful PE fund performance. Within this, he emphasizes diversification across industries as particularly important. Moreover, he perceives a narrow geographic focus to be less profitable, arguing that GPs should look for opportunities regardless of location. Along these lines and as part of the specific strategic choices undertaken by GPs, we expect industrial diversification and a European geographic focus to increase PE fund performance. We perceive these factors as means of knowledge and expertise sharing across a variety of industries and within certain geographies (Humphery-Jenner, 2013). We presume a European investment focus to be beneficial based on elements that characterize European markets in specific, including the deep-rooted fragmentation, the high number of founder and family-owned companies, and the arguably superior quality of goods and services produced in Europe (Damming & Pollock, 2020). Also, we believe European fund managers have advantageous skills and expertise in the European region. Thus, the following are hypothesized:

Hypothesis A3: PE Funds that are industrially diversified perform better than PE funds that are not

Hypothesis A4: PE Funds that are European focused perform better than PE funds that are not

Following research by Harris et al. (2014) and Fazekas and Becsky-Nagy (2015), we believe that the massive effects of the GFC influenced the performance of PE funds raised between 2006 and 2008. The economic reasoning behind this hypothesis relates to the combination of the PE sector being an illiquid asset class, combined with arguably overvalued deals across the sector, which resulted in a substantial overall decrease in both the number and the value of worldwide PE deals between 2006 and 2008. Thus, using this period as a proxy for times of crisis, we believe that PE funds raised in normal times provide stronger performance than funds raised within 2006-2008. Thus:

Hypothesis A5: PE funds with vintages 2006-2008 perform poorer than PE funds raised outside this time range

4.2.2 Section B - relative performance

Previous studies using the PME (Harris et al., 2014; Robinson & Sensoy, 2015; Gianfrate & Loewenthal, 2015) find that PE funds consistently outperform public markets. We aim to investigate whether this holds for the funds of our sample. Following the expectations outlined for the hypotheses constructed for Section A, we expect skills, expertise, and subsequent strategic choices of GPs to substantially influence the performance of PE funds in relative to public markets. The economic intuition behind these expectations is that to a greater extent than present in public market investing, PE managers directly add value to funds by applying special skills and expertise, and by taking advanced strategic decisions. GPs can take advantage of their knowledge in certain areas related to for instance diversification and geographic focus to generate value. Thus, we expect the following:

Hypothesis B1: A European focus has a positive relation with fund performance as measured by the PME

Hypothesis B2: Industrial diversification has a positive relation with fund performance as measured by the PME

In line with evidence presented by Harris et al. (2015) and Wilson et al. (2012), we believe that the inherent commitment risk of GPs rising from illiquidity and leverage serves as a driver of PE fund outperformance of public markets, as these underlying drivers of performance are not likewise present in public equity investments. In relation to this theory, we believe that PE funds with higher IRRs and TVPIs are more likely to substantially outperform public markets, as these measures are mechanically linked to PME. The economic reasoning for including IRR and TVPI in PME regression is to find out whether absolute performance measures also affect PE fund outperformance. Therefore, the following hypothesis is constructed:

Hypothesis B3: Higher PE fund IRR and TVPI have positive relations with fund performance as measured by the PME

As the findings presented by Kaplan and Schoar (2005) suggests, the experience of GPs is another factor that drives PE fund outperformance of public markets. The economic perception of this relates to the presence and concentration of knowledge within the PE industry, which is not likewise distributed within public markets (Diller & Kaserer, 2009). Also, Kim Wahl (see Appendix G) describes the active ownership present in PE as a value-driver that is not similarly existent in public equities. Therefore, as we perceive fund number and fund size as indicators of expertise and experience, we present the following hypotheses:

Hypothesis B4: Higher PE fund numbers have a positive relation with PE fund performance as measured by the PME

Hypothesis B5: PE fund size has a positive relation with PE fund performance as measured by the PME

4.3 Descriptive statistics

Table 1 reports descriptive statistics for the total sample of European PE funds between 1999 and 2016, in which all complete data available from Preqin are collected for this study.

Table 1: Descriptive statistics of total data sample

The table shows descriptive statistics for the total sample comprising 417 European PE funds. The figures here presented are estimated using data provided by Preqin, only including funds with complete data records, thus excluding funds with missing information. The performance analysis conducted in this paper is based on realized results for liquidated funds and estimated values of all unrealized results for closed but still not liquidated funds. The *IRR* is a money-weighted return expressed in percentage terms, which by Preqin is calculated net of fees and carry. The *TVPI* expresses how many times investors are likely to receive, or have received, their money back and make a profit from an investment, expressed as a multiple. *Fund size* is the amount of capital under management, measured in USD millions. *Fund number* is the ordered sequence number of a fund. The *Quartile Rank* of a fund is by Preqin calculated using both net IRR and TVPI, where the most consistent top performing funds are assigned to the 1st rank. The *DPI* is the actual returns received by a fund investor, expressed in percentage terms. The *RVPI* is a measure representing the sum at which an asset can be sold or acquired in a transaction between agreeable parties, expressed as a percentage. The *capital called* is a valuation of the cumulative amount of LP capital invested, shown as a percentage of total LP commitment. *Std.dev* is the standard deviations.

	IRR	TVPI	RVPI	DPI	Capital called	Quartile rank	Fund number	Fund size
Count	417.00	417.00	417.00	417.00	417.00	417.00	417.00	417.00
Mean	17.58	1.82	36.53	144.99	93.90	2.33	4.93	1187.90
Std.dev	17.37	0.67	50.02	87.43	12.91	1.05	6.89	2051.50
Min	-14.40	0.38	0.00	0.00	24.80	1.00	1.00	8.25
25%	9.00	1.41	0.00	87.00	88.81	1.00	2.00	193.14
50%	15.08	1.68	9.00	146.00	96.00	2.00	3.00	400.59
75%	23.00	2.12	67.00	193.29	100.00	3.00	5.00	1128.15
Max	239.80	5.82	329.41	580.00	140.84	4.00	57.00	17708.40

Variables that are excluded from regressions are displayed to provide a thorough explanation of every characteristic of our data sample. The count variable shows that our sample comprises 417 observations, in which no observations are missing

across the different factors. Median figures are lower than mean figures, indicating a positively skewed distribution. This is in line with our a priori expectation that the levels of skills and experience across different GPs vary substantially and thus lead to a skewed allocation of returns. Across the entire sample, the mean IRR is 17.58%, with a high standard deviation of 17.37%. This explains the wide range of IRR figures observed, which varies from a minimum at -14.40% to a maximum at 239.80%. Variety is also observed for the TVPI, with values ranging from 0.38 to 5.82, around a mean of 1.82. These patterns imply that the sample of this study represents a true distribution of the European PE fund market, in which not only the top-performing funds are reported. In like manner, the fund size varies from a minimum at $8.25 million to a maximum at $17708.40 million, with a mean of $1187.90 million. The average PE fund of our sample has a quartile rank of 2.33, denoting that the distribution comprises a variety of funds of all four performance rankings, as this is close to the median. The variable *Fund number* shows that a typical PE fund of our sample is the fifth (4.93) fund raised by the same GP, indicating a rather high level of average experience. However, the fund numbers across the sample varies from number 1 to number 57, reflected by the quite high standard deviation of 6.89. Despite the range between minimum and maximum values of several variables of this data sample, a closer investigation discloses that neither of the variables has substantial outlying observations. Thus, we do not drop any observations from our data sample but recognize that variation underscore the importance of performing robustness tests (see section 5.3.3).

4.4 Multicollinearity

The problem of multicollinearity arises when one of the independent variables is highly correlated with one (or more) of the other independent variables (Wooldridge, 2014). If present, multicollinearity can lead to regression coefficients being estimated incorrectly due to large sampling variance. It is important to underline that some correlation between the independent variables is not considered a problem - only highly correlated regressors are considered as an issue. The correlations between the independent variables are presented in Table 2. As shown in the table, the TVPI is relatively highly correlated with DPI, which in turn has some correlation with RVPI. Intuitively, this makes sense, as the TVPI is calculated using DPI and RVPI, as shown in section 4.5.1. Accordingly, we have chosen to omit both DPI and RVPI from our analysis, as the TVPI captures the effect of these

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variables. Moreover, the TVPI is highly used in the existing literature, further underlining the importance of this variable and our decision to retain this measurement in our analysis.

Table 2: Correlation between the independent variables

The table presents a correlation analysis of the independent variables of this research. Each number represents the correlation coefficient between the selected variables. The *Vintage year* is the inception year of the fund. *Fund size* is the amount of capital under management, measured in USD millions. The *TVPI* expresses how many times investors are likely to receive, or have received, their money back and make a profit from an investment, expressed as a multiple. The *RVPI* is a measure representing the sum at which an asset can be sold or acquired in a transaction between agreeable parties, expressed as a percentage. The *DPI* is the actual returns received by a fund investor, expressed in percentage terms. The *Capital called* is a valuation of the cumulative amount of LP capital invested, shown as a percentage of total LP commitment. The *Quartile Rank* of a fund is by Preqin calculated using both net IRR and TVPI, where the most consistent top performing funds are assigned to the 1st rank. *Fund number* is the ordered sequence number of a fund.

	Vintage year	Fund size	TVPI	RVPI	DPI	Capital called	Quartile rank	Fund number
Vintage year	1							
Fund size	0.0866	1						
TVPI	-0.2368	-0.0582	1					
RVPI	0.7753	0.0491	-0.0957	1				
DPI	-0.6253	-0.0727	0.8221	-0.6454	1			
Capital called	-0.2148	0.1453	-0.0270	-0.2421	0.1177	1		
Quartile rank	0.0297	-0.0026	-0.7099	-0.0461	-0.5183	0.0993	1	
Fund number	0.2171	0.4016	-0.1040	0.1562	-0.1692	-0.0685	0.0095	1

4.5 Private equity performance - research design

To measure the performance of PE funds both in absolute and relative terms, we use two respective data samples: one for section A and one for section B. In section A, we measure absolute performance of PE funds based on the IRR and TVPI. We closely investigate how these metrics change during the period of interest for this study, including a focus on both crises of concern to capture how performance is affected. In section B, we perform KS-PME analyses to answer whether PE

outperforms public markets. For both sections, we closely investigate the effects of expertise applied by GPs. To perform the analysis for section A, we use a data set comprising 417 different PE funds, in which Preqin provides detailed data on both IRR and TVPI. For section B analysis, all data with comprehensive PME values calculated by Preqin are extracted from the data set in section A, resulting in a sample of 51 funds. Further descriptions of data and variables follow in section 5.1 and 5.2, respectively.

4.5.1 Section A - absolute performance

The two most common measures of absolute PE fund performance are the IRR and the TVPI. Preqin provides thorough figures on both metrics.

The IRR measures the LPs annualized IRR based on contributions, distributions, and the current value of unrealized investments of a fund (Preqin, 2021a). It is the discount rate that makes the NPV of an investment equal to zero. The *net* IRR is calculated as the IRR adjusted for carried interest and management fees. For ongoing funds, IRR calculations consider the estimated value of any unrealized investments (NAV) as of the last date of reporting (Harris et al., 2014). This metric is a money-weighted return expressed in percentage terms. Preqin calculates the IRR net of fees and carry to reveal net-to-LP returns, and to provide an accurate calculation of the realized potential of an investment (Preqin, 2021a). In general, the IRR can be calculated in various ways, in which a higher net IRR signifies a profitable investment project. The standard formula for calculating IRR is the following:

$$0 = NPV = \sum_{n=0}^{N} \frac{CF_n}{(1+IRR)^n} \tag{1}$$

In which:

CF_n is the cash flows for periods 0 to N

n is each period

N is the holding period

The TVPI exposes how many times investors are likely to receive, or have received, their money back and make a profit from an investment. The TVPI is also known as the net investment multiple, the multiple of invested capital, or the total value to paid-in ratio. The metric considers the returns that would have been realized if

inherent assets were sold at current evaluations and distributed back to investors, as well as the capital already returned to investors. At the beginning of a fund's lifetime, this multiple is typically negative due to the net cash outflows and negative returns. In years one to three, the GP begins to utilize capital into assets such that asset values rise, and the TVPI increases. Any TVPI value above 1.00 indicates that the fund has distributed more capital than initially invested. Expressed as a multiple, it is given by the sum of DPI and RVPI (Preqin, 2021a):

$$TVPI = \frac{\big(DPI(\%) + RVPI(\%)\big)}{100} \qquad (2)$$

The DPI is defined as the actual returns received by a fund investor, and RVPI is a measure representing the sum at which an asset can be sold or acquired in a transaction between agreeable parties (Preqin, 2021a). See Appendix A for extended definitions of these two metrics.

Sensitivity of the IRR

It is important to notice that the IRR is sensitive to cash flow timings, and that the timing of capital calls and distributions are determined by the PE fund managers. This can give rise to concerns among investors related to the fact that GPs have the power to manipulate IRR calculations to some degree (Huss and Steger, 2020). Moreover, the IRR is an absolute performance measure, which in comparison to relative performance measures does not adjust for either market movements or systematic risk. However, evidence provided by Jenkinson et al. (2018) states that the IRR is a reliable measure of fund performance, as the timing skills of GPs are reflected in the IRR. Hence, to avoid the possible disadvantages following from applying the IRR in isolation, we also apply the TVPI and the PME as additional performance metrics in this research.

The J-curve effect

The J-Curve effect describes how the performance results of a typical fund are negative in the early years of the fund, before rising and turning positive later. Because of high fees related to management and investments, it is common practice for a fund to attain negative returns in the early years. The cash flows of a fund increase in line with the maturity of investments - known as the J-Curve effect. The

J-Curve model, calculated using the IRR, is commonly used to estimate the cash flows and value of a PE portfolio (Preqin, 2021b). We do not calculate this effect for the funds of our study but are highly aware of its relevance and thus attempt to interpret our findings in line with this theory.

4.5.2 Section B - relative performance

In this section, we compare the performance of PE funds with the performance of public markets. To perform this comparison, we apply the KS-PME metric, which compares an investment in a PE fund to an investment in the relevant public market, over the same period (Harris et al., 2014). As described by Kaplan and Schoar (2005), the PME is calculated by investing (or discounting) the total amount of cash outflows of the fund at the total return to the market index of the public market. The resulting value is compared to the total value of the cash inflows (net of fees) to the fund invested (discounted) by means of the total return to the same market index. In specific, the PME is equal to the NPV of the cash flows of a fund scaled by the present value of calls, plus one. In the NPV calculation, the discount rate used is the realized return of the market index of the public market (Robinson and Sensoy, 2015). If the PME is greater than 1.00, the fund outperformed the public market (net of fees). For sake of illustration, a PME of 1.15 indicates that at the conclusion of a fund's life, the fund outperformed a public market investment over the same period by 15%.

$$KS\ PME = \frac{Sum\ of\ future\ value\ distributions + NAV}{Sum\ of\ future\ value\ capital\ calls} \qquad (5)$$

Sensitivity of the PME to benchmark

In line with Kaplan and Schoar (2005) and Harris et al. (2014), as well as additional empirical support, we use the S&P 500 index as the default proxy in this study. It is however important to notice the potential limitations related to the sensitivity of outcomes to the right choice of proxy to apply in PME estimations. To accurately reflect the performance of smaller PE funds against a benchmark, several small- and mid-cap indexes, such as the S&P Small Cap 600, the Russell 2000, and the MSCI Europe Small Cap, are more suited than the S&P 500. It is crucial to benchmark PE fund performance against public companies of similar size, as the transaction price of companies is based on equivalent listed stocks (Phalippou,

2014). Thus, to examine the sensitivity of our results, we include the Russell 2000 and the MSCI Europe Standard as alternative benchmarks. The former is a commonly used proxy for funds of smaller magnitude, as it comprehends a variety of neutral- and small-cap stocks in the US, with capitalizations from $50 million to $2,500 million (Phalippou, 2014). The latter index captures a representation of the large- and mid-cap market for European developed markets equity universe, with a median market capitalization of approximately $12,400 million (MSCI, 2021). With use of data that is up-to-date and of high quality, the average fund size in the sample used for PME estimations in this study is $ 1,918 million, with funds ranging from approximately $28 million to $13,000 million in size. Therefore, with a mean fund size of this magnitude, the S&P 500 and the MSCI Europe Standard are seemingly the most proper proxies for comparison. The use of the S&P 500 in specific makes it possible to compare the results of our study to the results of the most comparable and reliable previous research, while the MSCI Europe presumably provides the most suitable comparison for the return on the European PE sector.

Sensitivity of the PME to systematic risk

Sørensen and Jagannathan (2013) esteem the strengths of the PME, indicating that if investors have log utility, all essential corrections for the public equity market risk of the fund are entrenched in the PME. Despite this, the PME ignores the time value of money, does not account for liquidity risk, and is argued to be sensitive to systematic risk (beta). In line with the methodology of Kaplan and Schoar (2005), we do not attempt to make complex risk adjustments in our analysis. This decision is supported by Sørensen and Jagannathan (2015), stating that conventions about systematic risk are not needed. Moreover, based on thorough investigations of PMEs for buyout funds during periods of extremely different market conditions, Harris et al. (2014) suggest this assumption to be rational. Though, we check the robustness of our results (see section 5.3.3), and control for systematic risk by applying the Fama French five-factor model to estimate which market risk factors that potentially affect the returns of the funds of our sample (see section 5.3.3).

4.5.3 The impact of expertise on private equity performance

Due to factors specifically characterizing PE as an asset class, such as high levels of debt and illiquid investments, the PE market is far from frictionless and perfectly

competitive (Diller & Kaserer, 2009). In contrast to public markets, it can be argued that the expertise, as selection and timing skills, of PE firms and fund managers have a significant relation with fund performance. Therefore, an important part of this study is to examine which expertise factors influence the performance of PE funds. Acharya et al. (2013) state that the returns following from GP expertise explain the persistent and significant outperformance of PE funds. For both sections A and B, we aim to capture the effect of expertise by applying the following residual factors in regressions: fund size, fund number, industrial diversification, and geographic focus. How these variables are examined is further explained in section 5.2. The motivation for including these factors in our study is to investigate whether LPs and GPs should focus on specific aspects when undertaking investment decisions. For example, whether LPs should seek funds with higher sequence numbers, and whether GPs should diversify across industries.

Quartile rank

The quartile rank of a fund is used as an indicator of fund management skills and experience. It indicates how a fund performs relative to peer funds, in which 1st quartile ranked funds are the 25% top performing funds, the 2nd quartile ranked funds are the 25% next best performing funds, and so on. Preqin provides figures on all funds of interest in this study, using data reported within the two past years. To determine the quartile rank of a fund, Preqin uses both IRR and the TVPI. The numbers on quartile rank are downloaded directly from Preqin, which in turn is created based on the entire PE sector. As a result, we do not have a perfectly even distribution of funds from each quartile, as can be examined in Figure 2 in section 5.3.1. Throughout this research, we investigate the performance of the top quartile performers of the funds of our sample, as we expect these funds to deliver both absolute and relative superior performance.

4.6 Regressions

This section presents the regression equations that are formally tested in this research, outlined for each section separately. The following regressions are chosen to investigate the relations of specific variables of interest on PE fund performance, and thus to answer the hypotheses. See section 5.2 for details of relevant variables.

4.6.1 Section A

Our baseline regression for section A is the following:

$$IRR = \beta_0 + \beta_1 TVPI + \beta_2 capitalcalled + \beta_3 fundsize + \beta_4 fundnumber + \beta_5 industrialdiversification + \beta_6 geographicfocus + u \tag{6}$$

To explore crisis versus non-crisis performance, we examine:

$$IRR = \beta_0 + \beta_1 TVPI + \beta_2 capitalcalled + \beta_3 fundsize + \beta_4 fundnumber + \beta_5 industrialdiversification + \beta_6 geographicfocus + \beta_7 vintageyear06 - 08 + u \tag{7}$$

4.6.2 Section B

Our baseline regression for section B is:

$$PME = \beta_0 + \beta_1 TVPI + \beta_2 IRR + \beta_3 capitalcalled + \beta_4 fundsize + \beta_5 fundnumber + \beta_6 industrialdiversification + \beta_7 geographicfocus + u \tag{8}$$

4.7 Risk and return - Fama French five-factor asset pricing model

Since PE funds are privately held, monitoring fund performance and analyzing risk and return still bring challenges. In line with this, we implement the Fama French five-factor asset pricing model to examine the systematic market risk of European PE funds. In essence, we aim to observe whether the average returns of the funds of our sample are captured by the five risk factors of Fama and French (2015). Due to observed deficits of the original 3-factor model constructed by Fama and French, two additional risk factors were included. The improved model is designed to capture the size, value, profitability, and investment patterns in average returns (Fama & French, 2015). The size factor (SMB) captures the return on a diversified portfolio of small stocks over the return on a diversified portfolio of large stocks (Small Minus Big). The value factor (HML) represents the return difference between diversified portfolios of high and low *B/M* stocks (High Minus Low). The profitability factor (RMW) is the difference between the returns on diversified portfolios of robust and weak profitability stocks (Robust Minus Weak), while the CMA represents the difference between the returns on diversified portfolios of low and high investment firm stocks (Conservative Minus Aggressive). Fama and

French (1993) cited in Næs et al. (2009) describes HML and SMB as core factors explaining changes in investment opportunities of investors, and consequently that these variables must be directly linked to fundamental market risks. The mathematical representation of this model is given by the following regression equation:

$$R_{it} - R_{Ft} = a_i + b_i(R_{Mt} - R_{Ft}) + s_i SMB_t + h_i HML_t + r_i RMW_t + c_i CMA_t + e_{it} \quad (9)$$

In addition to the abovementioned factors, e_{it} represents a zero-mean residual, R_{it} is the return of portfolio i for period t, R_{Ft} is the risk-free rate of return, and R_{Mt} is the return on the value weighted market portfolio. The five factor exposures are denoted b_i, s_i, h_i, r_i, and c_i, and a_i is the intercept. The intercept is zero if the five factor exposures capture all variation in expected returns (Fama & French, 20145. In this model, we regress the excess IRR ($R_{it} - R_{Ft}$) of the PE funds of our sample on the excess returns of the market ($R_{Mt} - R_{Ft}$) and the above outlined factors of the model. To perform this estimation, we use U.S research returns data downloaded from Kenneth R. French's data library (French, 2021). In preference, international factor data would have suited our analysis on European PE funds better, but due to the unavailability of such data we use US factors. However, it is important to notice that this is no major bias for the analysis to be conducted, as the US market typically comprises a substantial part of any portfolio (Jegadeesh et al., 2015). To match the average return data of our data sample, we use yearly data observations in this regression, covering the period from 1999 until and including 2016. Though, monthly data observations would undoubtedly been preferred for this regression analysis, as this would generate less variation and more consistent data. Our data source Preqin does not provide sufficient monthly fund level data to apply for this analysis, and yearly observations are therefore used, despite our awareness of potential insignificant results.

4.8 Sample limitations - selection bias and zombie funds

As part of the data collection process, it is important to consider whether sample selection bias and self-reporting are drivers of the performance results observed. Sample selection bias is defined as the bias in the OLS estimator directly connected to the use of data from endogenous sample selection, and self-reporting is referred to as an action based on the likely benefits, or costs, of taking that action

(Wooldridge, 2014). Such biases are well documented as a problem in previous literature because GPs tend to hand-select information from successful investments only (Cressy et al., 2007; Kaplan & Schoar, 2005; Robinson & Sensoy, 2015). However, in similarity with recent studies, a major advantage of our data set is that Preqin not only collects data from chosen GP contributions, but also directly from public institutions through the Freedom of Information Act regulation. Observations are included in the Preqin data set regardless of performance results. Also, by using data from Burgiss, Cambridge Associates, and Preqin, Harris et al. (2014) find qualitatively and quantitatively consistent results across the three different samples for their analysis. There is hence little evidence to suggest that any of these data sets suffer from sample selection issues, and strong evidence to suggest that our data sets are appropriate for academic research. Moreover, previous research states that a consistent hand-selection of best performing PE funds is highly unlikely to be feasible, as the persistence of GPs have drastically declined from 2000 onwards (Harris et al., 2015). Based on these arguments, we are confident that the Preqin data set is not likely to be heavily biased in the direction of more profitable and prosperous PE funds. Therefore, we do not control specifically for sample selection bias.

Another potential bias in our data is due to the large number of zombie funds that often follow economic downturns. Preqin (2015) defines a zombie fund as a fund that has retained some or all its assets longer than what was planned, i.e., beyond its intended holding period. These funds can struggle to create value in these assets, and therefore have an incentive to stay active, collecting management fees, rather than realizing the potential losses. A Preqin report (2015) estimated that 1,180 PE funds, with a value of $127bn of unrealized assets, existed at the time, in which 21% of these funds were buyout funds. The existence of zombie funds in the data could therefore result in a possible bias for our results. We acknowledge this potential bias, however, due to the limitations of our data set, we proceed with our analysis without undertaking any actions to correct it.

5. Data and preliminary analysis

The following section includes an outline of the data used in this empirical study. Within this outline, we describe the data sample and all regression variables. Additionally, as a foundation for the main analysis we discuss the results of preliminary analysis and tests.

5.1 Data description

With over 18 years of experience, and data ranging back to the 1970s, Preqin is the primary source of data in this thesis. A benefit of Preqin is that fund names, fund id numbers, and firm id numbers are made available, indicating highly representative and trustworthy data. Moreover, each investor on the Preqin platform is constantly monitored and updated by professional in-house researchers. According to our contact in Preqin, Anthony Williams, Preqin (as of January 2021) covers 33,732 PE funds, 18,733 active PE firms, and 7104 PE fund performances. The work conducted by Preqin acts in line with legal and ethical regulations, as all data are obtained under the Freedom of Information Act. Moreover, Preqin is committed to an ESG friendly future, aiming to act as a front figure of responsible investing for private capital markets (Preqin, 2021c).

The analysis in this study is based on a Preqin private capital cash flow data set latest downloaded in April 2021. On a quarterly basis, Preqin collects up-to-date data on summary performance metrics (IRR, TVPI, DPI, RVPI), fund level characteristics (such as fund size, geographic focus, quartile rank, and vintage year), fund level cash flow transactions (capital calls, valuations, and distributions), and public market equivalent indexes. The inclusion of such comprehensive data is a major advantage of Preqin, as it enables estimating both absolute and relative fund performance. Our initial data sample included 488 funds with vintage years from 1999 to 2016. This time setting is chosen to only include funds that were invested in the relevant years before, during, and after, the two crises of interest in this study. The experiential setting applied in this research is filtered to include closed and liquidated buyout funds from European located fund managers. However, funds with missing values regarding IRR and/or TVPI are removed, resulting in a final total sample of 417 buyout funds. Moreover, we wanted to examine the effects of dry powder and AUM, however, these variables are removed from the data set due

to incomplete data. For an outline of specific criteria that must be met for a PE fund to be included in this research, see Appendix B, Table 10.

We also extract a smaller sample comprising 51 funds from our default sample to perform PME-specific analysis in Section B. To arrive at this sample, all funds with incomplete data on PME figures are removed from the data set to be used in section B, resulting in a sample of 51 funds only, over the period from 2004 to 2016. We focus on buyout funds as this is the most significant part of PE as an asset class. Table 3 shows the number of funds by vintage year for both the total sample and the sample extracted for PME analysis.

Table 3: Number of private equity funds by vintage year

The table shows the number of PE funds per vintage year included in this study, for which complete data are available. Preqin provide figures covering the period 1999-2016 for the total data sample, and the period 2004-2016 for the smaller PME sample. The vintage year is the inception year of the fund.

Vintage year	Total sample	PME sample
1999	21	-
2000	25	-
2001	17	-
2002	19	-
2003	24	-
2004	14	1
2005	27	2
2006	38	3
2007	34	4
2008	23	3
2009	21	3
2010	14	2
2011	22	4
2012	19	5
2013	19	4
2014	24	9
2015	30	5
2016	28	6
Total	417	51

In comparison to our data sample, statistics from November 2020 report an existence of 2515 European PE funds in total (Rudden, 2020), whereas Invest Europe (2018) states that approximately 1110 European PE funds were raised in the period from 1999 to 2016. Further, Harris et al. (2014) analyze 598 funds, Robinson and Sensoy (2015) use a sample of 542 funds, and Kaplan and Schoar (2005)

employ 746 funds, in their respective studies. Also, for the relevant period of this thesis, Preqin covers a total of 958 European PE funds. This coverage, including both VC and LBO segments, is however not filtered to comprise complete data only. Due to the above-listed information, our data coverage is highly representative in terms of both previous literature and the present magnitude of PE in Europe.

The average fund size of the total sample is $1,187 million, while the average fund size of the reduced PME-sample is $1,918 million. For both samples, the variation in fund size is high, ranging from $8.25 million to $17,708 million in the initial sample. Because of this extensive variation, we include both the large-cap S&P 500 index, the small-cap Russell 2000 index, and the large- and mid-cap Europe-focused MSCI Europe Standard, in our PME analysis to account for the sensitivity of outcomes related to the right choice of proxy (see section 4.5.2 for an extended discussion of benchmark sensitivity).

In line with the advantage of having substantial and dependable data coverage, an additional advantage of this data set is, as already outlined in section 4.8, that Preqin collects data not only directly from GPs, but also via a variety of other sources, including institutional investors. The high variation in fund size amongst the funds indicates that our data set covers a true sample of the PE fund population, in which not only the best performing funds are handpicked by GPs for inclusion. This contrasts our study in a positive direction from many previous papers that solely base their research on data from one specific investor (e.g., Huss & Steger, 2020; Ljungqvist & Richardson, 2003). Also, this is highly favorable as it reduces the probability of sample selection issues. Another advantage is that the detailed data on a broad range of performance metrics enables us to perform precise fund performance estimations, by considering several important factors of valuation.

A potential limitation of our data set is that many funds are closed and still not liquidated. However, an inclusion of liquidated funds only would result in a scarce sample, as well as mitigation of important data. Thus, we aim to handle this potential issue by including only liquidated, closed, and mature funds into the analysis, and by excluding both open funds and funds with vintages after 2016. Based on previous literature on this issue, it is commonly accepted to identify mature funds by considering vintage year and/or minimum fund age (Diller & Kaserer, 2009). A second potential drawback of Preqin data relates to the already

discussed possibility of sample selection bias. However, as concluded in section 4.8, we have evidence to suggest that data provided by Preqin are reliable and free from such bias.

5.2 Variables

Table 11 in Appendix C outlines descriptions of the regression variables of this study.

Dependent variables
IRR and PME
To investigate the research question of this analysis, the dependent variable applied in regressions is fund performance, as measured by the two above-described performance indicators at the fund level: IRR and KS-PME. Following the methodology of Kaplan and Schoar (2005), we use net IRR records. Preqin provides net returns to avoid the potential of imprecise conventions about the cash flows and life of a fund occurring from using gross returns. Moreover, net returns provide accurate estimates of the returns received by fund investors. For liquidated funds, the IRR is calculated using all up-to-date realized cash flows, less carry and fees. For closed funds, the IRR is calculated using all up-to-date realized cash flows, as well as the estimated value of all unrealized assets (Humphery-Jenner, 2013). Preqin's calculations are based on in-house evaluations and on data obtained directly from LPs and funds (Preqin, 2021b). The KS-PME measures PE fund performance relative to the public market index, here the S&P 500, the Russell 2000, and the MSCI Europe Standard. The PME indirectly assumes a correlation between public market return and PE return, providing a like-for-like comparison. Preqin provides KS-PME figures calculated by discounting the cash flows of the private capital funds by the market index of the public market (Preqin, 2021b).

The IRR is the only dependent variable for the regression analysis in section A, as we in this section investigate the absolute performance of PE funds. The IRR is chosen as the dependent variable in preference of the TVPI to conveniently compare our results with the conclusions of previous literature. However, the IRR is not a relative performance measure and does not consider systematic risk or market

movements. Therefore, the S&P 500 PME[6] is the dependent variable in section B, as the PME is a relative performance measure controlling for differences in systematic risk between public and private markets.

Independent variables

TVPI and capital called

The TVPI (outlined in section 4.5.1) and capital called are included as essential measures of PE fund performance. The motivation for including these metrics in regressions is to find out if there are significant relations between these metrics and IRRs and PMEs. Definition and formula of the capital called follow below. A priori, we expect to observe a positive relation between both these variables and fund performance, as a higher TVPI indicates a profitable investment, and a higher amount of called capital signifies a higher valuation of capital committed by the LP. The capital called is a valuation of the cumulative amount of LP capital invested, shown as a percentage of total LP commitment (Preqin, 2021a):

$$Capital\ Called(\%) = \frac{Total\ LP\ Contribution}{Total\ LP\ Commitment} \times 100 \tag{10}$$

Vintage year

The inception year of the fund, defined as the first year of drawdown from the investor. A dummy variable taking the value one if vintages 2006-2008, and zero otherwise. Aim to capture performance of funds with different vintages, and to find out whether times of crises influence this performance. In essence, this variable is created as a proxy for the effects of macroeconomic crises. Our a priori expectation is that funds with vintage years close to the outbreak (2006-2008) of the GFC perform poorer than funds raised outside this time range. This variable is referred to as *Vintage year 06-08* in the regression results.

The succeeding variables are all, a priori, perceived as indicators of expertise applied by GPs.

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[6] The S&P 500 is the default proxy in this research, as argued in section 4.5.2

Geographic focus

A dummy variable for the geographic focus of the funds, taking the value one for European focus and zero otherwise. The geographic focus of each of the funds of our sample is one of the following: Africa, Asia, Europe, Middle East & Israel, or North America. Neither fund included in this research has a diversified geographic focus, as reported by Preqin. We include this variable in regressions to capture if the geographic focus of a fund relates to superior fund performance. Also, we find it interesting to investigate whether better performing European PE funds tend to be geographically concentrated in Europe, or not. We perceive this variable as an expertise indicator, as the geographic focus of a fund is a clear strategic choice taken by the fund managers. A divide between a geographical European focus and the rest of the world is chosen due to limited previous analysis on this subject. Thus, the geographical focus of the different PE funds of our sample remains a subject of investigation, in which a priori we expect to observe a positive relation between a European focus and PE fund performance.

Industrial diversification

A dummy variable for the industrial diversification of the funds, taking the value one if diversified and zero for all other cases. All other cases include the following core industry-specific focuses: industrials, consumer discretionary, information technology, telecoms & media, financial & insurance services, energy & utilities, and business services. In line with previous literature (Huss and Steger, 2020; Humphery-Jenner, 2013), we perceive this variable as an indicator of expertise provided by GPs. Our a priori expectation is that industrial diversification is positively related to fund performance, and thus that skilled fund managers diversify their funds across industries.

Fund number

The fund number is the ordered sequence number of the fund raised by the same GP. We interpret this variable as a factor of expertise, as previous literature shows a positive relation between fund number and fund performance (Kaplan & Schoar, 2005), stating that higher fund numbers indicate high previous fund performance and superior management.

Fund size

The size of the fund is the amount of capital under management, here measured in USD millions. We apply the natural logarithm in regressions because we expect a non-linear relation between fund size and fund performance to be likely, as this variable is highly skewed. The empirical evidence regarding the relation between fund size and fund performance is varying. Kaplan and Schoar (2005) argue that there is a positive relation between PE fund size and performance, measured by the IRR. The rationale behind this evidence is that larger PE funds can benefit from economies of scale and the larger amount of capital under management, in terms of higher returns, and thus stronger PE fund performance as measured by IRR and PME. Moreover, it can be argued that larger funds are run by more skilled and experienced fund managers. Cressy et al. (2007) find an 88% correlation between fund experience, in their study measured by the total number of investments within the fund, and fund size. Thus, we find it relevant to include this variable in our regressions to capture its effect on both IRR and KS-PME. Moreover, we perceive this variable as an indicator of expertise, and expect funds of larger size to perform better than smaller sized funds.

5.3 Preliminary analysis and tests

In this subsection, preliminary analyses, tests, and models are presented.

5.3.1 Section A - preliminary analysis

As shown in Figure 2, the funds of our sample are rather evenly distributed across the four quartile rankings, with 58% of the funds belonging to the two top quartiles and the remaining 42% representing the bottom two. This implies that our data set can be positively biased, as the sample is a bit skewed to the two top quartiles. Nevertheless, this skewness is not substantial, and is in line with the arguments discussed in section 4.8. This signifies that the sample of this study is a representative selection of the true European PE sector, which further emphasizes that our data sample is unlikely to suffer from issues related to selection bias. This is advantageous for the analysis of this thesis, as it provides us with a representative picture of PE fund performance. Also, with this allocation across the funds, we can compare the performance of funds of different rankings, capture potential differences, and examine the performance of funds of different rankings to the performance of public markets.
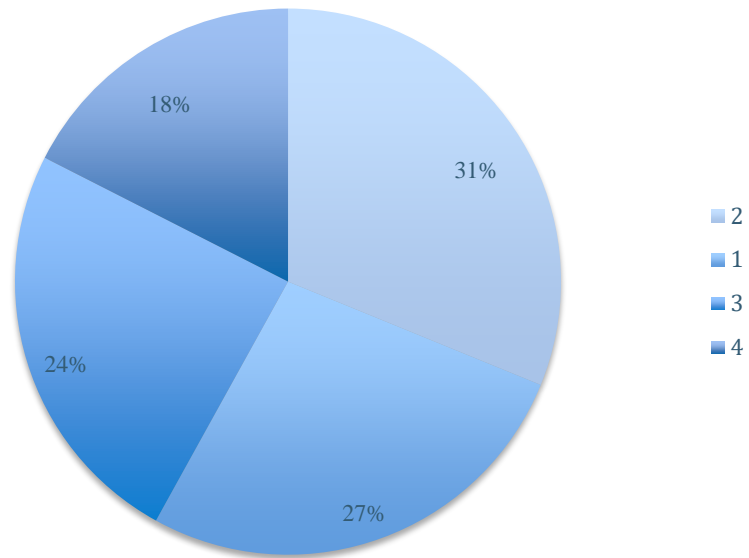
Figure 2: PE funds, split by quartile rank

Figure 3 shows that 95% (396) of the PE funds included in our data sample have a European investment focus, while the remaining 5% (21) are focused in either Africa, Asia, North America, or the Middle East and Israel. Hence, we find it very interesting to explore whether the geographic focus determined by the different fund managers across the funds of our sample has a significant relation with fund performance, and whether a European focus can be perceived as a driver of performance, as this focus stands out as most preferred across the funds here studied. The distribution observed further supports the choice of emphasizing the MSCI Europe Standard as a suitable benchmark of comparison in the PME analysis.
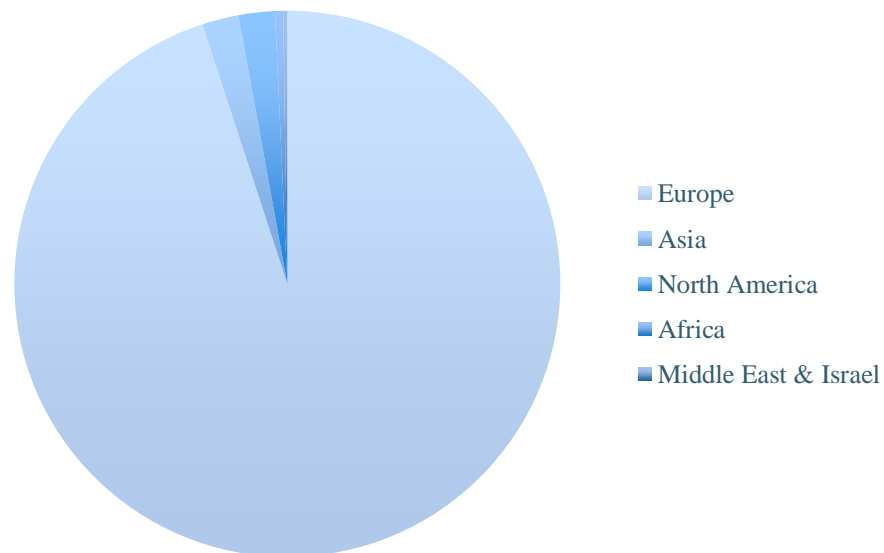
Figure 3: PE funds, split by geographic focus

Figure 4 illustrates how the PE funds of our total sample are split across industry focus. 86.57% (361) of the funds are industrially diversified, meaning that a substantial part of European PE buyout funds are diversifying commitments throughout a broad range of industries. Thus, only 56 out of the 417 of the funds of our sample have a core industry-specific focus. With this considerable observed preference for industrial diversification across the funds of our sample, one can argue that the decision undertaken by GPs of whether to diversify or not is a clear strategic choice. Thus, a part of this research is to investigate the effect this strategic choice has on PE fund performance, both in absolute terms and in relative to public markets. Also, based on the information in this chart, we aim to compare the performance of industry-specific and industrially diversified funds. Within this comparison, it is therefore fascinating to find out if there is a clear connection between the top performers and their industry focus.
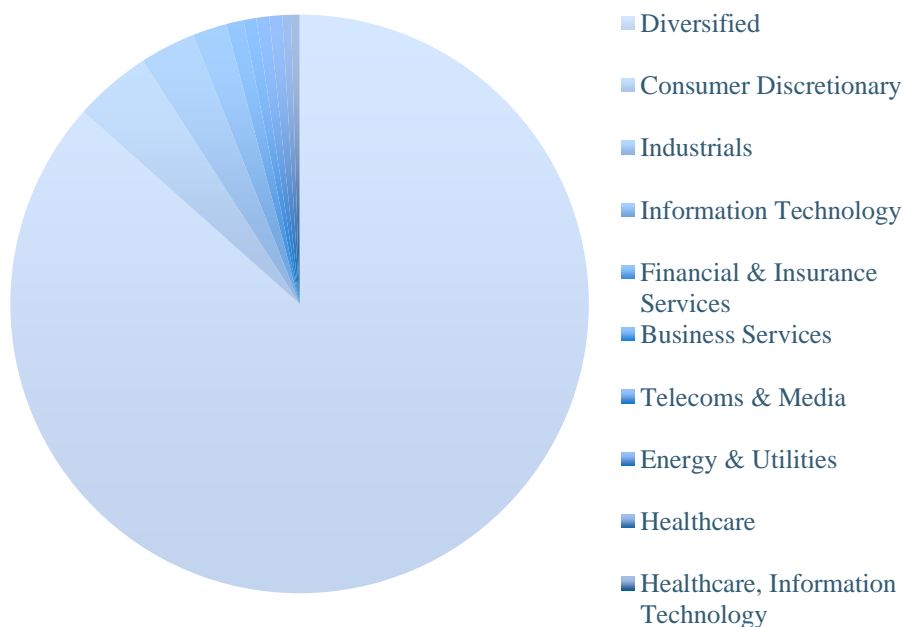
Figure 4: PE funds, split by industry focus

Figure 5 shows average IRR by vintage year for the entire period of investigation in this research. The year-by-year movements of this figure show that the performance of European PE funds has fluctuated substantially within this time frame, with a maximum average IRR of 33.17% and a minimum average IRR of 8.89% observed by the funds with vintage years 2003 and 2007, respectively. The low IRR figures of PE funds with vintage years 2006 and 2007 indicate that the GFC affected the absolute performance of the PE industry significantly, as these

funds were raised just before the outbreak of the crisis. However, the recuperation time was considerably short, as the recovery of the PE sector is significant already from 2008. This implies that PE investments offer great protection against financial distress. Moreover, by looking at the changes in the graph, one can argue that PE firms learned from the 2008 GFC and handled the 2014 oil price crash successfully, as the IRR values of these years did not fall anywhere close to what was observed by the market during the great recession. Hence, we find it interesting to explore how funds with vintages from 2006-2008 perform (see section 6.1.2).
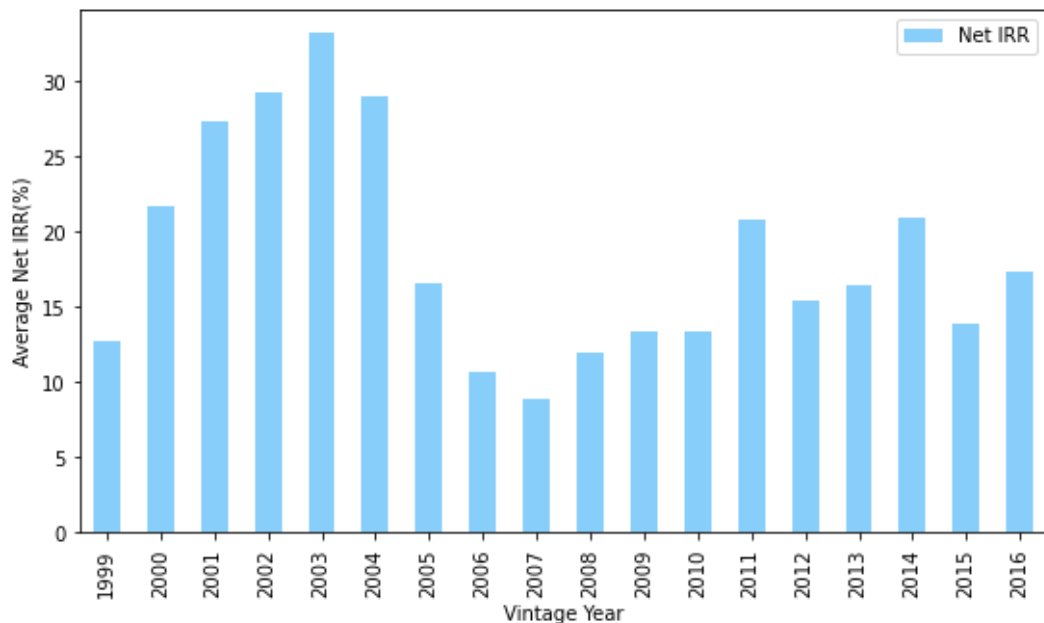
Figure 5: Average IRR by vintage year

5.3.2 Section B - preliminary analysis

Figure 6 shows average PME figures by vintage year for the three PME benchmarks included in this research, over the time frame of the data sample for section B. The PE funds of our data sample outperform public markets for nearly all vintage years of interest in this study. However, in line with the preliminary figures presented for section A, the performance of PE funds in relative to public markets is also lower for the funds with vintage year 2007. This indicates that the 2008 GFC affected the performance of the funds raised in 2007 both in absolute and relative terms. However, funds raised during and after the GFC have generally outperformed public equity. This implies that PE funds successfully recovered from the tumult of the great crisis, and that PE firms learned that sharpness during times of distress can result in good fund performance. The performance observed by funds with vintage

years 2012 and 2013 indicates that the PE firms of this study managed to implement past learnings and benefit from the uncertainties presented by the 2014 oil price crash by delivering significant outperformance, regardless of benchmark comparison.
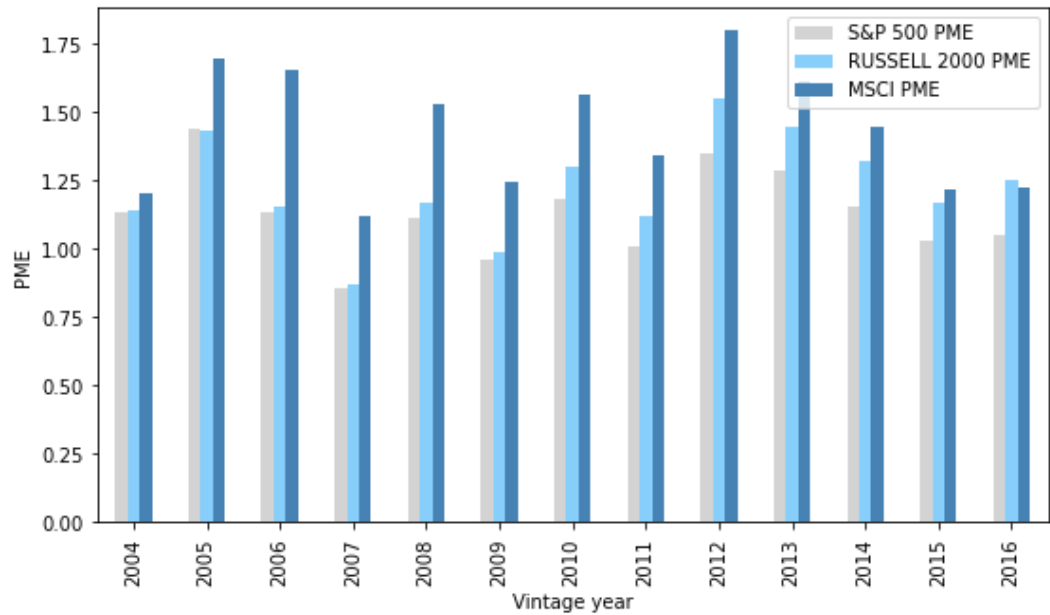
Figure 6: Average PMEs by vintage year

5.3.3 Preliminary tests and models

The following section presents findings of the statistical tests performed before arriving at the final models, and the Fama French five-factor model outlined in section 4.7. We derive these results using the total data sample of 417 PE funds, as this is the base data set underlying all subsequent analyses of this thesis.

Fama French five-factor asset pricing model

Table 12 in Appendix D presents the regression results of the five-factor model. The R^2 is 0.28, meaning that approximately 28% of the variation in the average excess return of European PE funds raised within the period from 1999 to 2016 is determined by the independent variables. This reflects that the model has a rather low explanatory power on European PE fund performance. Also, except for the intercept, neither coefficient of this regression model appears to be statistically significant. This is likely due to the quite small sample size relative to the variation in our data. However, we perceive the results of this model as important predictors of the systematic risk and performance of European PE funds, despite being aware of the low average sensitivity to the five factors observed.

The alpha (intercept) is positive and statistically significant, indicating an average PE fund performance above the return on a similar passive portfolio (Fama & French, 2010). In other words, the average European PE fund of our sample delivers returns in excess of a broad US-based market index comprising value-weighted returns of all CRSP firms included in the US and listed on the NYSE, AMEX or NASDAQ, that fulfill certain standard requirements (Fama & French, 2015). This implies that the average GP of our research attains sufficient expertise and skill to obtain fund returns well above costs and fees.

Leung (2013) argues that the typical PE fund invests in firms smaller than average listed firms. Therefore, we do not find the positive coefficient result of the SMB factor surprising, as this indicates that European PE funds are more sensitive to the power of small-cap stocks and more likely to have smaller market caps. The regression provides a slightly positive HML coefficient, indicating that the PE funds of our sample are more sensitive to value stocks, and less sensitive to growth stocks. The economic intuition behind this relates to the fact that PE funds tend to invest in value companies rather than growth companies, as they seek target companies that are perceived as undervalued in the market. Further, the positive RMW coefficient implies that for the typical European PE fund, higher profitability leads to better results. The negative coefficient of the CMA indicates that the performance of an average fund of our sample behaves similarly to the performance of firms that invest a lot despite low profitability (Fama & French, 2015). Overall, the economic intuition of these results is that, given ceteris paribus, the risk and return of European PE funds are not significantly affected by the factors of the Fama French five-factor model. However, in line with suggestions presented by previous literature, the positive and significant alpha observed provide evidence to infer that European PE funds deliver abnormal returns (Stutzer, 2006).

Pearson's Chi-squared

In our analysis, we have two categorical variables as independent variables; geographic focus, and industrial diversification. These categorical variables are motivating to examine, as one variable can be contingent upon another variable. For example, does the fact that a fund is diversified or not depend on the geographic focus of that fund (or vice-versa)? To study these relations, we perform the Pearson's Chi-squared test, which is a statistical hypothesis test with a null

hypothesis that the observed frequency of a categorical variable equals its expected frequency. In other words, the categorical variable does not depend on another categorical variable. The test results in a p-value of 0.999, which means that we do not reject the null hypothesis of independence between the categorical variables at a 5% significance level. As a result, we are confident that the categorical variables included in our models *can* and *should* be included.

Testing model for heteroskedasticity

This section evaluates the importance of various fund characteristics to the respective performance of our sample of funds. The approach involves regressing a performance measure against the different fund characteristics outlined in section 5.2. The first analysis uses the IRR as a measure of absolute performance, while the second analysis uses PME as a measure of relative performance.

Table 13 in Appendix D presents the standard OLS-estimation results for section A of our analysis. However, this method assumes homoscedasticity; that is, that the variance of the unobserved error, conditional on the independent variables, is constant (Wooldridge, 2014). In the presence of heteroskedasticity, the standard errors and the according *t, F,* and *LM* statistics must be adjusted to still be valid. As a result, we test for heteroskedasticity, as the assumption of homoscedasticity is unlikely to hold in our data due to the large variations in our data set. Accordingly, we test for heteroskedasticity using both the White test and the Breusch-Pagan test.

Each test returns two test statistics: an LM-statistic and an F-statistic, in addition to the corresponding p-values. The tests indicate heteroskedasticity if the p-values are below the 0.05 threshold. As shown in Table 14 and Table 15 in Appendix D, both p-values from each test are below 0.05. For each test, this results in the rejection of the null hypothesis of homoscedasticity, meaning our model is heteroskedastic. A possible solution to heteroskedasticity is to transform the dependent variable into a logarithm. However, as our dependent variable is a percentage, we proceed by using a standard robust error model, to ensure valid standard errors. In addition, as our base model is heteroskedastic, we assume that all sub-models will also be heteroskedastic and will therefore use models with standard robust errors throughout our analysis.

6. Results and analysis

This section presents the main absolute and relative performance results. The findings of section A and B are outlined separately, and each section is split into distinct representations of elementary and empirical results. The elementary parts present core results derived through descriptive statistical investigations of the data. Regression results are outlined and discussed in the empirical parts, in which the significance of all variables of interest to PE fund performance in the context of this research are considered.

6.1 Section A - absolute performance

6.1.1 Elementary results
PE fund IRR and TVPI
Table 4 outlines IRR and TVPI values for the entire sample of European PE funds of this research, comprising vintage years from 1999 until and including 2016. For each vintage year, the mean, median, and standard deviation figures are presented, as well as average figures for the three following periods: 1999-2005, 2006-2011, and 2012-2016.

Table 4: Private equity fund IRR and TVPI

The table displays average internal rates of return (IRR) and investment multiples (TVPI) by vintage year on European PE funds with data provided by Preqin. Median and standard deviation figures are also displayed, as well as number of funds per vintage year. The *vintage year* is the inception year of the fund. The *IRR* is a money-weighted return expressed in percentage terms, which by Preqin is calculated net of fees and carry. The *TVPI* expresses how many times investors are likely to receive, or have received, their money back and make a profit from an investment, expressed as a multiple. *Std.dev* is the standard deviations.

		IRR			TVPI		
Vintage year	Funds	Mean	Median	Std.dev	Mean	Median	Std.dev
1999	21	12.77	12.00	11.35	1.74	1.74	0.62
2000	25	21.70	23.60	9.22	2.03	2.09	0.53
2001	17	27.32	29.00	14.17	2.22	1.96	0.78
2002	19	29.26	27.30	17.13	2.32	2.08	0.79
2003	22	33.17	21.99	49.11	2.07	1.95	0.80
2004	14	29.01	22.57	23.15	2.24	2.06	0.98
2005	27	16.55	9.60	19.60	1.80	1.58	0.92
2006	38	10.74	10.73	8.89	1.74	1.65	0.67
2007	34	8.89	8.20	10.05	1.60	1.50	0.73
2008	23	11.95	12.00	6.08	1.76	1.71	0.42
2009	21	13.39	13.57	7.74	1.85	1.82	0.63
2010	14	13.36	16.44	9.66	1.75	1.78	0.57
2011	22	20.79	17.01	13.46	2.06	1.90	0.55
2012	19	15.39	15.98	12.56	1.88	1.80	0.67
2013	19	16.48	17.70	8.44	1.75	1.66	0.47
2014	24	20.99	20.23	10.71	1.70	1.54	0.45
2015	30	13.82	14.00	9.67	1.43	1.39	0.35
2016	28	17.29	17.20	10.40	1.43	1.42	0.26
Total	417	17.58	15.08	17.37	1.82	1.68	0.67
Average 1999-2005	145	23.54	19.00	24.70	2.03	1.90	0.79
Average 2006-2011	152	12.57	12.00	10.10	1.78	1.70	0.63
Average 2012-2016	120	16.73	16.20	10.50	1.60	1.49	0.46

Evidence from previous research implies that the average is the most convenient measure of buyout fund performance (Harris et al., 2014). Based on the findings outlined, the average absolute performance across time varies substantially and is

cyclical. Over the full sample of PE funds, the average IRR is 17.58% and the average TVPI is 1.82. By looking at IRR figures, the average performance of the funds of our sample peaked in 2003 and reached the bottom line in 2007, with mean IRR values of 33.17% and 8.89%, respectively. Based on the TVPI, the average best performers are the funds with vintage year 2002, while the funds raised in 2016 perform worst, with respective TVPIs of 2.32 and 1.43. However, funds with vintage year 2016 are likely to still be running, such that the prospective performance of these funds relies on the future investment outcomes of their outstanding lifetime. The performance of these funds is expected to improve if the historical J-curve pattern of PE funds - the performance of a fund increases over the lifetime of the fund - remains present (Harris et al., 2014). However, an absolute interpretation of both performance measures for each of the three periods outlined above shows that PE funds with vintage years 2006-2011, on average, have lower performance, with a mean IRR of 12.57%, and an average TVPI of 1.78. The highest average performance is found for funds raised with vintages from 1999-2005, followed by strong performance observed for 2012-2016 vintage year funds.

In relation to the overall research question of this thesis, several conclusions can be drawn from these results. Overall, both the average IRR and TVPI figures establish that European PE funds provide strong performance. An average IRR of 17.58% denotes a strong annual growth rate of the mean fund of our sample, while the TVPI result of 1.82 indicates that the average fund returns close to twice the capital committed to the fund. However, the mean performance is higher than the median performance, indicating that positive outliers influence abnormal returns. An analysis of which factors that contribute to such abnormal returns are provided in section 6.1.2. Results from previously documented research emphasize the strong performance observed, as Kaplan and Schoar (2005) account for an average net IRR of 19%, Harris et al. (2014) report a figure of 14%, and Robinson and Sensoy (2015) show a 9% return. This indicates that European PE funds in absolute terms provide stronger average performance than US PE funds, as the results of these three studies are derived using US data. See Table 16 in Appendix E for a comparison of previously documented results.

We find that the 2008 GFC negatively affected the absolute performance of the funds of our sample. This conclusion is inferred based on the performance of the

2006 and 2007 vintage year funds, with IRR averages of 10.74% and 8.89% respectively - significantly lower than the overall mean performance results. These results mirror the fallout of the crisis, as the funds raised in 2006 and 2007 were particularly exposed to this stock market crack. However, based on the TVPI, the mean performance results of 2006 and 2007 vintages were not particularly low, with multiples of 1.74 for 2006 and 1.60 for 2007. All things considered, in comparison to the average result figures of our data sample, previous findings, and the serious outcomes of the crisis, the results observed for funds with vintages 2006-2007 are not excessively poor. As follows, an investigation of whether PE funds offered better value protection than public equity during the GFC is provided in section 6.2. In contradiction, we find that the absolute performance of European PE funds was not adversely affected by the effects of the 2014 oil price crash. The 2012 and 2013 vintage year funds have IRR averages of 15.39% and 16.48%, and average TVPIs of 1.88 and 1.75, respectively. Thus, in comparison to the overall mean and the 2006 and 2007 figures, the performance of funds raised right before the 2014 oil crisis was strong. This leads us to suggest that the PE industry successfully learned from the consequences of the GFC and was well prepared for the next economic downturn.

PE fund performance by quartile rank

Using all data for the entire sample period, Figure 7 and Table 5 illustrate average IRR by quartile rank, and average data on IRR, TVPI, and fund size by quartile rank, correspondingly. On average, 1st quartile ranked funds perform significantly better than the remaining funds, both in terms of IRR and TVPI, with a mean IRR of 31.58% and a mean TVPI of 2.50. This signifies that the average 1st quartile ranked fund returns two and a half times the capital committed to the fund, as well as superior returns when compared to both the overall averages of our data sample, and average results presented by previous research. The performance of each quartile group follows the basic intuition behind the concept; the 1st quartile funds outperform the 2nd quartile funds, the 2nd quartile funds outperform the 3rd quartile funds, and so on. Interestingly, the top-performing funds have a lower average fund size than the second and third best performers, indicating that greater fund size is not necessarily a driver of fund performance. Thus, the results here outlined implies that the abnormal performance of PE funds is likely to be influenced by the skills and expertise of GPs.
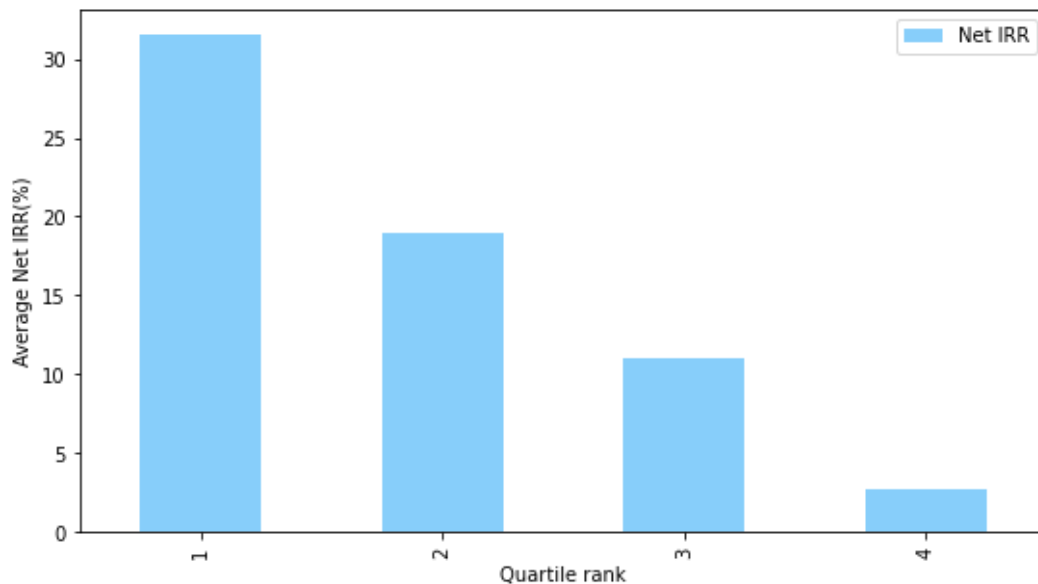
Figure 7: Average IRR by quartile rank

Table 5: Average results by quartile rank

The table shows average figures on IRR, TVPI, and fund size, by quartile rank, based on data and calculations provided by Preqin. The *Quartile rank* of a fund is by Preqin calculated using both IRR and TVPI, in which the most consistent top performing funds are assigned to the 1st rank. The *IRR* is a money-weighted return expressed in percentage terms, which by Preqin is calculated net of fees and carry. The *TVPI* expresses how many times investors are likely to receive, or have received, their money back and make a profit from an investment, expressed as a multiple. The *Fund size* is the amount of capital under management, measured in USD million. The figures here displayed are based on the total sample of 417 PE funds with complete data available for calculations, covering vintage years 1999-2016.

Quartile Rank	IRR	TVPI	Fund size (USD million)
1	31.58	2.50	1025.51
2	18.96	1.86	1338.39
3	11.06	1.49	1361.55
4	2.77	1.14	926.27

6.1.2 Empirical results

Baseline regression

Table 6 presents the fundamental OLS regression results for section A (with standard robust errors). The model has a fairly high R-squared of 0.529, meaning 52.9% of the observed variation in the IRR can be explained by the independent variables. In addition, the F-stat has a p-value of approximately 0.00, meaning the

independent variables are jointly statistically significant, and thus the model provides a better fit than an intercept-only model, given ceteris paribus (Mochrie, 2015).

Table 6: Fundamental OLS estimation section A

The table shows the fundamental OLS regression results for section A, with robust standard errors. The dependent variable (*IRR*) is a money-weighted return expressed in percentage terms, which by Preqin is calculated net of fees and carry. The *TVPI* expresses how many times investors are likely to receive, or have received, their money back and make a profit from an investment, expressed as a multiple. The *Capital called* is a valuation of the cumulative amount of LP capital invested, shown as a percentage of total LP commitment. *Fund size* (the natural logarithm is applied) is the amount of capital under management, measured in USD millions. *Fund number* is the ordered sequence number of a fund. The *Industrial diversification* is a dummy variable for the industrial diversification of the funds, taking the value one if diversified and zero for all other cases. The *Geographic focus* is a dummy variable for the geographic focus of the funds, taking the value one for European focus and zero otherwise. *Std err* is the standard errors.

Dep. Variable:	IRR	R-squared:	0.529
		Prob (F-statistic):	0.000
	Coefficient	Std err	P-value
Constant	-2.6290	5.917	0.657
TVPI	18.3785	2.229	0.000
Capital called	-0.1281	0.056	0.021
Fund size	-0.7311	0.527	0.166
Fund number	0.0425	0.051	0.409
Industrial diversification	3.2036	1.477	0.030
Geographic focus	0.4035	2.425	0.868

TVPI

The TVPI has, ceteris paribus, the most substantial relation with the IRR out of all the independent variables, with a coefficient of 18.3785. This finding is in line with existing literature, in which a positive relation between the TVPI and fund performance is found (Kaplan & Schoar, 2005; Harris et al., 2014; Robinson & Sensoy, 2015; Higson & Stucke, 2012). This is as expected, as both the TVPI and the IRR are measurements of PE fund performance. As previously explained, the IRR is chosen as the dependent variable due to the advantages it proposes, while the TVPI is included to examine the relation between the two. The coefficient is statistically significant even at the 1% level, with a p-value of 0.000.

Capital called

Somewhat surprisingly, we observe a negative relation between capital called and the performance of the funds in our sample. This is not in line with our expectations, as we would believe that utilizing all capital available would positively affect PE fund performance. This finding, however, suggests that funds that *don't* utilize all available capital increase performance, possibly implying that funds often have limited availability of profitable investment opportunities. Harris et al. (2015) find similar results; that buyout fund performance is significantly negatively related to capital committed. The result is statistically significant at the 5% significance level.

Fund size

The fund size variable has, ceteris paribus, a negative relation with the dependent variable; an increase in fund size results in a decrease in the IRR. The negative coefficient of -0.7311 predicts that smaller funds might in fact perform better than larger funds, and that diseconomies of scale are present in the European PE market. This result is not in line with our a priori assumptions, nor with the findings of Jordaan (2018), and Kaplan and Schoar (2005), who both find a positive relation between fund size and fund performance. However, we understand the economic reasoning behind these results; larger fund size might result in larger deals, which in turn imposes higher risk and less focused investments. There may be a greater incentive for smaller funds to find "unicorns", i.e. targets with extremely high growth-opportunities, since just one of these companies can multiply the fund's return several times over. In addition, it *is* in line with some of the existing literature on the field (Aigner et al., 2008; Humphery-Jenner, 2013), whose results are in line with ours. Interestingly, the result is not statistically significant at the 5% or 10% significance level, indicating that fund size is an inappropriate proxy for the expertise of GPs.

Fund number

We observe a positive relation between the fund number and fund performance. Kaplan and Schoar (2005) find similar results, stating that PE fund performance increases with fund sequence number. This result implies that the performance of funds tends to increase for follow-up funds, while first-time funds experience a lower performance in comparison. However, this result is not statistically

significant, which implies that the fund number is a rather poor proxy for the experience applied by GPs.

Industrial diversification

The dummy variable created for the diversification in core industries has a positive coefficient of 3.2036. This means, ceteris paribus, that industry agnostic PE funds provide stronger performance than funds with specialized industry focuses. The result is in line with the findings of Huss and Steger (2020), and Humphery-Jenner (2013), who also observe a positive relation between diversification in core industries and fund performance. The coefficient has a p-value of 0.0300, meaning that it is statistically significant at the 5% significance level.

Geographic focus

The dummy variable created for geographic focus indicates a positive relation between a European investment focus and fund performance. This is in line with our a priori expectations. However, the relation is not statistically significant, following previous research on the field, which does not support a significant relation between PE fund performance and geographical diversification (Huss & Steger, 2020; Brigl et al., 2008; Aigner et al., 2008).

Crisis vs. non-crisis regression

Vintage year

The vintage year-dummy created as a proxy for the effects of macroeconomic crises indicates a significant underperformance for the funds with vintages 2006-2008 compared to the funds with vintages outside these years, with a coefficient of -5.9345. The variable is statistically significant at the 1% significance level. This result is consistent with previous research (Harris et al., 2014; Jordaan, 2018), who find that funds raised prior to the GFC experienced a lower performance than funds raised outside these specific years, indicating that fund performance is highly cyclical. See Table 17, Appendix F for an outline of this regression.

6.2 Section B - relative performance

6.2.1 Elementary results
PE fund PME ratios
Table 7 outlines PME ratios for the reduced sample of European PE funds extracted for section B analysis, comprising vintage years from 2004 until and including 2016. For each vintage year, the mean PME ratios for each of the three benchmarks applied are shown.

Table 7: Private equity fund public market equivalent results

The table shows average PMEs by vintage year for the S&P 500, Russell 2000, MSCI Europe Standard benchmarks, as well as number of funds per vintage year. The PME benchmarks the performance of a fund against a public market index. If the PME is greater than 1.00, the fund outperformed the public market (net of fees). The figures here displayed are based on the sample of 51 PE funds with complete data available for PME calculations, covering vintage years 2004-2016. The *vintage year* is the inception year of the fund.

Vintage year	Nr. of funds	S&P 500 mean	Russel 2000 mean	MSCI Europe mean
2004	1	1.13	1.14	1.20
2005	2	1.44	1.43	1.69
2006	3	1.13	1.16	1.65
2007	4	0.86	0.87	1.12
2008	3	1.11	1.17	1.53
2009	3	0.96	0.99	1.25
2010	2	1.18	1.30	1.56
2011	4	1.01	1.12	1.34
2012	5	1.35	1.55	1.80
2013	4	1.29	1.44	1.61
2014	9	1.16	1.32	1.45
2015	5	1.03	1.17	1.22
2016	6	1.05	1.26	1.23
Total	51	1.12	1.24	1.43

In overall terms, European PE funds consistently outperform public markets. We observe similar cyclical performance patterns across the three different benchmarks, still different PME ratios, in which outperformance increases when using the Russell 2000 and the MSCI Europe. Over the entire sample, the average S&P 500 PME is 1.12, the Russell 2000 PME is 1.24, and the MSCI Europe PME is 1.43. This indicates an outperformance of the public markets by an average of

the average across the three benchmarks of approximately 26%. These results are slightly above previous findings, as Kaplan and Schoar (2005), Harris et al. (2015), Robinson and Sensoy (2015), Phalippou (2014), and Huss and Steger (2020), report average PMEs between 0.97 and 1.22. See Table 16 in Appendix E for an overview of results reported by previous studies.

Out of the 13 vintage years here included, only two vintages provide mean PME figures below 1.00 - 2007 and 2009 - based on S&P 500 and Russell 2000 results. However, we emphasize the appropriateness of the MSCI Europe comparison, and thus find an average PME across the three benchmarks for vintage year 2009 of 1.06. This signifies that the average European PE fund raised in 2009 performed slightly above public markets. Thus, in average terms, we find evidence of minor underperformance of funds raised in 2007 only, with a mean PME across the three benchmarks of 0.95. These lesser negative results reflect the tumult of the GFC. However, funds with vintage years 2006 and 2008 clearly outperform public markets, with average S&P 500 PMEs of 1.13 and 1.11, respectively. Therefore, based on the overall performance results of 2006-2008 vintages one can argue that in relative to public equities, European PE funds offered better value protection during the GFC. This confirms results obtained by Gianfrate and Loewenthal (2015) and Kosowski (2011) regarding fund performance during financial distress, as although the average IRR of our data sample was negatively affected by the GFC, it did not decrease in proportion with the major crash observed in 2008. Furthermore, the results of the following years indicate that European PE funds both quickly recovered from the 2008 GFC and successfully sustained the 2014 oil price crash, with PME ratios persistently above 1.00. This is in line with the absolute performance results.

For more than half of the vintage years, the average PME is above the mean, and the best average performing funds were raised in 2005 and 2012, irrespective of benchmark comparison. For these vintages, we find S&P 500 PMEs of 1.44 and 1.35, Russell 2000 PMEs of 1.43 and 1.55, and MSCI Europe PMEs of 1.69 and 1.80, respectively. Thus, we find akin, cyclical performance patterns for the absolute and relative performance over time. However, the disturbances observed for the absolute performance are clearly greater than what observed for the relative performance. This supports findings outlined by Robinson and Sensoy (2015)

stating that over time, the performance of PE funds varies much less in relative terms than in absolute terms, because PE cash flows are directly combined with a variety of market conditions. As follows, an important aspect of this study is that we find consistent abnormal returns obtained by the buyout funds studied. This indicates that average PMEs above 1.00 are not occasional and incidental but driven by regular high returns. The economic input of these findings is fundamental, as it provides evidence in favor of our a priori expectations that the abnormal returns obtained by PE funds are driven by factors related to expertise applied by GPs. The effect of these factors is explored in section 6.2.2.

PE fund PME by quartile rank

Figure 8 and Table 8 show average PME by quartile rank for the entire section B data sample. Regardless of PME benchmark, 1st quartile ranked funds perform significantly better than the remaining funds, with average PME figures of 1.43 (S&P 500), 1.61 (Russel 2000), and 1.90 (MSCI Europe standard). The performance of each quartile group also here follows the basic intuition behind the concept, and 4th quartile ranked funds slightly underperform public equity on average. However, not only 1st quartile ranked funds outperform public markets, but also funds of lower rankings. Thus, in line with previous discussions, these results indicate that the skills and expertise of GPs are drivers of abnormal PE fund performance.
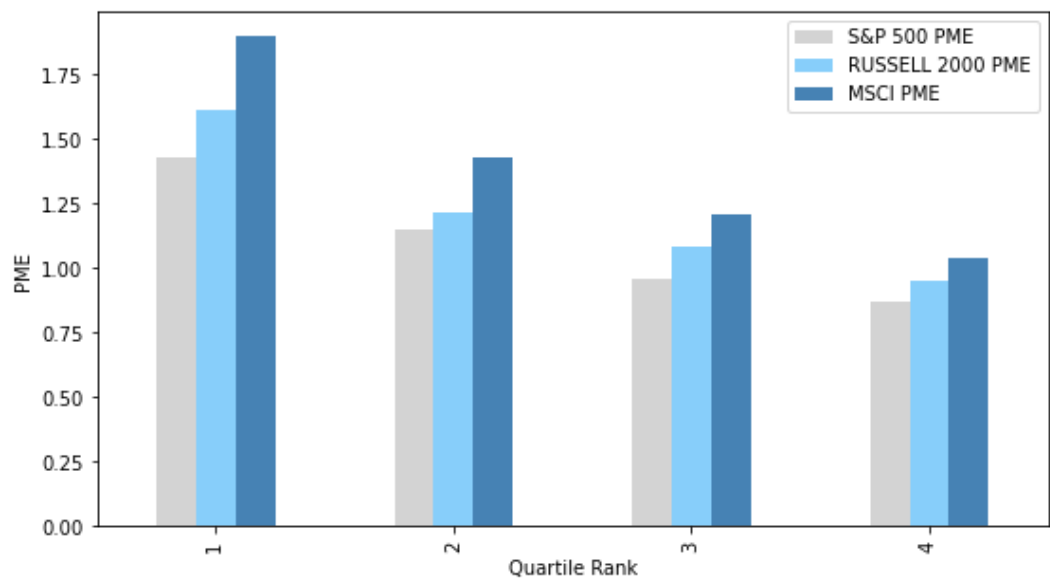

Figure 8: Average PME by quartile rank

Table 8: Average PME ratios by quartile rank

The table shows average PME figures by quartile rank for the S&P 500, Russell 2000, and MSCI Europe Standard benchmarks. The PME benchmarks the performance of a fund against a public market index. If the PME is greater than 1.00, the fund outperformed the public market (net of fees). The figures here displayed are based on the sample of 51 PE funds with complete data available for PME calculations, covering vintage years 2004-2016. The *quartile rank* of a fund is by Preqin calculated using both net IRR and TVPI, in which the most consistent top performing funds are assigned to the 1st rank.

Quartile rank	S&P 500 PME	Russell 2000 PME	MSCI Europe PME
1	1.43	1.61	1.90
2	1.15	1.22	1.43
3	0.96	1.08	1.21
4	0.87	0.95	1.04

6.2.2 Empirical results

Baseline regression

Table 9 presents the OLS regression results for section B (with standard robust errors). The model has a high R-squared of 0.85, meaning 85% of the observed variation in the PME can be explained by the independent variables. Moreover, the F-statistic has a p-value of approximately 0.00, indicating that this model, as in section A, provides a better fit than an intercept-only model.

Table 9: Fundamental OLS estimation section B

The table shows OLS regression results for section B, with robust standard errors. The dependent variable (*S&P 500 PME*) benchmarks the performance of a fund against a public market index, here the S&P 500. If the PME is greater than 1.00, the fund outperformed the public market (net of fees). The *IRR* is a money-weighted return expressed in percentage terms, which by Preqin is calculated net of fees and carry. The *TVPI* expresses how many times investors are likely to receive, or have received, their money back and make a profit from an investment, expressed as a multiple. The *Capital called* is a valuation of the cumulative amount of LP capital invested, shown as a percentage of total LP commitment. *Fund size* (the natural logarithm is applied) is the amount of capital under management, measured in USD millions. *Fund number* is the ordered sequence number of a fund. The *Industrial diversification* is a dummy variable for the industrial diversification of the funds, taking the value one if diversified and zero for all other cases. The *Geographic focus* is a dummy variable for the geographic focus of the funds, taking the value one for European focus and zero otherwise. *Std err* is the standard errors.

Dep. Variable:	S&P 500 PME	R-squared:	0.850
		Prob (F-statistic):	0.000
	Coefficient	Std err	P-value
Constant	0.6609	0.163	0.000
TVPI	0.3486	0.066	0.000
IRR	0.0142	0.004	0.000
Capital called	-0.0031	0.002	0.066
Fund size	0.0031	0.017	0.856
Fund number	0.0014	0.004	0.725
Industrial diversification	0.0004	0.088	0.997
Geographic focus	-0.0891	0.051	0.080

TVPI

The TVPI has, as expected, a positive relation with the dependent variable, ceteris paribus. This means that funds with a higher TVPI are more likely to outperform the public market. Intuitively, this makes sense, as the TVPI is a measure of performance. The result is statistically significant at the 1% significance level, with a p-value of 0.00. Harris et al. (2014) find similar results.

IRR

We observe a positive relation between the IRR and fund-outperformance of public markets, with a coefficient of 0.0142. Somewhat surprisingly, the coefficient of the IRR is substantially lower than that of the TVPI, indicating that the TVPI is a greater

driver of PME compared to the IRR. Harris et al. (2014) confirm this finding and argue that the TVPI is a stronger indicator of fund performance relative to public markets than is the IRR. The coefficient has a p-value of 0.00 and is therefore statistically significant at the 1% significance level. This result is also in line with the findings of Kaplan and Schoar (2005), who report a positive relation between IRR and PME.

Capital called

We observe a negative relation between capital called and the outperformance of the public market by the funds in our sample. As in section A, this finding suggests that funds that utilize all capital available struggle to outperform the public market. The coefficient of -0.0031 is statistically significant at the 10% significance level only, with a p-value of 0.066. This is consistent with findings of Gianfrate and Loewenthal (2015), who find a negative relation between capital called and PME, stating that PE funds that utilize most of their capital perform poorer than PE funds that use less capital.

Fund size

Conversely to the results in section A, we observe a positive relation between fund size and fund outperformance as measured by PME. This result indicates that larger funds are slightly better (coefficient of 0.0031) at outperforming the market compared to smaller funds. However, the result is not statistically significant, suggesting that fund size is not perceived as a key driver of PE fund outperformance. This is consistent with the findings of Harris et al. (2014), Kaplan and Schoar (2005), Robinson and Sensoy (2015), and Lopez-de-Silanes et al. (2015), who also report insignificant relations between fund size and fund outperformance.

Fund number

The fund number variable has, ceteris paribus, a positive relation with fund outperformance. The result suggests that follow-up funds are better at outperforming the market compared to first-time funds, underlining the importance of experience. The result is in line with the findings of Kaplan and Schoar (2005), who observes a positive relation in their studies. Nevertheless, the result is not statistically significant, in line with results of Lopez-de-Silanes et al. (2015).

Industrial diversification

Our model predicts that diversified funds are likely to do slightly better compared to non-diversified funds, as measured by PME. The result is in line with our expectations and the results in section A. However, the result is not statistically significant. The insignificant relation between diversification and relative performance in our sample is in line with the literature of Aigner et al. (2008) and Huss and Steger (2020), who also finds no significant relations between industrial diversification and PME.

Geographic focus

A European investment focus has, ceteris paribus, a negative relation with the outperformance of the public market. This is not in line with the results from section A, in which the relation is positive. A possible reason can be the use of an American index when measuring the European PE market. The result is statistically significant at the 10% significance level only.

7. Recommendations and limitations

Before presenting our conclusion, we discuss certain recommendations and limitations related to the field of PE discovered during this research. Throughout this thesis, we have consistently aimed to extract the most relevant information out of our data sample, to utilize our analysis and draw meaningful conclusions. However, we recognize that shortcomings are influencing some of our results, and that this can question the trustworthiness of our study. In addition, we identify several relevant areas of research within the field of PE that we recommend for future studies.

One drawback of this thesis relates to issues considering the sample used. For certain aspects of this research, the small sample size gave rise to unwanted methods. When performing the Fama French five-factor asset pricing model, a larger sample size with subsequent monthly observations would have been preferred, as this would make it possible to create a more correctly specified model with less variation and more precise outcomes. With a larger data sample, it would be possible to address the existence of systematic market risk more properly in PE fund investments. We find this line of research particularly important, as the

economics of PE as an asset class is likely to be highly shaped by the factors of the Fama French model.

As discussed formerly in this paper, sample selection biases are often documented as a problem when working with PE data. Even though we conclude that such biases are unlikely to be highly present with Preqin data, we acknowledge that a test to check for sample selection bias would have strengthened our analysis. One test of recommendation is the Heckman correction model, which is a regression test with a null hypothesis of no selection bias (Melino, 1982). The inclusion of this model in our analysis would have made it possible to confidently either reject or recognize that the superior PE fund performance observed might be influenced by sample selection biases. However, our data set is not suited for the implementation of a Heckman correction model, and the procedure is therefore not executed.

In like manner, another limitation of this study relates to the potential presence of zombie funds, which as described in section 4.8 could bias the results of this study, and thus restrict the constancy of our conclusions. Therefore, to further improve the reliability and results of this thesis, we recognize that an investigation of whether our data sample includes zombie funds or not could have been implemented. To perform this investigation, we could apply methodologies for zombie fund identification introduced by Preqin, including the use of different performance analyst products (Preqin, 2015). If a substantial number of the funds studied were identified as zombie funds, the performance observed would not represent a true distribution of the PE market, as previous research provides evidence to conclude that zombie funds underperform other PE funds (Eidesen & Erla, 2015).

A second limitation results from the inclusion of European PE funds only, as this constricted geographic scale can induce sample selection issues. An investigation of the descriptive statistics shows that 185 of the 417 funds of the main sample are originated in the UK. This large representation of British PE funds might influence the overall performance of the funds studied, both in absolute and relative terms. Moreover, by restricting the analysis to be European focused, the extracted sample used for PME analysis resulted in a rather small sample of 51 funds only, which consequently limits the possibility to comprehensively estimate relative performance.

An essential area for future studies is to examine the stable performance observed during the 2014 oil price crash. An important notice in these regards relates to the recentness of this crisis, which induces potential limitations related to the trustworthiness of the results observed due to the inclusion of non-liquidated funds. However, to better understand the underlying reasons of the apparently low effect of this crisis on European PE fund performance, we recommend several interesting angles of investigation. First, to find out whether this pattern is particular for European PE funds or not, it could be interesting to repeat the analysis of this research using a data sample of US funds only. Second, due to the concentration of this crisis, which heavily affected the oil markets, we believe it can be interesting to construct a similar analysis focusing on funds with oil-market oriented investments, versus funds with non-oil-market oriented investments. The expected outcome of such research is to observe clear performance differences between the two fund groups, with lower performance for the oil-market focused funds. Lastly, the economic landscape varies substantially across Europe, and it could therefore be interesting to look at the consequences of the oil price crash purely from a Norwegian PE perspective, as the oil sector is a fundamental part of the Norwegian economy.

Further, we believe it could be interesting to make a closer investigation of the fund outperformance observed. Despite our investigation of several expertise-related factors on PE fund performance, we still find it difficult to closely estimate the true relations of skills and expertise. Thus, a recommendation for future research is to pin down the most apparent sources of outperformance related to GP expertise. Within this investigation we suggest researchers to include interviews with GPs to understand their strategic choices and working methods. In line with this and inspired by Mr. Wahl (see Appendix G), another suggestion for future studies is to examine the composition of the management teams behind successful PE funds, to find out whether there are similarities among the teams of top performing funds.

 The clear cyclical performance pattern recognized inspires future research. Even though we find evidence to conclude that European PE funds consistently outperform public markets, we still observe cyclical performance patterns, in both absolute and relative terms. However, due to the covid-19 pandemic, we are

witnessing devastating costs related to human life and national economies across the globe. Consequently, production and manufacturing are growing slowly, while a recent stream of expectations are driving stock markets to high levels. Still, the aftermaths and future consequences of this crisis, including its effect on the PE industry, are yet to be measured. In line with this, an interesting area for future research is to examine the impact of this crisis on PE fund performance, both in absolute and relative terms. It remains interesting to detect whether the outperformance trend of European PE funds also endure this crisis, and whether the after-effects of a pandemic induce new PE fund investment strategies.

8. Conclusion

This thesis studies the absolute and relative performance of European PE funds. We use a high-quality cash flow data sample downloaded from the professional Preqin database, comprising 417 PE funds with vintage years between 1999 and 2016. Standard performance metrics used in the sector is examined, focusing on the IRR on a fund-level basis. In addition, the PME framework is adopted to examine the relative performance of the PE funds in the sample compared to returns in the public market. We also study the importance of other aspects of performance, with several variables serving as proxies for the value added by the expertise of GPs. Lastly, we explore the cyclicality of the European PE sector, examining how fund performance is affected by macroeconomic crises.

We find that the PE funds of our sample experienced great returns over the selected period, with average values being 17.58% for IRR and 1.82 for TVPI. Moreover, our results suggest that European PE funds consistently outperform public markets, regardless of benchmark comparison. Over the entire sample, the average S&P 500 PME is 1.12, the Russell 2000 PME is 1.24, and the MSCI Europe standard PME is 1.43. The cyclicality of the European PE segment is evaluated using funds with vintage years in the period from 2006 to 2008 as proxies for the difficulties associated with creating value during times of distress. The results indicate a significantly lower absolute performance for the funds with vintages in these years, underlining the cyclicality of the European PE sector. However, the relative PME investigation provides evidence to conclude that the performance of the average PE fund of our sample did not decrease in proportion with the effects of the GFC. Moreover, though performance is affected by global macroeconomic crises, our analysis on the oil price crash indicates that PE funds withstand crises that are not directly affecting the industries of each fund's investment segment.

Regression results highlight the relations of GP expertise with PE fund performance, and several variables indicate that LPs and GPs have benefitting options when taking strategic decisions. The results imply that both TVPI and industrial diversification has a positive significant relation with the IRR, while capital called has a negative relation. For the PME, the results indicate a positive significant relation for both TVPI and IRR, and a negative significant relation for capital called and a European geographic focus. Further, the outperformance

observed in this study underlines the value added by GP expertise. However, it is important to emphasize the additional costs and risks associated with PE investments compared to the traditional public market. Such costs and risks include illiquidity costs and commitment risks, which could reduce some of the gains available through PE investments. This, among other factors, explain the return premium investors seemingly require in the PE sector, as they need compensation for bearing additional risks.

We recognize several limitations to our research. First, the size of the data sample of our study is rather small, and the funds included for investigation are buyout funds only, all of which are European located. We concede that such restricted inclusion criteria can affect the results of this research, as the sample may not represent a true distribution of the PE sector. Moreover, as we do not specifically control for sample selection bias and the presence of zombie funds, we acknowledge that our results can be biased.

We believe there are two highly relevant areas to investigate for future research on the field. Firstly, it would be interesting to further evaluate the importance of GP expertise. Here, we suggest a particular focus on elements not included in this analysis, such as the importance of well-functioning management teams, both on a fund- and target company level. Secondly, it would be interesting to examine the effects of the Coronavirus pandemic on fund performance, as to evaluate if the asset class have become more robust in dealing with macroeconomic crises.

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Appendices

Appendix A – Extended definitions of DPI and RVPI

DPI (%): DPI is the abbreviation of the *distribution to paid-in ratio.* It is the actual returns that a fund investor receives. It is the income and capital obtained from the investments of the fund, less all expenses and liabilities, expressed as a percentage of total LP contribution (Preqin, 2021a):

$$DPI(\%) = \frac{Total\ LP\ distribution}{Total\ LP\ contribution} \times 100 \qquad (2)$$

RVPI (%): The RVPI is the abbreviation of the *remaining value to paid-in ratio.* It is a measure that represents the sum at which an asset can be sold or acquired in a transaction between agreeable parties, also known as the residual value, or Net Asset Value. Shown as a percentage of total LP contribution (Preqin, 2021a):

$$RVPI\ (\%) = \frac{Unrealized\ Fund\ Value}{Total\ LP\ Contribution} \times 100 \qquad (3)$$

Appendix B – Data sample inclusion criteria

Table 10: General data sample inclusion criteria

The table outlines which general criteria must be fulfilled for a private equity fund to be included in our total data sample and used in this research. The following criteria are chosen to make the investigation of our research question as complete as possible.

Criteria nr.	Description of criteria
1	The private equity fund must be a buyout fund
2	The private equity fund must have vintage year within the period 1999-2016
3	The private equity fund must be European fund manager located
4	The private equity fund must be closed or liquidated
5	The private equity fund cannot have missing values

Appendix C – Variable descriptions

Table 11: Description of variables

The table shows descriptions of the variables included in regressions in this study, in which the IRR and PME are applied as dependent variables, and the remaining listed variables are independent variables. The expected sign given each variable indicates our a priori expectation of the relationship between the given variable and the dependent variable. A positive sign indicates that an increase in the variable leads to an increase in private equity fund performance, a negative sign indicates that a decrease in the variable leads to a decrease in private equity fund performance. For the dummy variables, a positive sign indicates that if the variable is equal to one, a positive relation with the dependent variable is expected, and vice versa for a negative sign.

Variable	Expected sign	Description
IRR	+	The discount rate that makes the NPV of an investment equal to zero. A money-weighted return expressed as a percentage.
PME	+	A metric comparing PE performance to public market performance.
TVPI	+	A ratio that exposes how many times investors are likely to receive, or have received, their money back and make a profit from an investment. Expressed as a multiple.
Capital called	+	The cumulative amount of LP capital invested, expressed as a percentage.
Fund size	+	The amount of capital under management, measured in USD millions.
Fund number	+	The ordered sequence number of the fund.
Industrial diversification	+	A dummy variable equal to one if the fund has diversified investments, zero otherwise.
Geographic focus	+	A dummy variable equal to one if the fund has a European investment focus, zero otherwise.
Vintage year	-	Fund inception year. A dummy variable taking the value one if vintages 2006-2008, and zero otherwise.

Appendix D – Preliminary tests and models

Table 12: Fama French five-factor asset pricing model

The table shows the regression results of the Fama French five-factor model. The dependent variable (*MeanIRR-RF*) is the excess return of the average PE fund of our sample, estimated using the IRR. We use an OLS regression, with standard robust errors. The *Mkt-RF* represents the excess return of the market. *SMB* captures the return on a diversified portfolio of small stocks over the return on a diversified portfolio of large stocks. *HML* represents the return difference between diversified portfolios of high and low *B/M* stocks. The *RMW* is the difference between the returns on diversified portfolios of robust and weak profitability stocks, and the *CMA* is the difference between the returns on diversified portfolios of low and high investment firm stocks. *Std err* is the standard errors.

Dep. Variable:	MeanIRR-RF	R-squared:	0.279
	Coefficient	Std err	P-value
Constant	13.8777	2.078	0.000
Mkt-RF	0.0627	0.115	0.586
SMB	0.3924	0.218	0.072
HML	0.0800	0.202	0.692
RMW	0.1508	0.260	0.561
CMA	-0.0592	0.307	0.847

Table 13: Standard OLS estimation section A

The table shows the standard OLS regression results for section A, assuming constant variance. The dependent variable (*IRR*) is a money-weighted return expressed in percentage terms, which by Preqin is calculated net of fees and carry. The *TVPI* expresses how many times investors are likely to receive, or have received, their money back and make a profit from an investment, expressed as a multiple. The C*apital called* is a valuation of the cumulative amount of LP capital invested, shown as a percentage of total LP commitment. *Fund size* (the natural logarithm is applied) is the amount of capital under management, measured in USD millions. *Fund number* is the ordered sequence number of a fund. The *Industrial diversification* is a dummy variable for the industrial diversification of the funds, taking the value one if diversified and zero for all other cases. The *Geographic focus* is a dummy variable for the geographic focus of the funds, taking the value one for European focus and zero otherwise. *Std err* is the standard errors.

Dep. Variable:	IRR	R-squared:	0.529
		Prob (F-statistic):	0.000
	Coefficient	Std err	P-value
Constant	-2.6290	5.792	0.650
TVPI	18.3785	0.897	0.000
Capital called	-0.1281	0.047	0.006
Fund size	-0.7311	0.468	0.119
Fund number	0.0425	0.095	0.654
Industrial diversification	3.2036	1.734	0.065
Geographic focus	0.4035	2.773	0.884

Table 14: White test results

The table shows the test statistics of the White test. *LM Statistic* represents the Lagrange Multiplier test statistic.

LM Statistic	58.8514
LM-test p-value	0.0002
F-statistic	2.5699
F-test p-value	0.0000

Table 15: Breusch-Pagan test results

The table shows the test statistics of the Breusch-Pagan test. *LM Statistic* represents the Lagrange Multiplier test statistic.

LM Statistic	17.4198
LM-test p-value	0.0079
F-statistic	2.9790
F-test p-value	0.0074

Appendix E – Previously documented results

Table 16: Average private equity fund performance

The table displays a comparison of average PE fund performance results recognized by previous research. Mean IRR and PME metrics are presented. The *IRR* is a money-weighted return expressed in percentage terms, which by Preqin is calculated net of fees and carry. The *PME* benchmarks the performance of a fund against a public market index. If the PME is greater than 1.00, the fund outperformed the public market (net of fees). The S&P 500 is used as the benchmark in PME calculations in all studies outlined. The *vintage year* is the inception year of the fund.

Authors (years)	Vintage years	Mean IRR	Mean PME
Kaplan and Schoar (2005)	1980-2001	0.19	0.97
Harris et al. (2014)	1984-2008	0.14	1.22
Robinson and Sensoy (2015)	1984-2010	0.09	1.19
Phalippou (2014)	1993-2010	n/a	1.20
Huss and Steger (2020)	1998-2011	0.07	1.22
This research	1999-2016	0.18	1.12 – 1.43[7]

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[7] 1.12 for the S&P 500 PME, 1.24 for the Russell 2000 PME, and 1.43 for the MSCI Europe standard PME

Appendix F – Crisis versus non-crisis regression

Table 17: Crisis vs. non-crisis regression results

The table shows the regression results for section A, including the effect of macroeconomic crisis. We use an OLS regression, with standard robust errors. The dependent variable (*IRR*) is a money-weighted return expressed in percentage terms, which by Preqin is calculated net of fees and carry. The *TVPI* expresses how many times investors are likely to receive, or have received, their money back and make a profit from an investment, expressed as a multiple. The C*apital called* is a valuation of the cumulative amount of LP capital invested, shown as a percentage of total LP commitment. *Fund size* (the natural logarithm is applied) is the amount of capital under management, measured in USD millions. *Fund number* is the ordered sequence number of a fund. The *Industrial diversification* is a dummy variable for the industrial diversification of the funds, taking the value one if diversified and zero for all other cases. The *Geographic focus* is a dummy variable for the geographic focus of the funds, taking the value one for European focus and zero otherwise. *Vintage year 06-08* is a dummy variable taking the value one if vintages 2006-2008, and zero otherwise, in which vintage year represents the first year of drawdown from the investor. *Std err* is the standard errors.

Dep. Variable:	IRR	R-squared:	0.549
		Prob (F-statistic):	0.000
	Coefficient	Std err	P-value
Constant	-2.3650	5.821	0.685
TVPI	18.0854	2.208	0.000
Capital called	-0.1124	0.055	0.041
Fund size	-0.5306	0.522	0.309
Fund number	0.0258	0.048	0.589
Industrial diversification	2.8280	1.415	0.046
Geographic focus	-0.3101	2.340	0.895
Vintage year 06-08	-5.9345	0.795	0.000

Appendix G – Interview with Kim Wahl

The following is a summarization of the interview/conversation conducted with Mr. Kim Wahl, a pioneer within the Nordic PE sector. Graduating with an MBA from Harvard Business School, Mr. Wahl co-founded the European PE company IK Investment Partners, where he served as Deputy Chairman and Partner for 20 years. Mr. Wahl's thoughts and opinions are of great interest to us, as we are extremely interested in learning from someone with inside-experience related to the topic of this study.

Unsurprisingly, Mr. Wahl has a rather positive outlook on the methods and possibilities within the PE industry. He believes that the rise of PE as an asset class was highly inspired by family firms, in which ownership and control is less separated than in the asset classes of the public markets, reducing the risks of agency conflicts. Moreover, he believes that many investors, himself included, have little to no concern over the illiquidity of the asset class, as the time horizon of PE investments is long. Based on his many years in the sector, he estimates that the top quartilers deliver annual returns of over 12% (net fees and carry), while public market indexes often struggle to deliver anything above 8%. This information underlines previous research stating that the average PE fund outperform public markets.

Mr. Wahl believes numerous factors are important for value-creation within the PE sector. The first factor he highlights is fund IRR, in which consistency is key; investors would prefer an IRR of 15% over seven years rather than an IRR of 35% over 6 months. He perceives the IRR is the most important performance measure of a fund until a certain number is reached, typically 10-15%. After this return level, his focus switches towards the return figures of the different multiples. To ensure that all the investment opportunities of a fund are explored properly, he also emphasizes diversification as an important factor of value-creation, both across and within industries and geographies.

Further, he experiences that successful PE funds create value through a comprehensive focus on aspects including for instance growth, strategy, restructuring, corporate governance, and cost-reduction. In essence, he explains that

no two deals within a fund are equal, such that the strategy of each specific deal is individual and tailor-made. He also underlines effective, diverse, and cooperative management teams as important drivers of value-creation. According to Wahl, the structure and operations of a typical PE fund are comparable with that of the State Pension Fund, and he highlights active ownership as crucial for successful fund performance. Relatedly, he finds it easier to be an active owner in the PE industry, compared to the public market industry which is influenced by strict regulations. However, regulations are constantly introduced also to the PE business, partly due to the enormous growth of the industry observed after the 2008 GFC.

Although Mr. Wahl is generally very positive towards PE, he has a few remarks on the asset class. From the perspective of LPs and GPs, a significant drawback is the lack of timing within the sector. As the identification and subsequent purchase of potential target companies take time, it is difficult to forecast the state of the world when the transaction takes place. Consequently, GPs risk overpaying for companies, as the economic climate evolves over time. Nevertheless, PE companies have the luxury of control, and can therefore decide to hold companies for long periods, waiting for the economy to improve. Despite this luxury, he stresses that investors seldom agree on investment periods longer than 12-13 years. Due to this, he perceives the PE industry as less rational than often desired by GPs, in which "evergreen" deals are not possible. Further, PE is an expensive investment form, in which he emphasizes that a successful PE fund must deliver returns sufficient to provide premium returns over time, which constantly cover fees (typically 2%) and carry (typically 20%).

In conclusion, Mr. Wahl described how the PE segment has continually changed since the 2008 GFC. The industry has substantially developed into a mature and huge industry influenced by high competition, colossal volumes of money in circulation, and formal procedures. Interestingly, he notices that large funds are getting larger, and that small funds are more and more niche oriented. Also, compared to thirty years ago, the change of the PE industry has, according to Wahl, resulted in more intermediate return levels, in which "ridiculously lucrative deals" are no longer common practice.