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PRIVATE EQUITY STRATEGIES: Performance and its determinants

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Abstract

This thesis research focuses on the performance of private equity strategies, specifically on buyout funds, venture capital, funds-of-funds, growth equity, secondaries, and balanced funds. Furthermore, we examine the factors that determine the performance of funds. Our sample consists of 4,183 funds from the leading PE database Preqin and we obtain a sufficient number of observations for each strategy. In order to accurately compare these different strategies, we utilize the public market equivalent (PME) metric, developed by Kaplan and Schoar (2005), which compares PE returns to equivalently timed investments in public equity. Furthermore, we conduct an empirical analysis of three performance determinants – fund size, sequence number, and vintage year. Our results reveal that, except for fund-of-funds and secondaries, selected PE strategies significantly outperform public markets. While we document a great amount of variety among different strategies, the performance tends to be negatively affected by fund size and sequence. Similarly, high fundraising levels in the vintage year generally lead to the inferior subsequent performance of PE funds. It is worth noting that we are among the first research papers to report these results for other strategies than buyout funds, VCs, and FoFs.

Keywords: private equity, alternative investments, public market equivalent

1. Introduction

Private equity (PE) is a class of alternative investments that became a popular investment choice for institutional investors and high-net-worth individuals over the past few decades, as well as a capital source for many companies. Nowadays, limited partners (LPs) can choose from a variety of fund strategies, spanning from general direct funds to funds-of-funds (FoF), which invest provided capital to other PE funds. Furthermore, PE strategies also span from venture capital investments into early-stage start-ups to buyouts of large mature companies. That said, each PE strategy brings a certain set of benefits and costs to investors. While it remains relatively small compared to other asset classes, the private equity industry has gained considerable momentum over the years. The assets under management (AUM) of PE funds have been growing steadily in recent years at the annual rate of 20 %, reaching $11.7 trillion by Q2 2022 (McKinsey & Company, 2023).

The capital is typically pledged to PE firms through limited partnership structures. In such arrangements, limited partners (LPs), usually comprising institutional investors (e.g. pension funds, sovereign wealth funds) and high net-worth individuals, decide to commit capital to often closed-end funds managed by general partners (GPs), who usually supply some capital themselves as well (Braun, Jenkinson, and Schemmerl, 2020). Once GPs conduct capital calls, they are obliged to invest the pledged capital within the pre-determined timeframe, usually 5 years. They are also bound by the holding period (up to 10-12 years), after which general partners provide returns from exited investments to LPs (Kaplan and Schoar, 2005).

This thesis research contributes to the body of literature on the performance of private equity funds, which is of substantial value to the participants in the PE industry, especially to limited partners, as it provides the basis for prudent decisions on capital commitments to the funds raised by general partners. Among the key contributions of our paper is that we focus not only on mainstream strategies – buyout funds, venture capital, and funds-of-funds – but we also look at less prominent strategies - growth equity, secondaries, and balanced funds – that have not yet been studied by academic literature.

In our research pursuit, we build upon methodologies of leading papers in this topic. Most importantly, to measure the relative performance of PE strategies, we utilize the public market equivalent, developed by Kaplan and Schoar (2005), also called KS-PME. This metric compares the returns of individual PE funds to equivalently timed investment in public equity, in our case S&P 500 Price Index. Furthermore, we study the factors impacting the performance of selected PE fund strategies, namely fund size, sequence, and vintage. More specifically, we empirically assess the nature and functional form of the relationship between performance and size/sequence. Similarly, we determine how fundraising in the vintage year affects the fund's overall market-adjusted performance.

For the majority of fund strategies, our results document the resolute outperformance over the public equity market. The only exceptions are funds-of-funds and secondaries, whose performance falls below S&P 500 benchmark. In general, we document the negative and convex relationship between selected fund characteristics – size and sequence – and market-adjusted performance, measured by KS-PME. Furthermore, the performance also seems to be impacted by levels of fundraising in the vintage, as high fundraising is usually followed by a worse subsequent performance of the fund. Nevertheless, it is worth mentioning, that the impact of these characteristics on performance can vary considerably between individual strategies, as it is documented later in this thesis.

The remainder of this paper is structured as follows. Chapter 2 provides a comprehensive review of the extant academic literature, focusing on the performance of private equity funds, its determinants, and PE strategies in general. Chapter 3 describes the research sample from Preqin in detail. Chapter 4 thoroughly explains the methodology used to assess the relative performance of PE funds and the factors that determine it. In Chapter 5, we interpret the obtained results of our analysis. Chapter 6 concludes the thesis research.

2. Research background

2.1. Private equity industry

Recent years have seen alternative investments becoming an increasingly important investment choice. While this asset class generally comprises any investable asset other than equity and bonds, private equity (PE) denotes capital investments into private non-listed businesses. These transactions are conducted through closed-end funds operated by either specialized PE firms or consortiums of PE firms, so-called general partners (GPs), which raise capital from a plethora of institutional and private wealth investors, known as limited partners (LPs) (HBS, 2021). Among the best-known PE managers are Blackstone, Kohlberg Kravis Roberts & Co. (KKR), and Carlyle Group. Mega-funds, such as Blackstone's recently closed $30.4 billion real estate fund (Blackstone, 2023), reflects the interest of institutional investors in private equity. On the capital supply side, pension funds are the leading contributors, with 22% of total funds invested. Among other pivotal LPs are funds-of-funds, banks, endowments, sovereign wealth funds, and high net-worth individuals (ECB, 2007; Dutta, Ganguly, and Ge, 2015). The economics of the PE business model revolve around GPs building a portfolio of companies to diversify the investments of capital provided by LPs, who take a passive role and do not participate in funds' management. In this setting, GPs often employ the so-called "2-and-20" compensation structure, typical for the PE industry, where they receive an annual 2% management fee of the committed capital and 20% carried interest from realized profits over a specific hurdle rate, which is usually 8-12% (Harris et al., 2018).

While many finance insiders might assume that the private equity industry has only been around for the last 20 years, its origins can actually be traced many decades back. Financial historians often argue that the first formal PE deal has been facilitated already in 1901, when J. P. Morgan & Co. acquired the distressed Carnegie Steel Company for $500 million, and consequently transformed it into the largest enterprise of its time, U.S. Steel Corporation, which is still in operation to this day. However, the PE industry have seen truly rapid growth a couple of decades later, in the 1980s, during the merger wave fuelled by then-popular high-yield junk bonds. Among the many mega-deals closed in this period was the 1989 leveraged buyout of food and tobacco conglomerate RJR Nabisco by KKR, which remains the largest PE

deal in inflation-adjusted terms, as then $30.06 billion transaction equals 72.32 billion in 2023 US dollars (Dutta, Ganguly, and Ge, 2015). Despite widespread criticism that private equity investing received, mainly due to disruptive operational practices of PE funds, the stellar growth of the industry continued until 2007. While in 1995, the PE market averaged just under $30 billion, transaction volumes exceeded $750 billion by 2007 (Haarmeyer, 2008). Similarly, since the 1980s, amounts invested into PE funds rose ten-fold to $314 billion reported in 2007, a year that has also seen a record 450+ new funds created (Baker, Filbeck, and Kiymaz, 2015). Furthermore, between 1995 and 2011, the share of PE deals in overall US M&A activity grew from 7% to 25%, and similar developments have been mirrored by many other developed economies (Fruhan, 2012). Although the global financial crisis (GFC) meant a substantial slow-down for the industry, private markets quickly recovered and enjoyed the environment of low interest rates, accessible credit, and high valuations during the 2010s. What's more, they maintained decent levels of outperformance over public equity even during covid-19 pandemic. However, recent macroeconomic turbulences hit the private markets as well, resulting in a decrease of 26% in deal volume (to $2.4 trillion) and 11% in fundraising (to $1.2 trillion) in 2022 (McKinsey & Company, 2023).

The rational explanation behind the success and resilience of the PE industry is its unique business model, which finds substantial empirical support in leading corporate finance literature. In his seminal paper, Jensen (1989) postulates the concept of "avoidable waste", which is omnipresent in public corporations, and prompted by the conflict between managers and shareholders over the allocation of free cash flows. Private equity setup is, by design, resilient to such agency conflict, and, thus, the author predicts superior efficiency of PE-backed firms over public counterparts. In his earlier paper, Jensen (1986) also points out that PE-backed companies are often controlled by a small circle of sponsors, as opposed to widely dispersed ownership of listed companies, leading to more active engagement with the company and further mitigating agency problems. Underperforming entrenched CEOs and outside directors are often replaced by PE sponsors following the acquisition (Gong and Wu, 2011; Cornelli and Karakas, 2012). Furthermore, the extensive use of debt instruments is another key feature of many PE transactions, specifically leveraged buyouts (LBOs). Kaplan (1989) indicates that deductible interest payments on debt provide companies with tax shields, a crucial source of value creation. Moreover, debt also acts as disciplining device by

limiting free cash flows available to management. However, in spite of apparent monitoring benefits, Cotter and Peck (2001) argue that tighter debt obligations do not automatically lead to improved performance, as they can still put a considerable burden on LBO firms. Furthermore, the PE industry also creates value in the economy by fostering innovation, as Wright, Thomson, and Robbie (1992) report an increase in product development and asset purchases following PE transactions. Similarly, Ughetto (2010) finds that PE buyouts are followed by an increase in patent registrations, although the actual impact specifically depends on the type of private equity sponsors. That said, PE investments often tend to be associated with increased levels of bankruptcy. Specifically, Rappaport (1990) criticized LBO transactions for high leverage that allegedly limits firms' financial flexibility and increases the risk of bankruptcy. However, multiple studies (Boucly, Sraer, and Thesmar, 2011; Hotchkiss, Smith, and Strömberg, 2011; Tykvová and Borell, 2012; Wilson and Wright, 2013) find no evidence of increased sensitivity of portfolio companies to default, compared to their counterparts. Moreover, they conclude that PE-backed firms display superior financial distress management abilities that help them avoid insolvency or recover faster in case of default. What's more, research also shows that bankruptcies and restructurings represent only 15% of all exits (Harford and Kolasinski, 2014).

Overall, while PE firms have faced certain criticism in the past, their unique business model makes them an attractive asset category for sophisticated investors. Being a staple of institutional investing, the PE industry must also respond to many societal pressures faced by LPs, in particular endowments and pension funds. That is, for instance, most PE funds now consider ESG factors in their due diligence process, and sustainability-related deals experience 7% growth annually. Similarly, increasing focus on diversity, equity, and inclusion (DEI) considerations has prompted more transparency with regard to equal representation in senior positions and investing roles (McKinsey & Company, 2023).

2.2. Private equity strategies

Over decades of its existence, the PE industry has developed a plethora of ways through which fund managers allocate the capital committed by investors. Each of these strategies comes with a unique set of benefits and drawbacks. Moreover, each PE strategy follows its own distinctive business model. In this section, we introduce fund strategies studied in this paper, ranging from most to least prevalent.

2.2.1. Buyout and venture capital funds

Probably the most frequently represented categories *are venture capital (VC)* and *buyout (BO)* funds. Although both strategies share some common characteristics, they focus on companies on opposite sides of a business life cycle. This also means that they follow fundamentally different processes to achieve their returns.

Venture capital (VC) funds invest in companies at the very early stage of their lifecycle. Some of those companies are nothing more than just an unproven business concept with uncertain prospects, which makes this kind of investing inherently risky. Hence, VCs provide initial funding to those start-ups in exchange for a share in it. They also usually do not require majority ownership in the start-up, which has two advantages. Firstly, it acts as a risk management tool, as funding is usually provided in stages – when a portfolio company achieves a pre-determined milestone, VC extends a new round of funding. This ensures VC firms maintain sensible exposure to risky start-ups. Secondly, minority stakes make VC funding an attractive option for founders, who can maintain a controlling interest in their growing businesses (HBS, 2021).

In general, VC funds tend to specialize even within their own category. *Seed funds* focus on business development and proof of concept. Similarly*, start-up funds* invest in companies that have not yet proven commercially viable but are actively developing and marketing their products. *Expansion (late-stage)* venture capitalists invest towards the end of the venture cycle and provide funds necessary for the portfolio companies to achieve profitability (Preqin, n.d.). Not to mention, venture capital is often confused with angel investing. However, the

fundamental difference between the two is that, while VCs invest the capital provided by LPs, angels strictly employ their own resources (Metrick and Yasuda, 2021).

On the opposite side of the business lifecycle spectrum stand *buyout (BO)* funds. Buyout targets are often mature publicly traded corporations with stable cash flows, so executing a buyout generally involves acquiring a majority stake in the company and delisting it from the stock exchange. This gives PE sponsors more flexibility and control to conduct necessary changes to the company's operations, as the ultimate goal of any buyout deal is to sell the company at a higher valuation than the purchase price. At the end of the holding period, PE funds usually exit either through an initial public offering (IPO), selling to a strategic buyer, or re-selling the company to another PE fund (ECB, 2007). In general, we can distinguish 2 types of buyouts. *Management buyout* (MBO) encompasses current executives taking the company private, possibly with the aid of a PE firm, which in this case takes a minority interest in exchange for providing funding (HBS, 2021). On the other hand, a more common *leveraged buyout* (LBO) involves a PE sponsor taking the company private and loading it with high levels of leverage, using its assets as collateral. Over the holding period, debt is gradually repaid, making the remaining equity in the capital structure more valuable. Together with operational improvements conducted in parallel, this allows PE funds to sell the company at profit during exit.

2.2.2. Funds-of-Funds

Another relatively common fund strategy are so-called *funds-of-funds (FoF)*, which have over the years become an increasingly vital component of PE markets. Identically to other funds, they raise capital from various types of limited partners. What distinguishes them from direct funds is that, instead of investing the money directly to individual businesses, they allocate the committed capital to direct funds, therefore, adding the second layer of financial intermediation to the PE industry. Although this also encompasses additional fees, FoF managers possess specialized skills and, as suggested by Harris et al. (2018), they provide investors with 3 significant benefits. Firstly, they offer cost-effective diversification due to distinctive economies of scale in fund administration and liquidity management. Many direct

funds have both strict minimum and maximum investment thresholds that might be limiting to some investors. Therefore, FoFs are often used to scale up investments to PE funds, both in terms of the total sum of funds invested as well as their size. Secondly, FoFs possess unique fund selection and monitoring skills. Although LPs belong to the ranks of sophisticated investors, many of them simply lack the skills and human capital necessary to make prudent decisions on capital allocations to direct funds, especially in the case of industries where they have limited expertise. Hence, they outsource those decisions to FoF managers, who can provide such services at a lower cost. Thirdly, FoFs can provide investors with exclusive exposure to otherwise over-subscribed funds. This is because LPs can leverage FoF's privileged relationship with fund managers of many top-quartile funds, as a result of being among regular contributors to their earlier funds. Therefore, by investing in FoFs, even less established LPs can gain exclusive exposure to highly sought-after funds (Harris et al., 2018).

2.2.3. Other strategies

While the vast majority of funds follow one of the common strategies outlined above, the dataset used in this paper also includes a considerable population of other fund strategies that are rather niche, yet still play an important role in the PE market. Therefore, this section provides an overview of three PE categories – *growth funds*, *secondaries*, and *balanced funds* – for which empirical research is rather scarce, if any.

Growth equity shares many characteristics with VCs, as they obtain rather a minority interest in their portfolio companies and generally abstain from using debt to finance their deals. However, similarly to buyout funds, their targets are profitable enterprises, and their holding periods are reminiscent of those seen in BO deals. But unlike buyout funds, this strategy focuses on growing companies rather than established businesses (Preqin, n.d.). Furthermore, growth equity belongs among the fastest-growing PE segments, attracting a record $132 billion (56.5% YoY increase) of funding worldwide in 2021. However, turbulent macroeconomic conditions since then drove down technology sector valuations, subsequently causing a decline in the number of companies that achieved unicorn status, which belong

amongst the main targets of growth equity (Edlich, Hayes, and Miele, 2023). Despite the cited challenges, this PE segment remains an interesting destination for LP capital.

Secondaries play an important role in the PE industry. Private markets are quintessentially illiquid, meaning that once LPs commit capital to the fund, their money is locked-in for the entirety of the holding period, up to 10 years, during which they have no control over cash flows. Nevertheless, Nadauld et al. (2019) outline several reasons, which force LPs to withdraw from their commitments prematurely. Firstly, unexpected macroeconomic events, for example GFC or covid-19 pandemic, might catch investors short of liquidity. Furthermore, even in times of prosperity, changes in investment policies of institutional investors might require divestments from certain funds, in order to concentrate on the core set of investment objectives. Last but not least, especially in the case of banks, regulatory concerns or portfolio restrictions might force LPs to limit outweighed exposures to PE markets. To fill this gap, secondary funds operate by purchasing stakes of existing LPs before the fund's maturity, thus, providing much-needed liquidity services for institutional investors.

Lastly, as the name suggests, *balanced funds* invest in companies throughout the entire business lifecycle. Unlike specialized funds, they build diversified portfolios of both growing risky start-ups and established buyout targets (Preqin, n.d.). Despite the identical name, balanced PE funds should not be confused with balanced mutual funds, which denote investment vehicles that allocate capital across different asset classes.

2.3. Hypotheses development

In this section, we intend to provide a detailed overview of extant academic research on private equity performance. In this pursuit, we summarize a growing, yet still relatively limited, population of studies that focus on the performance of specific PE fund strategies. Additionally, we also outline recent conclusions from academic literature on the leading factors determining performance.

2.3.1. Performance of private equity strategies

While various studies of PE performance mostly reach a consensus on the superior performance of private markets over public equity, findings of individual papers show a considerable level of ambiguity with regards to specific fund categories. Notably, Harris, Jenkinson, and Kaplan (2014) examine performance data of 1400 US buyout and venture capital funds available on the Burgiss database. When looking at absolute performance, represented by the internal rate of return (IRR) and multiple on invested capital (MOIC), they report an average of 14% annual IRR and 2x MOIC for *buyout* funds. For *VC* funds, authors find even higher levels of absolute performance before the mid-1990s, however, the subsequent collapse of the dotcom bubble led to diminished performance in the later vintages.

Those trends are also mirrored by relative (market-adjusted) performance, as the superior performance of VC against public markets is replaced by underperformance in the 2000s. Moreover, results provide strong evidence of BO outperformance over public equity benchmarks, net of fees. Reaching somewhat contradicting results, Kaplan and Schoar (2005) study the performance of VC and buyout funds between 1980 and 2001, using data from Venture Economics. In contrast with the previous paper, they report superior performance over public equity for VC funds, but not for buyouts. Since both papers benchmark performance against S&P 500, a possible explanation for differences in results could be the use of different data sources. Although Harris, Jenkinson, and Kaplan (2014) indicate that performance data in Burgiss, Preqin, and Cambridge Associates databases yield qualitatively similar results, Venture Economics data used by the earlier study is not considered.

However, results for the combined sample of both strategies in Kaplan and Schoar (2005) imply that average fund returns are roughly equal to the public market benchmark on the net-of-fees basis, and even outperform S&P 500 gross of fees. Furthermore, the authors provide a rationale for the superior performance of private equity over public markets. Firstly, GPs might be able to allocate capital to better investments as they often boast so-called "proprietary deal flow", i.e. having exclusive access to certain deals, due to their broad industry network and track record. Secondly, PE funds are not merely a source of capital for portfolio companies. PE investing goes beyond financial engineering and GPs regularly provide

comprehensive advice to their portfolio companies, further improving their performance. This closer relationship is even more evident in venture capital, where leading VCs are often able to negotiate more favourable terms, for instance, lower valuations at entry than it would be possible in public markets, due to superior inputs they can potentially provide to firms (Hsu, 2004).

In terms of performance, results for *funds-of-funds* are much less ambiguous. Harris et al. (2018), studying the period between 1987 to 2007, demonstrate that investing through FoFs is beneficial for LPs, as they can earn returns that are either equal to or above to S&P 500 benchmark, net of fees. Although, the outperformance margin is smaller when compared to small-cap Russell 2000 index, FoFs still strongly beat public market returns.

While differences persist, extant research on *venture capital*, *buyout funds*, and *funds-of-funds* indicates that PE funds are capable of achieving returns that are either equal or superior to public equity. With regards to the three remaining strategies – *growth equity, secondaries, and balanced funds* – we encounter the lack of performance research. However, based on their characteristics outlined earlier, we assume that their performance should be in line with more mainstream strategies:

H1a: "All fund strategies outperform public market benchmarks."

With regards to *funds-of-funds*, Harris et al. (2018) also conclude that FoFs show consistently better performance than direct funds, possibly due to their specific characteristics outlined in the previous section. This notion is further supported by Gresch and von Wyss (2021), comparing the performance of FoFs and direct funds in the sample of 1641 funds from the Preqin database, which obtains very similar results. Hence, we postulate:

H1b: "Funds-of-funds outperform direct fund strategies."

2.3.2. Performance determinants of private equity fund strategies

Apart from simply measuring the performance of different PE fund strategies, contemporary academic literature has also explored the factors that determine fund performance. In this part, we will focus on the 3 key variables that been prominently featured by leading papers as the factors determining PE performance.

Firstly, *fund size* is possibly the most widely researched determinant of PE performance. Among the leading papers, Kaplan and Schoar (2005) document a positive relationship between fund performance and its size for *venture capital* and *buyout funds*. However, unlike mutual funds, the size-performance relationship in the case of *VC/BO* funds is concave. This means that while larger funds achieve superior performance to smaller funds, very large mega-funds actually experience returns that diminish with their size. There might be several explanations for such concavity. Firstly, because GPs provide their time and expertise to portfolio companies, alongside capital, their investments are not easily scalable. Secondly, it is very difficult for top-performing funds to find investment managers of equal quality to the existing ones, making it hard to hire new partners. Apart from human capital constraints, the number of favourable investment opportunities in the economy is finite, putting further limitations on the scalability of PE investments (Kaplan and Schoar, 2005). That said, partially in contrast to previous findings, Harris, Jenkinson, and Kaplan (2014) find no significant link between the size of buyout funds and their performance. Despite the best performance in their sample is achieved by the funds in the top size quartile, their performance is not significantly different from funds in lower quartiles.

In the case of other fund categories, conclusions on the size-performance relationship for *FoFs*, *growth equity*, *balanced funds*, and *secondaries* are absent in extant academic literature. Notwithstanding this limitation, we infer that constraints outlined by Kaplan and Schoar (2005) should be applicable to other fund strategies as well. Hence, we suppose:

H2: "Positive concave relationship exists between fund size and performance for all private equity fund strategies."

Secondly, fund performance is presumably related to its *sequence (series) number*. Sequence number serves as a useful proxy for general partners' experience, as a higher fund series number means that a particular GP has managed other funds in the past, providing valuable information about their track record. While research on this specific variable is scarce, Kaplan and Schoar (2005) imply that, aside from size, GP's experience also matters for *VC* and *BO* funds, as funds of higher sequence tend to outperform public equity by a greater margin. What's more, the authors further suggest that GP's track record also affects capital flows into funds, as investors base their decisions on capital contributions to follow-on funds on the past performance of a particular fund manager. Again, due to the absence of relevant research for strategies other than *VCs* and *BOs*, we expect the assumption that GP's experience increases performance to hold for other fund categories as well, therefore:

H3: "Fund sequence number is positively related to the performance of all strategies."

Last but not least, existing research considers *vintage year* among the leading determinants of PE fund performance. Vintage year denotes the time of the first investment by the fund, which generally comes shortly after GPs make capital calls. This is important because fundraising, and by extension performance, in private equity markets have been highly cyclical. Brown et al. (2021), focusing on the timing of *VC* and *BO* investments, indicate that aggregate volumes that LPs commit to PE funds drastically differ between periods of economic expansion and contraction. Authors claim that because LPs are generally institutional investors, this cyclicality is mechanically induced to the PE sector from public equity, as run-ups in stock markets might affect the capital allocation decision of LPs. Furthermore, the findings of Brown et al. (2021) also suggest that vintages with high fundraising tend to be followed by periods of lower performance, and the effect is more visible in absolute performance rather than market-adjusted terms. Again, due to limited academic literature, we assume that growth equity and balanced funds, which share many key characteristics with *VC* and *BO* funds should be subject to the same cyclicality that has been documented in *VC/BO* research. Therefore, we postulate:

H4a: "Performance of venture capital, buyout, growth, and balanced funds is negatively related to levels of fundraising during the vintage year."

That said, funds-of-funds do not seem to be impacted by changes in the business cycle. As Gresch and Wyss (2010) indicate, *FoFs* display comparably more robust performance than *VCs* and *BOs* and tend to be immune to changes in public equity markets. Such returns stability is a consequence of high levels of vintage year diversification, since FoFs hold portfolios of direct funds that started investing in different periods. This logic might also be extended to secondaries, as their portfolios consist of stakes in direct funds with varying vintages that have been purchased from primary LPs. Therefore, our last hypothesis is as follows:

H4b: "Vintage year is not significantly related to the performance of funds-of-funds and secondaries."

All things considered, the extant literature on the performance of private equity strategies seems to be rather limited, especially with regard to non-mainstream strategies. Therefore, this paper aims to close this gap in the research. The next section provides a comprehensive overview of our dataset, together with descriptive statistics.

3. Data

Both the performance comparison and empirical analysis in this thesis paper are based on detailed fund-level data obtained from Preqin, which includes a large set of performance-related variables, used in later chapters of this paper in assessing fund performance and its determinants. Preqin belongs among the leading data providers for the alternative investments industry and its data is predominantly derived from the obligatory Freedom of Information Act (FOIA) requests to public pension funds in the United States and the United Kingdom, as well as more than 900 contributing general partners (Preqin, 2013). Importantly, since all reported funds are assigned a specific fund strategy, this dataset allows us to compare the performance of well-researched mainstream strategies (e.g. VC, buyout) alongside the less prominent one, where extant literature is rather limited.

In the pursuit of our research objectives, we specifically utilize the fund-level performance dataset, which has been assessed through May 2023. The dataset has not been altered in any way during the data collection process. However, since the raw dataset includes a large set of variables, those deemed irrelevant to our research have been removed from the original dataset. Additionally, the following criteria have been applied in the selection process:

- Funds assigned to one of the selected PE strategies of interest – *Venture Capital (incl. VC generalists, seed, start-up, early-stage, expansion/late-stage), Buyout, Fund-of-funds, Growth Equity, Balanced, Secondaries (incl. direct secondaries)*

- Funds reporting absolute performance variables - *Net IRR, Net Multiple (TVPI)* - as well as those necessary to construct public market equivalent (PME) measure – *Residual Value to Paid-In (RVPI), Distributions to Paid-In (DPI)*

- Funds reporting variables required for performance determinants analysis – *Fund Size, Vintage year, Fund sequence*

- Funds with *vintage years 2011 and earlier* – in line with previous research (Harris et al., 2018; Brown et al., 2021; etc.) and to allow for calculation of public market equivalent (PME) metric

- Funds deemed "economically relevant" – with *funds size over $5 million* – in accordance with Kaplan and Schoar (2005)

- Funds with a *lifespan not exceeding 2022* - to allow for PME calculation (only relevant to funds reporting lifespan)

After applying the outlined criteria to the raw dataset (11,197 funds), we obtain our final dataset comprising 4,183 observations. It is worth noting that this dataset is larger than most of those used in previous research. Moreover, each of the selected fund strategies is represented by a sufficient number of observations. Specifically, our dataset includes *1,451 VC funds, 1,413 buyout funds*, *662 funds-of-funds*, *345 growth funds*, *194 secondaries*, and *118 balanced funds*. As shown in Fig. 1, our dataset does not oversample against any individual strategy. The two most common strategies, *buyout* and *VC*, each account for approximately one-third of the funds. For instance, the dataset in an earlier paper by Kaplan and Schoar (2005) comprised 78% of VC funds and only 22% of BO funds. Therefore, our dataset is more evenly split between the respective fund categories. The remainder of funds is then almost equally divided between *FoFs* and non-mainstream strategies. In general, the proportional distribution of strategies in our dataset is fairly representative of the current PE market.

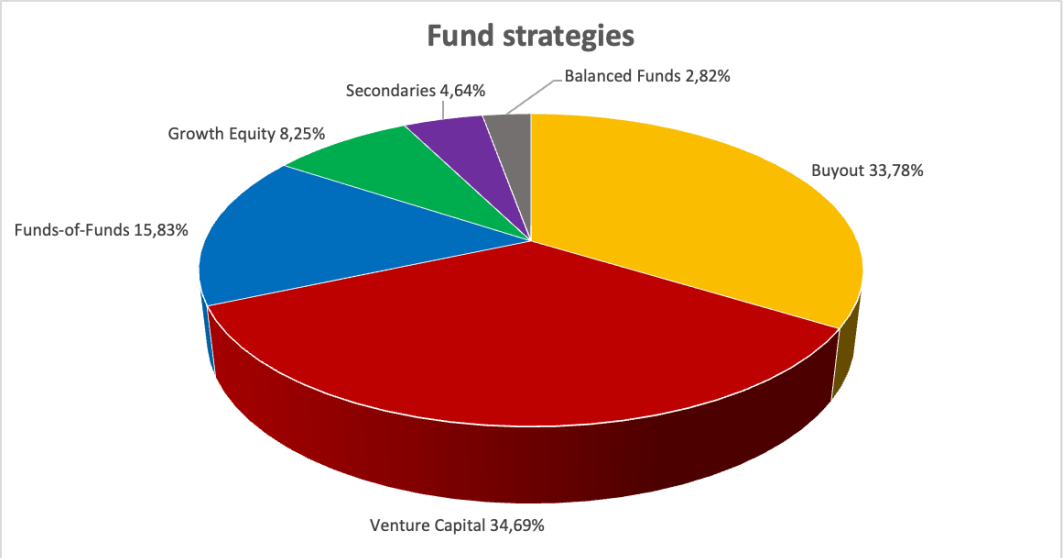


Fig. 1: Distribution of PE fund strategies

When we look at the *geographic distribution* of PE funds in Fig. 2, according to their reported primary region, we can see that over half of the funds in our dataset invest their capital in Northern America, followed by Europe and Asia, accounting for approx. 22% and 9%

respectively. While it might seem that our dataset is overly inclined towards US funds, relatively similar distributions can be seen in earlier studies using Preqin data. For instance, Gresch and von Wyss (2010) report over 80% of funds in their sample being focused on the US, 11% on Europe, and only the remaining 9% on other geographies. Provided that the PE industry is most developed in North America and Europe, our sample relatively closely depicts the reality of current private equity markets. Rather surprising is that only less than 1% of all funds are geographically diversified. However, this might be explained by the range of non-capital inputs, outlined in the previous section (e.g. time and expertise), that PE managers provide to portfolio companies, which might set limitations for the geographical proximity of their investments.

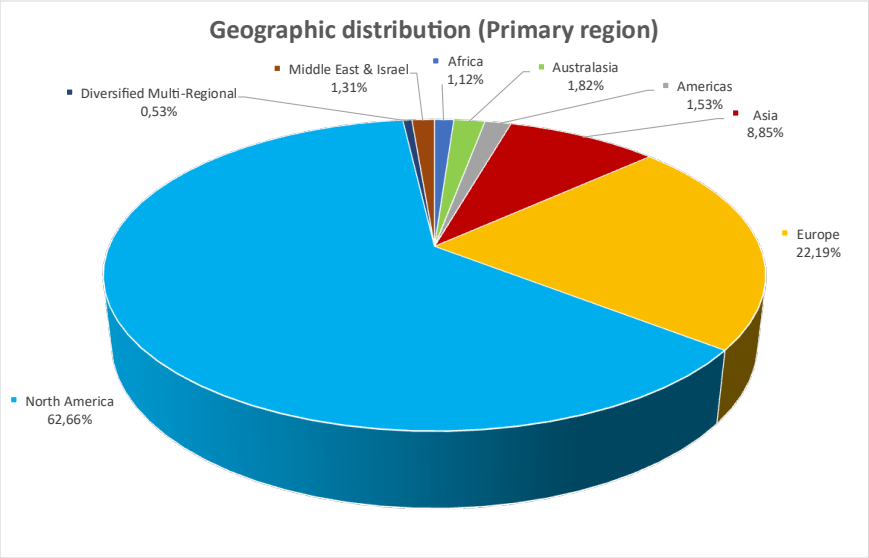


Fig. 2: Geographical distribution by primary regions

In terms of *vintage years*, we obtain a sample period spanning 40 years. The earliest observation in our sample is the balanced fund *EMW Ventures*, which began investing in 1971. By contrast, the latest funds in our dataset are from 2011, due to the aforementioned vintage year restriction. Regarding current status, 60% of funds in our sample are liquidated, and the remaining 40% are closed for investment (see Appendix B.1). Table 1 reports the number of fund observations per vintage year, which are further grouped into decades. Funds are also divided by their strategies. The full table outlining observations per individual year can be found in Appendix B.2. In line with the development of the PE industry, we document rather scarce observations in the 1970s, which is replaced by a massive spike in fund registrations

during the 1980s, fuelled by growth in *buyouts* and *venture capital* investing. That said, we see other strategies emerging with a substantial lag. While the first *fund-of-funds* appears already in 1982, we only register double-digit observations in the late 1990s. Similarly, now-trending *growth equity* funds gained sufficient momentum at the turn of the millennium, despite their first occurrence in 1986. Around the same time, the first *secondary funds* emerged. However, this strategy has also experienced sizeable growth way later in the mid-2000s. Having said that, balanced funds seem to be rather an exception in our sample. While all other strategies have been constantly growing over the decades, balanced funds reached their peak in the late 1990s and their numbers have been declining since then. This might be due to the notable trend of fund specialization in recent decades.

Table 1: Fund observations per vintage decades

The following table divides our sample among different vintage decades, covering the sample period 1971-2011. This is done for the full sample, as well as individual strategies. The full table showing the fund observations per individual vintage years can be found in Appendix B.1.

Vintages	All strategies	Buyout	VC	FoF	Growth	Secondaries	Balanced
1971-1979	8	2	5	0	0	0	1
1980-1989	207	63	119	11	2	3	9
1990-1999	1,016	375	424	86	45	36	50
2000-2011	2,952	973	903	565	298	155	58

Another interesting highlight is the division of our observations among *sequence* numbers. The fund's sequence denotes its chronological order among all funds raised by the same GPs. It can also be used as a proxy for GP's experience, as PE fund managers gain deeper expertise through managing follow-on funds. Earlier research by Kaplan and Schoar (2005) uses a sample, which comprises 41% of first-time funds. Moreover, authors also conjecture that oversampling first-time funds might affect performance results, as they usually tend to underperform higher-sequence funds. However, this does not seem to be the case with the dataset examined in this paper. For comparison, Fig. 3 depicts the proportion of different sequence numbers in our sample. While first-time funds account for 26.78% of the sample, they outnumber second- and third-time observations by only a small margin as those take 19.87% and 14.06% respectively. What's more, our sample in fact includes a surprisingly broad set of even higher-sequence funds, accounting for 39.30% of all observations. Interestingly,

the fund with the highest sequence in our sample is the $540 million *Secondary Overflow Fund*, managed by HarbourVest Partners as their record 59th fund.

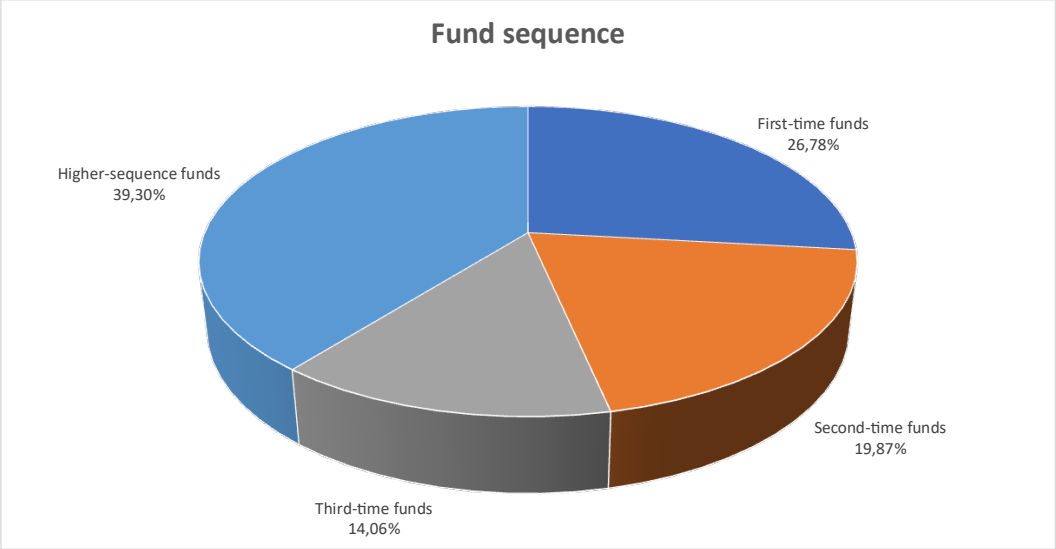


Fig. 3: Proportion of fund sequences

Although the fund performance will be more thoroughly examined in the next chapters, Table 2 documents the share of different PE fund strategies among performance quartiles. *Quartile ranks* are a conventional way of benchmarking the performance of individual funds against their peer group, with top-quartile funds being the best performing. Especially insightful are the last 2 rows of the table, which show the proportion of individual strategies within the top-quartile rank and compare it to their percentual representation among all observations. While the share of *FoFs* among the top-quartile funds almost perfectly mirrors their fraction within the whole sample (approx. 16%), *buyout funds* and *VCs* make up a rather disproportionate portion of top-quartile ranks (38.4% and 36.8%), considering they represent 33. 8% and 34.7% of our sample respectively. On the other hand, *growth* and *secondary* funds are relatively under-represented in the top quartile (5% and 1.9%), while they account for 8.3% and 4.6% of all funds. However, it is also worth noting that roughly half of all growth and secondary funds do not report their quartile ranks.

Table 2: Quartile ranks

This table divides fund observations in our sample into respective performance quartiles. The best-performing funds are in the top quartile. We further show the percentage of funds that do not report quartile ranks. In the last two rows, we compare the representation of individual strategies in our sample against their representation among top-performing funds.

Quartile rank	All strategies	Buyout	VC	FoF	Growth	Secondaries	Balanced
Top quartile	779	299	287	118	39	15	21
2nd quartile	770	273	277	104	53	39	24
3rd quartile	715	259	236	110	42	37	31
4th quartile	503	206	157	83	28	10	19
Not reported	1,416	376	494	247	183	93	23
(%)	*(33.85)*	*(26.61)*	*(34.05)*	*(37.31)*	*(53.04)*	*(47.94)*	*(19.49)*
% of observations		*33.78%*	*34.69%*	*15.83%*	*8.25%*	*4.64%*	*2.82%*
% of top quartile funds		38.38%	36.84%	15.15%	5.01%	1.93%	2.70%

3.1. Descriptive statistics

Table 3: Summary statistics

This table reports summary statistics for the full sample of 4,183 funds, as well as for each of the examined strategies separately. The sample includes individual private equity funds raised between 1971 and 2011. Our data comes from Preqin and includes funds that comply with the above-mentioned selection criteria.

ALL STRATEGIES	*Fund size ($M)*	*Vintage*	*Sequence*	*Lifespan*	*Net IRR (%)*	*TVPI (x)*	*DPI (%)*	*RVPI (%)*
Mean	480.09	2002	5	10.50	14.22	1.97	173.24	24.14
Standard Error	16.66	0.10	0.11	0.21	0.49	0.03	2.78	0.87
Median	180.00	2004	3	10	10.70	1.63	148.93	0.00
Mode	100.00	2007	1	10	12.00	1.00	0.00	0.00
Standard Deviation	1,077.47	6.46	6.91	2.23	31.96	1.83	179.80	56.03
Sample Variance	1,160,947.87	41.74	47.74	4.97	1,021.60	3.34	32,327.99	3,139.16
Kurtosis	85.75	0.75	17.33	3.46	283.63	98.59	101.19	79.24
Skewness	7.52	-0.96	3.78	0.39	11.98	7.65	7.59	6.61
Range	20,294.90	40	58	16	1,115.71	38.72	3,832.53	1,052.00
Minimum	5.10	1971	1	4	-100.00	0.00	0.00	0.00
Maximum	20,300.00	2011	59	20	1,015.71	38.72	3,832.53	1,052.00
Sum	2,008,210.96	8,375,975	20,556	1,218	59,477.77	8,256.31	724,648.88	100,981.71
Count	4,183	4,183	4,183	116	4,183	4,183	4,183	4,183

BUYOUT	*Fund size ($M)*	*Vintage*	*Sequence*	*Lifespan*	*Net IRR (%)*	*TVPI (x)*	*DPI (%)*	*RVPI (%)*
Mean	850.85	2002	3	10.72	16.22	1.97	184.85	11.92
Standard Error	42.20	0.17	0.10	0.27	0.56	0.03	3.53	0.76
Median	332.67	2004	2	10	13.40	1.75	169.34	0.00
Mode	300.00	2007	1	10	8.00	1.70	0.00	0.00
Standard Deviation	1,586.17	6.29	3.81	1.99	21.20	1.28	132.81	28.64
Sample Variance	2,515,943.80	39.55	14.53	3.94	449.42	1.63	17,637.86	820.04
Kurtosis	40.87	0.42	16.27	2.93	57.68	108.17	94.68	19.75
Skewness	5.27	-0.84	3.58	-0.80	4.41	7.42	6.72	3.68
Range	20,291.95	34	31	12	418.00	26.04	2,603.91	334.90
Minimum	8.05	1977	1	4	-100.00	0.00	0.00	0.00
Maximum	20,300.00	2011	32	16	318.00	26.04	2,603.91	334.90
Sum	1,202,254.32	2,829,166	4,887	579	22,920.34	2,780.25	261,189.33	16,836.16
Count	1,413	1,413	1,413	54	1,413	1,413	1,413	1,413

VENTURE CAPITAL	*Fund size ($M)*	*Vintage*	*Sequence*	*Lifespan*	*Net IRR (%)*	*TVPI (x)*	*DPI (%)*	*RVPI (%)*
Mean	179.95	2001	3	10.43	13.66	2.08	176.04	32.21
Standard Error	6.30	0.18	0.10	0.56	1.25	0.07	6.71	2.03
Median	100.60	2001	2	10	7.40	1.46	122.96	0.00
Mode	100.00	2000	1	10	7.00	1.00	0.00	0.00
Standard Deviation	240.13	6.95	3.80	2.69	47.63	2.65	255.49	77.27
Sample Variance	57,661.69	48.37	14.46	7.26	2,268.33	7.00	65,272.91	5,970.19
Kurtosis	29.84	0.31	57.00	0.75	162.68	56.43	62.69	57.02
Skewness	4.23	-0.77	5.94	0.38	9.96	6.13	6.42	6.12
Range	2,794.90	39	53	11	1,115.71	38.72	3,832.53	1,052.00
Minimum	5.10	1972	1	6	-100.00	0.00	0.00	0.00
Maximum	2,800.00	2011	54	17	1,015.71	38.72	3,832.53	1,052.00
Sum	261,110.93	2,903,144	4,989	240	19,825.08	3,021.64	255,429.28	46,734.55
Count	1,451	1,451	1,451	23	1,451	1,451	1,451	1,451

FUNDS-OF-FUNDS	*Fund size ($M)*	*Vintage*	*Sequence*	*Lifespan*	*Net IRR (%)*	*TVPI (x)*	*DPI (%)*	*RVPI (%)*
Mean	328.98	2005	11	11.00	10.20	1.81	147.59	32.93
Standard Error	15.88	0.19	0.47	1.00	0.32	0.03	2.92	1.84
Median	185.64	2006	6.5	11	9.31	1.64	147.57	11.09
Mode	300.00	2007	1	N/A	12.10	1.60	0.00	0.00
Standard Deviation	408.61	5.00	12.10	1.41	8.23	0.81	75.08	47.43
Sample Variance	166,961.54	24.99	146.52	2.00	67.78	0.65	5,636.65	2,249.27
Kurtosis	11.87	2.20	2.31	N/A	16.22	21.44	24.57	13.25
Skewness	2.94	-1.31	1.68	N/A	1.15	3.34	2.70	2.70
Range	3,128.89	29	57	2	135.92	9.73	978.91	463.00
Minimum	5.40	1982	1	10	-52.68	0.41	0.00	0.00
Maximum	3,134.29	2011	58	12	83.24	10.14	978.91	463.00
Sum	217,786.69	1,327,035	7,359	22	6,751.87	1,195.04	97,705.44	21,798.98
Count	662	662	662	2	662	662	662	662

GROWTH EQUITY	*Fund size ($M)*	*Vintage*	*Sequence*	*Lifespan*	*Net IRR (%)*	*TVPI (x)*	*DPI (%)*	*RVPI (%)*
Mean	377.01	2006	4	10.17	14.31	2.08	174.92	32.68
Standard Error	40.57	0.26	0.23	0.61	1.20	0.08	8.74	3.06
Median	175.00	2007	2	10	12.30	1.72	150.00	6.00
Mode	100.00	2008	1	10	14.00	1.00	0.00	0.00
Standard Deviation	753.55	4.80	4.31	2.92	22.21	1.57	162.41	56.81
Sample Variance	567,833.44	23.05	18.58	8.51	493.23	2.45	26,377.78	3,227.88
Kurtosis	72.89	0.80	20.69	5.17	11.52	17.06	15.67	17.40
Skewness	7.41	-1.11	4.01	1.47	1.54	3.54	3.28	3.40
Range	8,815.60	25	35	14	254.90	12.52	1,253.30	424.00
Minimum	5.40	1986	1	6	-87.90	0.03	0.00	0.00
Maximum	8,821.00	2011	36	20	167.00	12.55	1,253.30	424.00
Sum	130,069.46	691,903	1,220	234	4,936.53	716.23	60,349.04	11,273.74
Count	345	345	345	23	345	345	345	345

SECONDARIES	*Fund size ($M)*	*Vintage*	*Sequence*	*Lifespan*	*Net IRR (%)*	*TVPI (x)*	*DPI (%)*	*RVPI (%)*
Mean	623.98	2004	8	10.20	16.20	1.64	149.32	14.78
Standard Error	75.81	0.41	0.69	0.37	0.90	0.04	3.95	2.27
Median	213.40	2006	5	10	13.86	1.54	148.00	0.41
Mode	250.00	2006	2	11	16.50	1.70	170.00	0.00
Standard Deviation	1,055.95	5.64	9.62	0.84	12.51	0.52	54.96	31.68
Sample Variance	1,115,027.09	31.84	92.54	0.70	156.49	0.27	3,020.20	1,003.76
Kurtosis	11.73	0.30	7.74	-0.61	2.15	3.56	2.77	8.09
Skewness	3.14	-0.99	2.61	-0.51	1.14	1.51	0.42	2.83
Range	7,043.70	24	58	2	76.76	3.15	381.39	182.00
Minimum	10.00	1987	1	9	-10.78	0.67	0.00	0.00
Maximum	7,053.70	2011	59	11	65.98	3.81	381.39	182.00
Sum	121,052.44	388,813	1,559	51	3,142.34	318.35	28,968.67	2,866.81
Count	194	194	194	5	194	194	194	194

BALANCED FUNDS	*Fund size ($M)*	*Vintage*	*Sequence*	*Lifespan*	*Net IRR (%)*	*TVPI (x)*	*DPI (%)*	*RVPI (%)*
Mean	643.53	1999	5	10.22	16.12	1.90	178.03	12.47
Standard Error	158.58	0.65	0.46	0.22	2.50	0.10	10.46	2.79
Median	156.48	1999	3	10	10.92	1.64	156.46	0.00
Mode	300.00	1997	1	10	8.10	3.30	330.00	0.00
Standard Deviation	1,722.57	7.10	4.96	0.67	27.11	1.11	113.63	30.30
Sample Variance	2,967,245.19	50.47	24.57	0.44	735.20	1.23	12,912.02	917.98
Kurtosis	45.56	1.42	4.74	9	39.36	3.34	2.83	7.88
Skewness	6.17	-0.82	2.15	3	5.17	1.68	1.43	2.85
Range	15,101.50	40	24	2	254.79	6.01	642.00	144.00
Minimum	5.50	1971	1	10	-15.00	0.41	0.00	0.00
Maximum	15,107.00	2011	25	12	239.79	6.42	642.00	144.00
Sum	75,937.12	235,914	542	92	1,901.62	224.79	21,007.12	1,471.48
Count	118	118	118	9	118	118	118	118

Table 3 reports both performance and non-performance summary statistics for the combined sample of all strategies as well as individually for each strategy. As shown in the table below, the cumulative value of LP commitments to funds over our sample period totalled to roughly $2 trillion. That said, the average *fund size* in the combined sample is $480 million, whereas the median fund managed $180 million. Such disparity between mean and median values indicates that fund sizes are asymmetrically distributed, and mean values are drawn upwards by the presence of numerous mega-funds in our sample. For instance, the $20,3 billion buyout fund *GS Capital Partners VI* holds the size record among all funds in our dataset. However, the magnitude of size variance differs amongst fund strategies. While *buyout, growth, secondary*, *balanced* funds, and *FoFs* display large differences between mean and median sizes, the magnitude is much smaller for *VCs*. Overall, *buyout funds* tend to be the largest on average, with a mean size of $851 million, followed by *balanced funds* ($644 million), *secondaries* ($624 million), *growth equity* ($377 million), and *FoFs* ($329 million). In contrast, *venture capital* funds with an average size of $180 million are the smallest.

As shown in the second column of Table 3, most funds started investing in 2007, which is with a total of 388 occurrences the most common inception year in our sample. However, this sample mode is different from the median vintage year (2004), which denotes the midpoint between the oldest and youngest observation in our sample. That said, *balanced funds* are overall the oldest fund category, with the median inception year being 1999, whereas the 2007 median vintage year makes *growth equity* the youngest. This is in line with market trends outlined earlier. While growth equity belongs among the fastest-growing strategies in recent years, the ranks of balanced funds have reduced substantially over the past decade. To that end, we can see similar patterns for other strategies as well. Being a rather recent phenomenon, vintages of *FoFs* and *secondaries* are generally above the median. On the contrary, the inception years of *VC funds*, which have always been the staple of PE strategies, are below the median.

The last of the non-performance statistics denotes the *lifespan* of PE funds. Although this statistic is reported by only a limited number of funds in the dataset, it provides valuable insight into typical fund structure. As shown in the fourth column of Table 3, the partnerships can last as long as 20 years, but funds can also be liquidated only after 4 years. However, a

typical fund in our combined sample has a lifespan (incl. extensions) of 10.50 years, which is quite similar to the holding periods reported by earlier papers (Gresch and von Wyss, 2010; Harris, Jenkinson, and Kaplan, 2014). Unlike other characteristics discussed earlier, we do not observe significant differences in lifespans among individual strategies. *VCs, growth equity*, *secondaries,* and *balanced funds* have a slightly shorter duration – 10.43, 10.17, 10.20, and 10.22 years respectively. Conversely, *FoFs* and *buyout* funds have generally a bit longer than the sample mean, lasting on average 11 and 10.72 years.

Although a detailed analysis of relative performance will follow further in this paper, Table 3 also presents key summary statistics related to fund performance in the combined sample. Firstly, the table shows the *internal rate of return (IRR)* and *total value to paid-in (TVPI)*, which are both measures of absolute performance. We can see that the average fund, regardless of the strategy, offers 14.22% IRR and 1.97x TVPI. The highest returns are offered by *buyouts*, averaging 16.22% net IRR, followed by *secondaries* (16.20%), and *balanced funds* (16.12%). *Growth equity*, yielding 14.31% IRR, outperforms the sample mean only marginally. Conversely, *funds-of-funds* have the lowest average IRR of 10.20%. In a similar fashion, *VCs* underperform the aforementioned strategies, as they yield 13.66% IRRs. However, when looking at total value to paid-in (TVPI), we see rather different patterns. The sample average is only marginally outperformed by *venture capital* and *growth equity*, both delivering 2.08x TVPI. That said, the average multiple of *buyout funds* is identical to the sample mean (1.97x), while markedly below the sample average are *secondaries* (1.64x), *FoFs* (1.81x), and *balanced funds* (1.90x). Overall, our sample exhibits IRRs that are either on par (Harris, Jenkinson, and Kaplan, 2014) or lower (Kaplan and Schoar, 2005) than those documented by previous studies of VC and buyout funds, and higher for *FoFs* (Gresch and von Wyss, 2012; Harris et al., 2018).

Secondly, Table 3 reports summary statistics for *distributions to paid-in (DPI)* and *residual value to paid-in (RVPI)*, variables that provide valuable insight into fund cash flows and will be further utilized in the performance analysis chapter of this paper. Furthermore, those variables combined make up TVPI, which has been discussed earlier. DPI denotes the share of cash distributions that have been paid to LPs on their committed capital, while RVPI is the ratio of the value of remaining unrealized fund investments to the investors' contribution (Preqin, n.d.). As documented in the table, investors received on average 173.24% of their

contributions from investing in PE funds in our sample. In terms of individual strategies, they have been better off investing in *buyout funds* (184.85% DPI), *balanced funds* (178.03% DPI), *venture capital* (176.04%), and *growth equity* (174.92% DPI). On the other hand, below-average DPIs have been realized by *FoFs* (147.59%) and *secondaries* (149.32%). However, it is worth noting that investment in any strategy would return more to LPs than what they invested. Apart from distributions, the value of unrealized investments (RVPI) averaged 24.14% in the sample. While some strategies (*VC, FoF, growth*) displayed RVPI of roughly 33%, *balanced funds* and *secondaries* maintained comparably lower RVPI levels of 12.47% and 14.78%. Moreover, the lowest residual values have been exhibited by *buyout funds*, accounting only for 11.92% of capital contributions.

All things considered, considerable differences persist between individual performance metrics outlined above, and we obtain often contradicting results. To resolve this ambiguity, in the next chapters of this paper, we will construct a relative measure of performance that benchmarks PE returns against public equity.

4. Methodology

This chapter provides a detailed overview of the empirical strategy for testing hypotheses derived earlier in this paper. In this pursuit, we divide it into 3 sections. The first part outlines steps used to construct the fundamental variable in this research - public market equivalent (PME), originally developed by Kaplan and Schoar (2005) and, hence, also referred to as KS-PME. The original methodology has been specifically modified to maintain the large number of observations, which we regard to be one of the main advantages of this thesis. The second section explains the approach used to determine the relationship between fund size or sequence and market-adjusted performance, as well as to test for the functional form of this relationship. In the final part of this chapter, we outline the empirical approach used to uncover the impact of macroeconomic conditions in the vintage year on the subsequent performance of private equity funds. In all cases, regression and estimations are conducted on the full sample, as well as separately for each of the examined strategies. All our results are then presented in the next chapter.

4.1. Public market equivalent (KS-PME)

In order to test our first hypothesis, concerning the performance of selected PE fund strategies relative to public equity markets, we construct a public market equivalent (PME). This variable is a widely recognized measure of performance in the private equity industry and has been employed by a number of past studies, including those that this research builds upon. In general, PME compares LP's contribution to PE fund to equivalently timed investment in public equity and implicitly assumes that capital, which is not allocated to the PE, would be allocated to public equity (Harris et al., 2018; Brown et al., 2021). Essentially, PME can be interpreted as a market-adjusted multiple of invested capital and it reflects the level of outperformance (or underperformance) that LP achieves by pledging their capital to PE fund instead of the stock market. While there are several other performance measures widely used in the industry (IRR, top quartile rank, etc.), Mulcahy, Weeks, and Bradley (2012) argue that PME should be preferred over such measures, because it is solely based on cash flows. Hence, this measure is quite immune to manipulation, unlike, for instance, internal rate of return (IRR), which can be altered by deliberate choice of investment timing and size. Moreover, IRR is based on the

implicit assumption that cash flows can be reinvested at the same rate, which might not always be feasible (Sorensen and Jagannathan, 2014).

We can find multiple alterations of public market equivalent measure in contemporary academic literature, e.g. Long-Nickels PME (LN-PME), PME+, or Direct Alpha. That said, certainly the most widely used is a version developed by Kaplan and Schoar (2005), also known as KS-PME. Specifically, the calculation of KS-PME involves splitting the cash flow stream into 2 components – negative capital outflows (calls) and positive cash inflows (distributions). The former denotes money that is provided by LP to the fund upon a so-called "capital call", which usually follows after GPs have selected their first targets and require capital to execute investments. The latter signifies returns that are transferred to LPs once the PE fund successfully exits its portfolio investments.

One of the specifics of PE markets is that funds make investments in privately held enterprises, which do not have any publicly available quoted valuations. Therefore, CFs often become the only basis for the calculation of returns. The original PME definition by Kaplan and Schoar (2005) is as follows:

$$KS - PME = \frac{\sum_t \frac{dist(t)}{1+r_m(t)}}{\sum_t \frac{call\,(t)}{1+r_m(t)}} \qquad (1)$$

In Equation 1, *dist(t)* denotes cash distributions over period *t*, and *call(t)* represents investments provided by LPs to the PE fund during the same period, both net of fees. Furthermore, r_m is the return realized in the public equity markets over the same timeframe. Therefore, KS-PME in its original form basically comprises cash flows from and into the fund discounted by market return. The resulting number can take values that are either below or above 1. PME > 1 signifies that the investment has been of value to the LP, since cash distributions from the fund exceed capital committed in calls. Contrastingly, PME < 1 implies that LP would be better off investing in the stock market, as the PE fund underperformed the public equity benchmark (Kaplan and Schoar, 2005; Sorensen and Jagannathan, 2014). In support of this metric, Sorensen and Jagannathan (2014) provide a rigorous justification of KS-PME as a historical performance measure. Authors argue that "PME is valid regardless of the

risk of PE investment and it is robust to variation in the timing and systematic risk of the underlying cash flows along with potential manipulations by fund managers". That said, they also conclude the KS-PME is more applicable for measuring ex-post past performance rather than forecasting future fund returns.

Kaplan and Schoar (2005) base their PME calculations on individual cash flow data from Venture Economics. This is, however, unfeasible in our case, as direct cash flow data are unobservable in our sample from Preqin. Nevertheless, we construct PME measure indirectly from a wide range of available variables in our dataset:

$$Indirect\ KS - PME = \frac{DPI+RVPI}{r_m} \quad (2)$$

We first transform *distributions to paid-in (DPI)* and *residual values to paid-in (RVPI)*, both net of fees, from percentage to decimal terms. When combined, these two variables are the indirect expression of cash flows from the respective funds in our dataset and give us an outlook of the value of LP's investments. As shown in Equation 2, we conduct our calculations in relative terms and determine what value would be returned to investors from $1 contribution to a given fund. For instance, an investment of $1 to a fund with DPI 1.20 and RVPI 0.20 would mean that LP would obtain $1.20 in distributions and $0.20 in the residual value of the remaining interest.

To be able to match the yields from the PE investment with *public market return (r_M)*, we have to know the lifespan of the fund. That said, only 116 funds in our dataset explicitly report their lifespan. To overcome this shortcoming, we construct synthetic lifespans for all funds not reporting this variable. This synthetic variable is based on the mean lifespan of funds for which this data is available. Furthermore, means are taken for each fund strategy separately. Buyout funds and funds-of-funds last on average 11 years, while remaining strategies revolve closely around 10 years. Such lifespans are also in line with values reported in the academic literature. Consequently, this solution allows us to estimate the return that LP would receive if they invested in the public equity benchmark during the vintage year and hold their interest until the end of the fund's life.

Regarding the benchmark, we specifically use the close price of the S&P 500 Price Index, which has also been widely employed by previous research and is commonly regarded as the best proxy for US equity market returns. We obtain this benchmark data from Refinitiv. Moreover, this benchmark is one of the few equity indices that sufficiently cover our sample period, spanning all the way to 1971. Although some authors might advocate for the use of different benchmarks, e.g. Russell 2000 small-cap index or NASDAQ Composite, for reasons of size or investment focus being closer to PE funds, Harris, Jenkinson, and Kaplan (2014) obtain PMEs of similar magnitudes, regardless of the chosen benchmark. Hence, the choice of benchmark should not have much influence on our results.

4.2. Performance determinants: fund size and sequence regressions

In the second part of our analysis, we move away from merely measuring the relative performance of selected PE fund strategies. To test our second and third hypotheses, we investigate the effect of fund size and its sequence number on performance. To accurately test for a correlation between market-adjusted performance and these fund characteristics, we partially follow the methodology developed by Kaplan and Schoar (2005). We first examine the cross-sectional relationship outlined in Equation 3:

$$PME = \beta_0 + \beta_1(Fund\ Size) + \beta_2(Sequence) + \varepsilon_t \qquad (3)$$

In the equation above, PME denotes the public market equivalent obtained in the previous section. This variable is calculated for each fund in our dataset. $Fund\ Size$ is the logarithm of fund size reported by Preqin. Similarly, $Sequence$ represents the logarithm of the chronological number of the fund among all the funds raised by the same GP. Finally, ε_t denotes the error term in our specification. All regressions are estimated using the ordinary least square (OLS) model with year and GP fixed effects and are conducted on the full sample of 4183 funds, as well as for each fund strategy separately.

Apart from examining the cross-sectional relationship, we further analyse the functional form of the relationship between fund characteristics and measured performance. Specifically, we

aim to uncover whether this relationship is concave, meaning that performance increases with the size or sequence of the fund but the largest or highest-sequence funds experience diminishing returns. In this pursuit, we expand the previous specification by including squared terms of both *Fund Size* and *Sequence* into the previous equation:

$$PME = \beta_0 + \beta_1(Fund\ Size) + \beta_2(Fund\ Size^2) + \beta_3(Sequence) + \beta_4(Sequence^2) + \varepsilon_t \quad (4)$$

Similarly to the previous specification, we estimate Equation 4 using the OLS model with year and GP fixed effects to control for unobservable variation in those variables.

4.3. Performance determinants: vintage year analysis

Our final hypothesis is concerned with the role of vintage years in determining fund performance. As defined earlier, vintage (or inception) year denotes the exact year, in which given a private equity fund made its first investment into the portfolio company. The performance of those firms, and by extension the performance of the PE fund, might be affected by macroeconomic drivers at the time of investment, which can have long-lasting implications on the performance of the PE portfolio. To examine their impact on the performance of different strategies, we look at levels of fundraising during the fund's vintage year. This variable serves as a reliable proxy for macroeconomic cycles, as investors tend to decrease their contributions during periods of economic contraction. In our pursuit, we partially follow the methodology developed by Brown et al. (2021). Yet again, we employ the OLS regression model. However, this time we only include GP fixed effect and use a smaller sample of 2952 funds. Despite the size of this sample, we still obtain a sufficient number of funds for each PE strategy – 973 *buyout funds*, 903 *VCs*, 565 *FoFs*, 298 *growth equity funds*, 155 *secondaries*, and 58 *balanced funds*. The fundamental reason for using a smaller sample is the availability of fundraising data. We obtain annual aggregate fundraising volumes from Preqin, which, however, only publishes this statistic from 2000 onwards. Hence, our empirical specification is as follows:

$$PME = \beta_0 + \beta_1(AFVY) + \varepsilon_t \quad (5)$$

Similarly to previous regressions, the dependent variable in Equation 5 is the fund's PME, capturing its market-adjusted performance. On the right-hand side of the equation, we include the logarithm of the *aggregate fundraising in the vintage year (AFVY)* as the explanatory variable. To more accurately capture the underlying economic conditions at the fund's inception, we scale the annual fundraising levels by the total value of the stock market in the vintage year. Correspondingly to Brown et al. (2021), we use a capitalization-weighted total market index. In their research, the authors use CRPS Total Market Index. However, this index does not cover our sample period, so we instead choose the Wilshire 5000 Total Market Index, which is also a capitalization-weighted index of the US equity market. As outlined in the previous chapter, the vast majority of our observations are funds based in Northern America, which allows for the use of the US market index. More specifically, we calculate the scaling factor with the base year 2000 for each vintage year in our sample, using the index value on the first trading day of that year. Aggregate fundraising levels (AFVY) are then calculated using obtained scaling factor, as outlined in Equation 6:

$$AFVY = Aggregate\ fundraising\ in\ fund's\ vintage\ year * scaling\ factor \quad (6)$$

In the following chapters, we present empirical results obtained using the methodologies outlined in this section. Furthermore, we conduct robustness checks on those results. Last but not least, we acknowledge the limitations of our methodology and outline paths for future research.

5. Research findings

Building on the methodologies explained in the previous chapter, this section provides a comprehensive overview of our findings. Apart from a simple interpretation of the results, we compare them to the extant literature and, where applicable, we conjecture about possible explanations for the differences. Correspondingly to the methodology section, we first compare the public market equivalent (PME) measures of selected PE strategies, followed by regression results from the analysis of performance determinants. Interestingly, this thesis research is among the first papers to report findings for less mainstream strategies, such as *secondaries* or *balanced funds*.

5.1. Public market equivalent

Table 4: KS-PME means

*The following table shows the results of the one-sample t-test to determine whether PME means are significantly different from one. We indicate statistical significance using following indicators: *** = highly statistically significant (p < 0.1%), ** = highly statistically significant (p < 1%), * = statistically significant (p < 5%), + = marginally statistically significant (p < 10%)*

KS-PME	All strategies	Buyout	VC	FoF	Growth	Secondaries	Balanced
Mean	1.12 (***)	1.13 (***)	1.20 (***)	0.97 (+)	1.18 (**)	0.90 (**)	1.15 (*)
Std. Error	0.02	0.02	0.04	0.02	0.06	0.03	0.07
Median	0.86	0.91	0.84	0.84	0.89	0.78	0.97
Mode	0.44	1.91	0.75	0.80	0.44	1.38	N/A
Std. Deviation	1.05	0.77	1.43	0.52	1.11	0.48	0.77
Sample Var.	1.09	0.60	2.06	0.27	1.23	0.23	0.59
Kurtosis	60.45	10.01	44.18	13.67	22.10	3.98	7.73
Skewness	5.90	2.27	5.58	2.64	3.87	1.87	2.30
Range	17.66	8.19	17.66	5.22	10.46	2.59	4.95
Minimum	0.00	0.00	0.00	0.23	0.01	0.30	0.24
Maximum	17.66	8.19	17.66	5.46	10.47	2.89	5.19
Sum	4,689.25	1,590.19	1,736.60	643.94	407.86	175.07	135.60
Count	4,183	1,413	1,451	662	345	194	118
t-statistic	*7.49*	*6.10*	*5.23*	*-1.36*	*3.05*	*-2.86*	*2.10*
p-value	*4.20016E-14*	*6.7783E-10*	*9.758E-08*	*0.086794683*	*0.00121713*	*0.002374048*	*0.01878995*

We begin our analysis by critically evaluating the PME means that we obtain from calculations, which have been explained in the preceding chapter. As outlined previously, the individual PME value is calculated for each fund in our dataset and those funds are grouped by their

respective strategy. The resulting PME means of the six strategies examined in this paper, as well as of the full sample, are reported in Table 4. Aside from mere calculations, we also perform one-sample t-tests to determine whether our results are statistically different from one.

Our first hypothesis posits that all PE funds strategies outperform equivalently timed investments in public equity markets. As shown in Table 4, this hypothesis can be accepted only partially. We obtain a PME of 1.12 for the full sample, which is highly statistically significant at a 0.1% level. This indicates that on average and regardless of the strategy, the LP's contribution to PE funds in our dataset would return 12% more value than an equivalently timed investment in public equity. However, if we look at each of the strategies separately, we see some level of disparity in the results. *VCs, growth equity, buyout,* and *balanced funds* show statistically significant PME values higher than 1, thus beating the S&P 500 benchmark, whereas the remaining two strategies underperform, although in the case of *FoF* only marginally at a 10% level. Moreover, these two strategies display inferior performance compared not only to others but also against public markets, which means that we reject hypothesis H1B stating that "funds-of-funds outperform direct market strategies". A possible explanation for this underperformance might lie in similarities between funds-of-funds and secondaries. Both strategies have, by default, a considerable level of vintage year diversification, as opposed to direct funds, and represent the "secondary market" in the PE industry. While extant literature on *FoF* infers that vintage year diversification could be advantageous for *FoF* returns (Gresch and von Wyss, 2010), it seems that its effects on performance might be limited by the additional layer of fees that exist in FoFs, which our PME calculation also takes into account. Furthermore, this may apply also to secondaries, which share a plethora of characteristics with FoFs.

Being a fundamental measure of performance in the PE industry, the public market equivalent has been employed by several studies in the past. The extant academic literature provides results mostly for mainstream strategies, predominantly *VCs* and *buyout funds*, and we can therefore compare our results to the findings of other papers. In their seminal paper, Kaplan and Schoar (2005) not only develop the KS-PME methodology but also examine the performance of buyout and venture capital funds. They provide two different PMEs for each

of the strategies – one calculated on the equal-weighted basis, and the other one on the size-weighted basis. As highlighted earlier, our PMEs are constructed in relative terms, i.e. we do not take the size of the investment into account but rather assume how much would investment of $1 returned to the investor. Therefore, our findings are directly comparable to equal-weighted results. Nevertheless, we obtain results that are substantially higher than both equal-weighted and size-weighted PME means in Kaplan and Schoar (2005). Moreover, our findings document significant outperformance of *buyout* and *venture capital* funds over public equity, whereas Kaplan and Schoar (2005) report PMEs < 1 for both strategies, 0.97 and 0.96 respectively. The same applies when compared to the full-sample PMEs.

Another study focusing on the market-adjusted performance of venture capital and buyout funds is Harris, Jenkinson, and Kaplan (2014). This research also builds upon the KS-PME methodology. However, unlike Kaplan and Schoar (2005), their findings suggest that both VC and BO funds outperform the S&P 500 benchmark, averaging PME of 1.36 and 1.22. This is in line with our results for the same strategies (1.20 and 1.13), reported in the 2nd and 3rd columns of Table 4. Although our PMEs are comparably lower, we see VCs delivering superior performance to buyout funds, which is consistent with the findings of Harris, Jenkinson, and Kaplan (2014). A completely different pattern can be seen when we compare our findings for *funds-of-funds* to the extant academic research. While the PME mean of 0.97 in our research points towards underperformance, Harris et al. (2018) obtain contradicting results. Their research reveals an average *FoF* PME value of 1.13, indisputably outperforming the public markets. However, it is worth noting that our result is only marginally significant at the 10% level, as shown in the 4th column of Table 4.

In general, for the three rather mainstream strategies discussed so far – *VCs, buyout funds, and FoFs* – our results fall within the range of values reported by the extant academic literature. To that end, there are several potential explanations behind the differences. Most importantly, each of the studies uses a different data source – Kaplan and Schoar (2005) use Venture Economics (VE), Harris, Jenkinson, and Kaplan (2014) and Harris et al. (2018) utilize the Burgiss database, and our research examines data from Preqin. Although there should be a great amount of overlap, each of these databases might harvest their data in a different manner, which could affect results. Moreover, each of the papers also focuses on a different

sample period. Lastly, while all papers use KS-PME as a measure of performance, we modify the original methodology to overcome the issue with the unobservable direct cash flows.

Notably, a key aspect of this thesis research is that we are among the first studies to focus on less mainstream PE strategies, which are in our case *growth equity, secondaries, and balanced funds*. As highlighted earlier, these strategies often share characteristics with more mainstream strategies, and we can see those linkages in our results as well. First of all, the focus on expanding, but not yet matured, businesses makes *growth equity* close to *venture capital*. It is therefore no surprise that they also perform very similarly. While *VCs* show the highest outperformance over public equity (PME 1.20), they are closely followed by *growth equity* (PME 1.18). We can also see analogous patterns between *FoFs* and *secondaries*, both representing the secondary PE markets. Although the difference between their PME means (0.97 and 0.90) is considerably larger than in the previous case, they both show inferior returns to S&P 500. Furthermore, *secondaries* display the worst market-adjusted performance of all examined strategies. A potential explanation for this might be that *secondary funds* are not necessarily focused on delivering the highest possible returns but rather offering liquidity services for LPs in this otherwise illiquid market. Lastly, if we look at *balanced funds*, their PME mean of 1.15 is relatively close to the mean of the overall sample (1.12). Since these funds invest in companies at various lifecycle stages, covering natural domains of both *buyout* and *VC* funds, their performance values also fall in between the PME means of these two leading strategies.

Table 5: T-test against sample mean

*The table shows the results of a one-sample t-test to determine whether PME means are significantly different from the sample mean. We indicate statistical significance using following indicators: *** = highly statistically significant (p < 0.1%), ** = highly statistically significant (p < 1%), * = statistically significant (p < 5%), + = marginally statistically significant (p < 10%)*

KS-PME	Buyout	VC	FoF	Growth	Secondaries	Balanced
Mean	1,13	1,20 (*)	0,97 (***)	1,18	0,90 (***)	1,15
Standard Deviation	0,77	1,43	0,52	1,11	0,48	0,77
Count	1413	1451	662	345	194	118
S.E. of mean	0,02	0,04	0,02	0,06	0,03	0,07
Degrees of freedom	1412	1450	661	344	193	117
Sample mean (μ)	1,12	1,12	1,12	1,12	1,12	1,12
t-statistic	0,21	2,01	-7,40	1,03	-6,40	0,40
p-value	0,4157	0,0221	0,0000	0,1530	0,0000	0,3462

Apart from testing if PME means of different strategies are statistically different from one, which denotes performance on par with public equity, we also conduct additional t-test to determine, which strategies have PME means significantly different from sample mean. Hence, Table 5 reports the results of a one-sample t-test against the sample mean. Out of the six selected strategies, we find that only three strategies are significantly different from the sample PME mean of 1.12. Surprisingly, among these strategies are FoFs, which have been only marginally significant in the previous t-test but shows to be statistically different from the sample mean at 0.1% level. A similar significance levels can be seen in secondaries, which are correspondingly to FoFs below the sample mean. The only strategy which is significantly above the sample mean is venture capital, at a 5% significance level.

5.2. Performance determinants

In the remaining part of this chapter, we turn our focus on the factors that determine the performance of selected private equity strategies. Specifically, we look at fund size, sequence number, and vintage year. In our research pursuit, we conduct regression analysis following the empirical strategy established in the previous chapter.

5.2.1. Fund size and sequence

Table 6 shows empirical results obtained from regressions conducted on the full sample and separately for each strategy. In the first column of each strategy, we report cross-sectional results from estimating Equation 3. In the second column, you can find regression coefficients resulting from Equation 4, which also includes squared terms of fund size and sequence. As mentioned earlier, our research approach builds on Kaplan and Schoar (2005), which examines the impact of these characteristics on the performance of VC and buyout funds. In our paper, we also provide results for other PE strategies.

Table 6: Fund size and sequence regression analysis

*The dependent variable is Kaplan and Schoar (2005) public market equivalent (KS-PME). The independent variables are linear and squared logarithms of fund size and sequence. We indicate statistical significance using the following indicators: *** = highly statistically significant (p < 0.1%), ** = highly statistically significant (p < 1%), * = statistically significant (p < 5%), + = marginally statistically significant (p < 10%). Standard errors are in parentheses.*

Dependent Variable: PME (Public Market Equivalent)						
	Full sample		***Buyout***		***Venture Capital***	
	(1)	(2)	(1)	(2)	(1)	(2)
log (Size)	-0.1541***	-0.3330***	-0.1337***	-0.2963*	-0.2601***	-0.2890
	(0.02)	(0.09)	(0.03)	(0.12)	(0.08)	(0.29)
log (Size)²		0.0174*		0.0135		0.0034
		(0.01)		(0.01)		(0.03)
log (Sequence)	-0.1988***	-0.3006***	-0.2212**	-0.2131*	-0.2932	-0.3050
	(0.06)	(0.07)	(0.07)	(0.09)	(0.18)	(0.21)
log (Sequence)²		0.0551**		0.0031		0.0112
		(0.02)		(0.03)		(0.08)
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
GP FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Adjusted R^2	0.26	0.27	0.50	0.50	0.12	0.12
# obs.	4,183	4,183	1,413	1,413	1,451	1,451

	FoF		***Growth***		***Secondaries***		***Balanced***	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
log (Size)	-0.0041	-0.0492	-0.3345**	-0.5894	-0.0094	-0.1897	0.0958	-0.2658
	(0.02)	(0.14)	(0.12)	(0.42)	(0.03)	(0.12)	(0.13)	(0.47)
log (Size)²		0.0038		0.0252		0.0159		0.0340
		(0.01)		(0.04)		(0.01)		(0.04)
log (Sequence)	-0.2515***	-0.1726**	-0.1816	-0.3450	-0.0912	-0.2270*	0.0019	0.4353
	(0.05)	(0.06)	(0.26)	(0.36)	(0.08)	(0.10)	(0.23)	(0.41)
log (Sequence)²		-0.0510**		0.1138		0.0502*		-0.2299
		(0.02)		(0.16)		(0.02)		(0.19)
Year FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
GP FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Adjusted R^2	0.51	0.51	0.24	0.23	0.72	0.73	0.58	0.58
# obs.	662	662	345	345	194	194	118	118

Nevertheless, when we compare our cross-sectional findings to Kaplan and Schoar (2005), we obtain quite the opposite results. While authors report positive *fund size* and *sequence* coefficients for both the full sample and individual strategies, we receive negative and highly significant coefficients for the same variables. This means that larger funds and those of higher sequence have lower ex-post PMEs, suggesting that increasing size and sequence does not lead to the better market-adjusted performance of the funds in our data. Similarly to KS-PME results, such difference might have been caused by using different datasets, as well as modification in KS-PME calculation.

When we look at individual strategies, we can see corresponding patterns to the full sample. In the case of *buyout funds*, both coefficients are significantly negative and relatively close to the full sample results. However, the *size* coefficient is slightly lower, whereas the *sequence* coefficient is higher. This implies that sequence number impacts the performance of buyout funds more than its size. When we turn to *VC funds*, we see much more negative size coefficients than in buyout funds. This is actually in line with Kaplan and Schoar (2005), who also find larger magnitudes, although in the opposite direction, for VCs than buyout funds. Therefore, it seems that the effect of fund size is comparably stronger in venture capital. That said, our coefficients for sequence are not statistically significant in the case of VC funds, suggesting that sequence does not have a significant impact on performance for this strategy. In contrast, *funds-of-funds* do not seem to be affected by fund size, as we only obtain statistically significant results for sequence. On the other hand, *growth equity* shows identical patterns to VC funds, with only fund size impacting performance, although with larger magnitudes. For the last two strategies, we do not obtain results statistically different from zero. While insignificant, coefficients for *secondaries* resemble those of FoFs. Moreover, *balanced funds* are the only strategy with positive coefficients, however statistically insignificant.

Furthermore, if we turn to Equation 4, i.e. regressions with square terms, we observe empirical results that, yet again show reverse patterns to Kaplan and Schoar (2005). In their research, the inclusion of the square term causes a significant increase in the linear coefficient for the size variable and negative coefficients on a squared variable, hence indicating a concave relationship between performance and size. In contrast, our results for the full sample

show a large significant decrease in the coefficients compared to Equation 3, i.e. becoming more negative, while we obtain positive coefficients on the squared terms. Unlike in Kaplan and Schoar (2005), our results reveal similar patterns for sequence as well. Therefore, it seems the relationship between fund characteristics and performance is rather of convex than concave nature. In other words, it seems that the performance of funds in our sample tends to decline with increasing fund size and higher sequence, however, very large funds and those of very high sequence see their performance increase with these characteristics. This is in direct contrast with Kaplan and Schoar (2005), who find evidence of concavity in their results.

Although these results are generally mirrored by individual strategies, we only obtain statistically significant results for some of them. In the case of *venture capital* and *buyout funds*, we see similar patterns as in the full sample, but coefficients on the squared terms are insignificant. Therefore, we cannot resolutely verify the existence of a convex relationship for those strategies. In the case of *funds-of-funds*, we only obtain statistically significant results for sequence. Interestingly, these results show an increase in linear coefficient, i.e. becoming less negative, accompanied by negative squared coefficient. Such patterns would suggest a concave functional form for *FoFs*. Surprisingly, results for *secondaries* are different from FoFs, and indicate the same convex relationship as full sample results. Albeit, similarly to FoF, our results are significant only for fund sequence. Lastly, we do not obtain any statistically significant results for *growth equity* and *balanced funds*. As for cross-sectional results, we postulate that differences between our results and extant literature might stem from different datasets and modifications in KS-PME calculation.

In summary, our research findings suggest that the market-adjusted performance, measured by KS-PME, tends to decrease with the size and sequence of the PE fund. Moreover, the functional form of this relationship seems to be convex rather than concave. Therefore, we reject both hypotheses H2 and H3, which assumed a positive (and concave) relationship with these fund characteristics.

5.2.2. Vintage year analysis

In the last part of our analysis, we examine how levels of fundraising in the vintage year affect the subsequent performance of private equity funds. As outlined earlier, we assume that macroeconomic conditions prevalent at the time that the fund starts investing impact its overall performance. We expect this to be the case specifically for *buyout funds, VCs, growth equity,* and *balanced funds (*H4a). That said, we also expect that a considerable level of vintage year diversification would considerably mitigate the effect of vintage years for *secondaries* and *FoFs* (H4b).

Table 7: Aggregate fundraising levels in vintage years

*The dependent variable is Kaplan and Schoar (2005) public market equivalent (KS-PME). The independent variable is aggregated fundraising in the vintage years scaled by the value of the Wilshire 5000 Total Market Index. We indicate statistical significance using the following indicators: *** = highly statistically significant (p < 0.1%), ** = highly statistically significant (p < 1%), * = statistically significant (p < 5%), + = marginally statistically significant (p < 10%). Standard errors are in parentheses.*

	Dependent Variable: PME (Public Market Equivalent)						
	Full sample	*Buyout*	*VC*	*FoF*	*Growth*	*Secondaries*	*Balanced*
log (AFVY)	-0.1255***	-0.2873***	0.1305	-0.0298	-0.4283**	-0.1609*	-0.1727
	(0.03)	(0.05)	(0.10)	(0.03)	(0.16)	(0.07)	(0.22)
Constant	2.6652***	4.8011***	-0.5574	1.2185**	5.6560**	2.6913**	4.1826
	(0.58)	(0.76)	(1.51)	(0.44)	(2.15)	(0.86)	(2.69)
Year FE	*No*	*No*	*No*	*No*	*No*	*No*	*No*
GP FE	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Adj. R^2	0.08	-0.13	-0.07	0.09	-0.27	-0.08	0.58
# obs.	2,952	973	903	565	298	155	58

Table 7 reports empirical results obtained from regressions according to Equation 5, which uses *aggregated fundraising in the vintage year (AFVY)* as the explanatory variable. First of all, estimations on the full sample of all funds reveal negative coefficients for this variable, which are highly statistically significant at a 0.1% level. This result indicates that high levels of fundraising in the fund's vintage year negatively affect its subsequent performance, measured by KS-PME. Moreover, our findings support the conclusion of previous research by Brown et al. (2021), who also document the negative influence of vintage-year fundraising levels. Furthermore, results for individual PE strategies firmly mirror the full sample, despite we

obtain statistically significant results only for half of the examined strategies. Notably, the effect of fundraising levels in a vintage year is the strongest for *growth equity*, which reports a negative coefficient of the largest magnitude out of all strategies. Similarly, *buyout funds* are impacted more than other strategies, reaching the second-highest negative coefficients. It is surprising that we obtain negative and statistically significant coefficients also for *secondaries*. As shown in Table 7, coefficients for *FoF, VCs,* and *balanced funds* remain insignificant.

All things considered, PE funds in our sample seem to be negatively affected by the amount of aggregate fundraising in their inception year, which is in line with our assumptions. However, hypothesis H4a can be accepted only partially, as our results are only significant for *buyout* and *growth funds*. The same applies to hypothesis H4b. Although we document statistically insignificant results for *FoFs*, we receive negative and significant coefficients for *secondaries*, contrary to our hypothesis.

5.3. Robustness checks

Table 8: Robustness tests

*The dependent variable is Total Value to Paid-In (TVPI). The independent variables are identical to previous regressions. We indicate statistical significance using the following indicators: *** = highly statistically significant (p < 0.1%), ** = highly statistically significant (p < 1%), * = statistically significant (p < 5%), + = marginally statistically significant (p < 10%). Standard errors are in parentheses.*

Dependent Variable: TVPI (Total Value to Paid-In)			
Full sample	***Size/Sequence***		***Vintage Year***
	(1)	(2)	(3)
log (Size)	-0.2703***	-0.5017***	
	(0.04)	(0.15)	
log (Size)^2		0.0223	
		(0.01)	
log (Sequence)	-0.2272**	-0.3243**	
	(0.10)	(0.12)	
log (Sequence)^2		0.0545	
		(0.03)	
Log (AFVY)			-0.0735
			(0.05)
Year FE	*Yes*	*Yes*	*No*
GP FE	*Yes*	*Yes*	*Yes*
Adjusted R^2	0.25	0.25	0.30
# obs.	4,183	4,183	2,952

To further test the strength of our results, we estimate all 3 regression models with a total value to paid-in (TVPI) as a dependent variable instead of KS-PME. We do not adjust the variables or models in any way and estimate the regressions on the full sample of 4,183 funds (columns 1 and 2) and a smaller sample of 2,952 funds (column 3) respectively. Table 8 reports the results for regressions with TVPI. Although coefficient values slightly differ from the baseline results, the signs of these coefficients remain the same as in the previous estimation. Hence, regressions with TVPI produce qualitatively similar results to estimations with KS-PME.

5.4. Limitations and future research

Perhaps the main limitation that we encountered in our research pursuit was the unobservable direct cash flow data, which required developing a modified version of KS-PME for the purpose of this thesis research. In the case of vintage year analysis, we were also encountered with unobservable fundraising data for the pre-2000 period. This led us to use a smaller sample with shortened time frame, covering only years from the millennium onwards. Many of those issues are linked to the general problem of data availability and quality in private equity research. Hence, future research could potentially focus on evaluating the performance of individual PE strategies with the use of different data sources, possibly comparing differences in results between them. Furthermore, our research focused on three key fund characteristics – fund size, sequence, and vintage year. However, there are also many other variables that can be found in most datasets. Therefore, in the future, a study focusing on a wider array of PE fund variables could be conducted. Lastly, since the PE industry is still evolving and new strategies keep emerging, practitioners could benefit from further research into these new strategies, not covered by this thesis research.

6. Conclusion

This thesis research examines the performance of private equity strategies. Over past decades, the private equity industry has become a popular destination for capital of various institutional investors, such as banks, pension funds, and sovereign wealth funds. Increasing specialization of fund management companies, so-called general partners (GPs), paved the way for the evolution of different PE strategies. In our research pursuit, we specifically focus on *buyout funds, venture capital,* and *funds-of-funds*, which belong among the mainstream PE strategies. Moreover, we further focus on three less prominent strategies - *growth equity, secondaries, and balanced funds* – which we consider to be one of the key contributions of this research. It is worth noting that the population of research papers focusing performance of PE fund strategies remains quite limited. Therefore, with this paper, we aim to expand the extant literature in this field.

To accurately measure the performance of PE strategies, we employ the public market equivalent (PME) metric developed by Kaplan and Schoar (2005). This measure, which compares returns of PE funds to equivalently timed investment in public equity, has been widely used in previous studies. Specifically in this paper, we use a modified version of KS-PME, with S&P 500 as a benchmark. Our results document significant outperformance of *buyout funds, VCs, growth equity*, and *balanced funds* over public markets. In contrast, *FoFs* and *secondary funds* tend to underperform the S&P 500 benchmark. Furthermore, we also examine factors that impact the performance of different PE strategies. Our empirical results indicate the existence of a negative and convex relationship of market-adjusted performance to fund size and sequence. We also conclude that high levels of fundraising in the vintage year lead to the inferior subsequent performance of the fund.

All things considered, it is worth noting that results for individual strategies can vary considerably. However, strategies with similar characteristics tend to show analogous performance patterns. It is also necessary to acknowledge that our research is subject to a number of limitations, e.g. unobservable direct cash flows, which required several modifications to our methodology to be able to maintain the large sample.

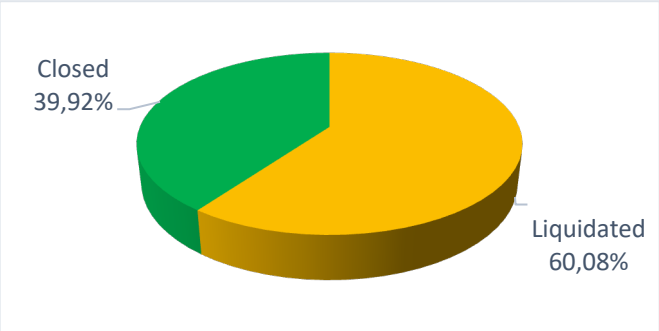
Appendix

Appendix A: Alphabetical List of Abbreviations

AFVY	Aggregate Fundraising Level in Vintage Year
BF	Balanced fund
BO	Buyout
CF	Cash Flow
DPI	Distributions to Paid-In
FoF	Fund-of-funds
FOIA	Freedom of Information Act
GE	Growth Equity
GFC	Global Financial Crisis
GP	General Partner
IPO	Initial Public Offering
IRR	Internal Rate of Return
KS-PME	Kaplan and Schoar (2005) Public Market Equivalent
LBO	Leveraged buyout
LN-PME	Long-Nickels Public Market Equivalent
LP	Limited Partner
MBO	Management buyout
MOIC	Multiple on Invested Capital
OLS	Ordinary Least Squared
PE	Private Equity
PME	Public Market Equivalent
RVPI	Residual Value to Paid-In
Sec	Secondaries
S&P 500	Standard & Poor 500 Price Index
TVPI	Total Value to Paid-In
VC	Venture Capital
VY	Vintage Year
YoY	Year-on-Year

Appendix B: Fund-level data

B.1: Fund status



Status	Obs.	%
Liquidated	2,513	60.08%
Closed	1,670	39.92%

B.2: Observations per vintage year

Vintage year	All strategies	Buyout	VC	FoF	Growth	Secondaries	Balanced
1971	1	0	0	0	0	0	1
1972	1	0	1	0	0	0	0
1973	0	0	0	0	0	0	0
1974	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0
1976	0	0	0	0	0	0	0
1977	1	1	0	0	0	0	0
1978	3	0	3	0	0	0	0
1979	2	1	1	0	0	0	0
1980	8	4	3	0	0	0	1
1981	3	0	3	0	0	0	0
1982	9	1	7	1	0	0	0
1983	14	2	9	1	0	0	2
1984	21	5	15	1	0	0	0
1985	20	5	14	1	0	0	0
1986	24	9	12	0	1	0	2
1987	33	10	19	2	0	1	1
1988	34	12	16	3	0	1	2
1989	41	15	21	2	1	1	1
1990	45	19	19	2	0	2	3
1991	26	7	12	4	0	2	1
1992	55	21	25	3	3	2	1

Table continues on the next page …

1993	62	17	30	5	2	4	4
1994	77	36	26	4	3	4	4
1995	93	35	35	8	4	5	6
1996	95	38	41	3	6	3	4
1997	155	56	65	11	9	1	13
1998	199	76	79	20	7	6	11
1999	209	70	92	26	11	7	3
2000	296	96	135	36	14	4	11
2001	197	55	82	34	15	7	4
2002	141	45	56	20	11	7	2
2003	140	57	43	23	5	11	1
2004	185	63	61	34	9	13	5
2005	281	110	75	57	19	13	7
2006	353	119	100	71	36	20	7
2007	388	131	99	91	44	14	9
2008	352	100	98	79	50	19	6
2009	160	58	35	37	18	12	0
2010	206	65	52	30	36	20	3
2011	253	74	67	53	41	15	3

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