The Cyclicality of Returns for Private Equity Funds

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Master's Thesis

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May 2018

Abstract

This paper aims to empirically test whether European Private Equity investments made at the end of the investment cycle underperform with respect to investments made earlier in the cycle. A theoretical model suggesting the occurrence of such a behavior, due to the structure of the fees paid to the general partners is suggested by Axelsson, Strömberg and Weisbach (2009). Our goal is to test whether this behavior can be found in our data. We have used a unique dataset provided by the European Investment Fund containing deal level data for 294 PE/VC funds and 3,150 investments. Excess returns were measured for each individual investment using the Public Market Equivalent method. We did not find any significant results for time affecting excess returns and could therefore neither prove nor disprove the occurrence of lower returns at the end of the investment cycle. We believe that this result could be partially driven by EIF specific biases. However, we did observe low returns for investments made both at the beginning and at the end of the investment cycle. We found a positive relationship between the size of the management fees and the investments' excess returns. Furthermore, we found that almost half of the funds made their last investment well before the end of the investment period, while still having a large part of their committed capital unutilized.

Keywords: Private Equity, Venture Capital, Performance, Investment Period

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Acknowledgments

We would like to express our gratitude to the European Investment Fund, especially Simone Signore and Julien Brault for giving us the opportunity to use this dataset and share with us their professional experience. They made it possible for us to write this paper while also making the process fun and smooth.

We would also like to thank our tutor, Vincent Maurin, for his valuable feedback and support through the process of writing this thesis.

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1. Introduction

The Private Equity (PE) industry has been growing strongly over the past decades. In 1991, Investors committed less than 10 billion USD to these partnerships, while in 2017, PE firms raised 701 billion USD globally. The number of Private Equity firms has also grown significantly over the years, reaching almost 8,000 at the end of 2017 (Bain & Company, 2018). This increase sparks the interest to look closer at how these partnerships operate and what it is that drives them. PE funds are usually structured as limited partnerships, where general partners (GPs) manage the fund and limited partners (LPs) contribute almost all of the capital. The "normal" lifespan of these partnerships is 10 years, in which the GPs can invest money for the first five, after which they manage and then exit their investments. The limited partners, contributing the capital, have no say in how the money is used, which puts a lot of discretion in the hands of fund managers to act in their investors' best interest.

While many researchers have found that Private Equity consistently outperforms the public market (Harris, Jenkinsson and Kaplan, 2014), more and more research has begun to appear regarding the relationship between Limited Partners (LP) and General Partners (GP). Questions have been raised whether GPs always act in the best interest of LPs, and whether their actions are aimed at maximizing their own wealth or the returns of the funds that they are managing. GPs are usually compensated using two different fees. One fixed fee, called the management fee, and a performance-based fee, called the carry. The fixed fee is used by the funds to cover their overhead and pay salaries to their employees, while the carry is supposed to align the interests of investors and GPs, by letting the GPs share in the profits of the fund.

The question has been raised by Axelsson, Strömberg and Weisbach (2009), whether the way that the fees are structured could incentivize managers to burn cash at the end of their investment cycle. Managers with capital left at the end of the cycle might make investments with high risk that, if successful, increase their carry, but if unsuccessful, the losses will be carried

by investors, not the GPs. We suggest that an additional reason for why this behavior might occur is that the fixed fees after the investment cycle are often based on the invested capital and not the committed capital, as it is during the investment cycle. Managers with a lot of capital left at the end of the investment cycle therefore stand to lose a large part of their fixed fees, unless they invest the capital. This could drive them to invest, even if they don't have any good investments lined up, causing these investments to underperform *vis-à-vis* investments made earlier.

To this end, we use deal-level data regarding 294 PE funds based in Europe and supported by the European Investment Fund (EIF). These undertook 3,150 realised investments in the period 1997-2017. To the best of our knowledge, this is the first time such data has been used for this type of research.

The purpose of this thesis is to investigate empirically whether there is a difference in returns between investments made at different points of time in a PE fund's investment cycle, for the European private equity industry. Degeorge, Martin and Phalippou (2016) made a similar study to test whether GPs seemed to burn cash at the end of the investment cycle, but only looked at Secondary Buyouts (SBO). We will contribute to this research literature by looking at EIF-supported investments made by venture capital and private equity funds.

Furthermore, we will also investigate whether other factors, such as the level of management fees and committed capital left at the end of the investment cycle affects GP's decision making regarding their investments.

1.1 Disposition

In section 2, we step through the previous literature and explain what the Private Equity industry is and how it is organized. Section 3 presents the main hypothesis that will be tested. In section 4, we describe the data that we've used and its strengths and limitations. Section 5 describes the main data

findings and in section 6 we present our empirical strategy. We discuss our results in section 7, followed by a conclusion in section 8.

2. Previous Literature

2.1 The Private Equity Industry

The simplest way to describe Private Equity, is as any investment made into the equity of a non-publicly listed company. There are two main types of funds making such investments, Venture Capital (VC) and buyout funds. Venture Capital, also known as early stage or seed investments, usually takes minority stakes in smaller companies, providing capital to companies that are usually too early in their development to get funding from the public market. Buyout funds on the other hand prefer to take large controlling stakes in the portfolio companies they invest in. These companies could be whole companies, or a division from a mature company. They are not limited to investing in currently private companies, but also invest in public equity, with the intent of buying the whole company and taking it private. This is usually done with a substantial amount of debt, in contrast to VC that almost never uses debt, due to the uncertainties involved in the investments that VC funds make. Both investor types then act as active owners, providing the portfolio companies with advice and business networks (Kaplan and Strömberg, 2009 and Söderblom, 2011).

2.2 The Structure of the Partnership

Almost all Private Equity funds are organised as limited partnerships, where the fund (and its managers) are known as general partners (GPs). Under the structure of each fund, GPs are given the right to manage the private equity fund and to pick which investments will be included in their portfolio. GPs are also responsible for attaining capital commitments from investors known as limited partners (LPs). Typical limited partners are institutions such as pension funds, university endowments, insurance companies, and high-net-worth individuals and state actors.

From the outset, clear contracts are drawn up regarding how long the fund will last and how the GP's compensation will be structured. The funds normally have a life of 10 years, where money can be invested in the first five,

called the investment period. General Partners are compensated both by a fixed fee, often called management fee, and a variable rate, called the carry (Metrick & Yasuada ,2010). While the management fee is often paid semi-annually (but can also be paid quarterly or yearly), the carry usually only gets paid after the LPs have recovered all of their committed capital investment, Phalippou (2009). The yearly management fee rate is around 2% of committed capital (the total money that the fund raises) depending on what focus the fund has (early stage, buyout, etc.), while the carry is almost always 20% of the returns of the fund, above a specified hurdle rate, determined in the original contract, Robinson & Sensoy (2013).

2.3 The Agency Problem Associated with The Compensation of General Partners

According to Axelsson, Strömberg and Weisbach (2009), there is an inherent problem with the way Private Equity funds are structured. General Partners' decision making can be influenced in a negative way by the structure of the compensation package they receive from the LP's. The management fees, that, according to Metrick & Yasuada (2010), represent about two thirds of the GP's revenues, are calculated based on the capital committed during the investment period (the first 5 years). Following this, it's not uncommon for them to change and instead be calculated using employed capital (the money that has been invested by the fund) as the base. This means that a GP with unutilized commitments left at the end of the investment period might feel a need to invest this capital in order to maximize the total fees. These investments, driven by the need to invest all committed capital, regardless of if the fund has a great investment opportunity, would then be expected to generate lower returns for LP's than does investments made earlier, when the GP isn't put under the time constraint created by the end of the investment cycle.

In their article, Axelsson, Strömberg and Weisbach (2009), investigate these agency problems and try to come up with a way to mitigate them

through changing the contract structure. They are, however, only hypothesizing as they haven't been able to empirically test whether GPs actually exhibit this behavior. We would therefore like to expand on their article by using deal level data to study the returns of individual investments in order to see if this behavior can be observed in praxis.

A similar study has been done by Degeorge, Martin and Phalippou (2016), who used data on Secondary Buyouts (SBO) to see whether investments that were made at the end of the investment cycle underperformed those made earlier in the investment cycle. They found significant results for late SBO's underperforming SBOs done at a different stage in the investment cycle.

In contrast to Degeorge, Martin and Phalippou (2016) we will look at all types of investments done by the funds in our data, and not limit our analysis to one single type of investment. Additionally, we will focus on the underlying factors to why this agency problem exists and how they affect the returns of investments made at different times in the investment cycle, such as the size of management fees and whether funds invest all of their commitments, while Degeorge, Martin and Phalippou (2016) focused their analysis on the general profitability of SBO's and what factors influences the profitability of these investments.

2.4 Measurement of Returns within Private Equity

In order to empirically test whether investments made at the end of the investment cycle have lower returns than investments made earlier in the cycle we had to decide how returns should be measured.

One of the most common ways to measure a PE fund's returns according to Harris, Jenkinson and Kaplan (2015) is through the Internal Rate of Return (IRR) or an investment multiple. However, as one often wants to compare funds that are started in different years (vintages) the IRR has been found lacking as a good comparison, as it does not give any indication for how well the market performed during the same time period. To address this,

a robust method for measuring private equity returns is using the Public Market Equivalent method, according to Sorensen and Jagannathan (2015). This method was first suggested by Long and Nickels (1996) and was called the Index Comparison Model (ICM). This method operated by investing the equivalent amount into a comparable public index, as a counterfactual, each time a fund made an investment. Similarly, if the fund paid out capital to its investors, an equivalent amount was withdrawn from the index (all cash flows being net of fees). By then calculating the IRR of the fund and that for the comparable index, you get the excess return of the fund, by subtracting the index IRR from the fund IRR. This method takes into account the opportunity cost of investing into a fund. It also makes it possible to compare the returns of different funds, at different times, as the returns are adjusted for how well the market is performing.

3. Hypothesis

In order to test whether the behaviour suggested by Axelsson, Strömberg and Weisbach (2009) prevails in the data, we have formulated the following hypothesis to test:

H_0: It does not make a significant difference at which point in the investment cycle an investment is made.

H_1: Investments made at the end of the investment cycle have lower excess returns than investments made earlier.

4. Data

The data used for this thesis is provided by the European Investment Fund (EIF). The EIF is part of the European Investment Bank Group (EIB Group), and carries out activities using either own resources or those provided by the European Investment Bank, the European Commission, by EU Member States or other third parties. The EIF aims at investing in independent GP teams that raise funds from a wide range of investors to provide risk capital to growing Small and Medium Enterprises (SME) in Europe. As such, the EIF fosters EU objectives in support of innovation, research and development, entrepreneurship, growth and employment. The provided data regarding the EIF's activities in the Venture Capital (VC) and Private Equity (PE) funds, provides us with a general overview of the European PE and VC market. The investments carried by EIF grant the institution the status of LP. Against this background, our data stems from GPs quarterly reports received by EIF. To derive certain "global" fund-level figures, we discounted EIF-specific figures by the quarterly updated EIF percent stake in the fund.

The initial dataset included observations from 1,069 funds that the EIF invested into during the period from 1997 to 2017. The data comprises 11,375 deals (into 9,861 companies) that those funds have invested in and exited during the same period. The dataset contains deal-level information of EIF-supported funds, coupled with a series of quarterly-updated fund-level characteristics. In comparison to the commonly used VC and PE datasets, we surpass some of the limitations commonly associated with PE data, documented e.g. in Kaplan and Lerner (2016)[3].

[3] The most commonly used research datasets on the performance of the PE & VC industry are provided by Burgiss Private I, Cambridge Associates (CA), Pitchbook and Preqin. The limitations of those datasets include reporting bias, bias towards US investments, lack of complete time-series on financial rounds, limited amount of funds. The most commonly used research datasets on the performance of the PE & VC industry are provided by Burgiss Private I, Cambridge Associates (CA), Pitchbook and Preqin. The limitations of those datasets include reporting bias, bias towards US investments, lack of complete time-series on financial rounds, limited amount of funds.

We restrict the focus of our research to funds that show any sign of investment activity as of the end of December 2017. In addition, as we are interested only in deals that have been exited, we removed all deals and funds that are still active. We further removed all funds that are located outside of Europe, since the purpose of our research is to understand the European VC/PE market behaviour.

For each fund we observe: the "stage" strategy of the fund (whether the fund is focused on investments in the early stage, growth, expansion, balanced, mid-market or lower mid-market); the fund size on a quarterly basis throughout the end of the investment period; the amounts in EUR per date of occurrence for capital and revenue repayments, drawn amounts, invested capital and management fees; whether management fees change post the investment period; committed capital to the fund; vintage year; start and end date of the investment period; geographical focus; team composition (whether it is a new or old team); EIF stake in each fund.

For each deal, we observe information regarding: the amount invested and the proceeds (exit value) of the deal; investment and exit date; the initial stake of the fund in the company; geographical location[4], sector and macro sector of the company receiving the investment.

The investment activity undertaken by the EIF is mostly focused on having a policy impact, and funds need to follow the economic policies aimed at increasing the socio-economic state of a country, rather than simply maximizing returns[5]. To mitigate this effect, we excluded funds purely focused on social impact. However, we recognise that the remaining dataset may still not be purely composed of funds with an exclusive return-driven perspective.

[4] Eight geographical macro regions were defined as follows: ISL: GB, IE; CENTRE: BE, FR, LU, NL; DACH: AT, CH, DE; SOUTH: GR, ES, IT, MT, PT; NORDICS: DK, FI, NO, SE; CESEE: BG, CZ, PL, RO, SK, TR, CY; BALTICS: EE, LT, LV; WORLD: AR, CA, CN, IL, RU, SG, US. See Signore (2016) for a breakdown of the EIF activity by regions.

[5] For further information regarding the socio-economic policies that the EIB and EIF have focused only, please refer to "EIB Group Support for the Social Sector".

We converted the funds and deals country focuses into macro-regions, since this will give us a better overall picture of their geographical preferences/specialisation. Our final dataset contains quarterly-level data on 294 EIF-supported funds, together with investments and return information on 3,150 investments (into 2,824 companies) carried by said funds. The tables below summarize all our variables depending on if they are at a Fund or a Deal Level.

Table 1: Summary Table of All Variables Retrieved from The EIF's Databases, Sorted by Fund

Fund Level Data	
Name	Description
Vintage Year	The year in which each fund has been established
Fund Stage	In what stage is the fund (i.e. Signed, Terminated, Sold, etc.)
Geographical Focus of the Fund	Country of fund focus
Multicounty	Tells us if a fund is active in more than one country (i.e. if a Fund invests only in France, or also in Italy and Spain)
Macro region Focus of the Fund	Geographical region in which the fund is focused (i.e. Baltics, Nordics, Center, etc.)
Stage Focus of the Fund	What stage the fund's focus of investment is (i.e. Early Stage, Expansion, Growth, Lower Mid-Market, etc.)
New Team	Whether this is the first time for a given team to start a fund
EIF Stake in the Fund	What percent of the total fund size is investments by the EIF
Switching Regime	Whether the management fee % changes post investment period
Fee Rate Margin	Management Fees in %
Total Repayment in EUR	Total amount of money paid back to the investors
Fund Size in EUR	Total Size of the Fund
Total Invested Capital in EUR	How much money has each fund invested in deals

Table 2: Summary Table of All Variables Retrieved from The EIF's Databases, Sorted by Deal level

Deal Level Data	
Name	Description
First Investment Date	When did a fund invest in each company for the first time
Exit Date	When did a fund exit from each company
Total Investment in EUR	How much did a fund invest in each company in EUR
Total Proceeds in EUR	How much proceeds did each fund receive from company investments in EUR
Fund stake in the company	What percent belongs to the fund in a given company
Macro region Company	Where each one of the companies is located. (i.e. Nordics, Center, South, Baltic)
Macro region Focus	Company's region of focus. In which region does the company focuses it's operations. (i.e. Nordics, Baltics, Center)
Sector of the Company	The company's specific industry (i.e. Computer and Consumer Electronics, Life Sciences, Business and Industrial Products)
Macro sector of the Company	Company macro-industry (i.e. ICT, Life Sciences, Manufacturing, Services, etc.)

4.1 Inflation Adjusting Investment and Exit Values

As investment and exit values were provided in Euros, we did not have to consider any currency effects. However, since investments were made at different times, and exited many years later, we needed to take into account the inflation rate so as to get comparable investment figures over such long

periods of time. For example, €100 in 2002 is the equivalent of €123.5 in 2012 (Euro Inflation Calculator). Therefore, we cannot say that a fund's investment of €100 in 2002 is the same as one done in 2012 for the same nominal amount of money. To make all investments comparable, we applied an inflation adjustment with the base year of 2010 to all our monetary values. We did this by checking in what country the fund making the investment was based, and adjusted the amount using The Gross Fixed Capital Formation Index (GFCF) corresponding to that country. GFCF is a component of the expenditure on gross domestic product (GDP), provided by Eurostat and shows how much of the new value added in the economy is invested rather than consumed[6].

We used the inflation rate of the country in which the fund was based at the time of the fundraising. In doing so, we assume that each fund is subject to the price dynamics of the country in which it mainly operates from.[7]

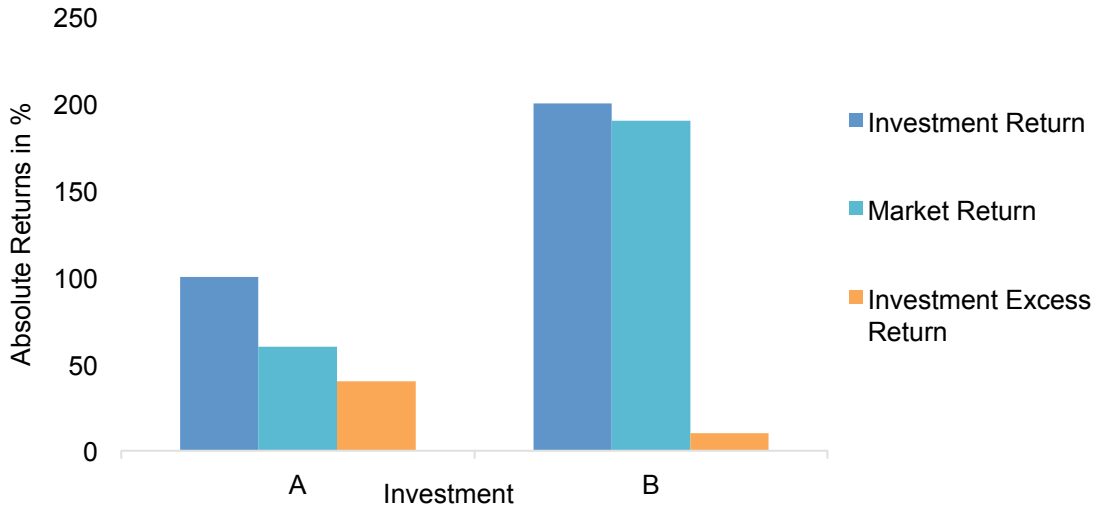
4.2 Match with Relevant Public Market Equivalent Index

An investor, however, is not only interested in the total returns of an investment, s/he also takes the opportunity cost into account. The alternative to investing in PE could be seen as investing in the market in general, represented by a broad index. As an example of this, consider two investments made at different points of time, one with a total return of 100% and the other with a total return of 200%. At a first glance the second investment can clearly be seen as the best alternative. But if you add the additional information that the market, during the same time as the first investment returned 50% while for the second investment it returned 190% the excess returns for these two investments become 50% and 10%. Now the first investment is clearly the better choice.

[6] For further analysis on inflation adjustment see Vaze (2001)

[7] For this reason, we typically do not use the legal country in which the fund is established. Instead, we use the country of main operations of the fund and/or the country in which the fund manager team is located.

Figure 1: Illustration of PME Example. Investment A has absolute return of 100%, while the market returns 50%, giving A an excess return of 50%. Investment B has absolute return of 200%, while the market returns 190%, giving B an excess return of 10%. Showing the importance of comparing returns to the market.



It is therefore important to take into account how the market performed during each time period when comparing two investments. This method of comparing the return of a PE fund to the return of an index is called the Public Market Equivalent (PME). The earliest iteration of this method was created by Long and Nickels (1996), who called it the Index Comparison Model. In contrast to our work here, this model was developed to compare the returns of whole funds to the market. We believed, however, that with a small adjustment it could be applied to individual investments, thereby applicable to our data. The model works by matching the cash flows of the PE fund using an index. Every time the fund makes an investment, a similarly timed and sized investment is made into the index. Whenever the PE fund exits an investment, the same amount of money is withdrawn from the index. This thereby replicates the cash flows that the LP's receive from the PE fund. We used a similar method, but instead of using it at a fund level, we applied this model to each individual investment in our dataset. We compared the return of each investment with the return of a large index,

over the same time period. The excess return was thus calculated by subtracting the total return of the index from the total return of the investment.

When selecting an index, it's important to choose one that represents the same type of investments as could be made by the VC/PE fund in order to fully capture the local market conditions. If it was a U.S. PE fund for example, only investing in American stocks, the Russell 2000 or the S&P 500 could be used to represent the market alternative. In order to be as precise as possible, we have looked at each individual deal, and seen in which country the investment was made. We then matched this deal to a broad index for that country. Thereby, a different public market equivalent was used for each deal.

In addition to this, we also ran a test to see how much of an effect the choice of PME had on the excess returns. We have done so by calculating all excess returns using the MSCI world index, instead of using the local indices.

Table 3: List of European Countries' Indices and The Reporting Currencies. List containing which index has been used as the Public Market Equivalent for each country that an investment has been made in, and what currency the index is using, so that all indices could be converted into Euros.

European Indices		
Country	Index	Index Currency
Austria	ATX	Euro
Belgium	Bel20	Euro
Bulgaria	SOFIX	Bulgarian Lev
Croatia	CROBEX	Croatian Kuna
Cyprus	CYPMAPM	Euro
Czech Republic	PX Index	Czech Koruna
Denmark	OMX 20	Danish Krone
Estonia	OMXT	Euro
Finland	OMXH25	Euro
France	CAC40	Euro
Germany	DAXS	Euro
Greece	FTSE.AT	Euro
Hungary	BUX	Hungarian Forint
Ireland	ISEQ	Euro
Italy	FTSE MIB	Euro
Latvia	OMXR	Euro
Lithuania	OMXVGI	Euro
Luxembourg	LUXX	Euro
Malta	MALTAIX	Euro
Netherlands	AEX	Euro
Norway	OSEBX	Norwegian Krona
Poland	WIG	Polish Zloty
Portugal	PSI20	Euro
Romania	BET-10	Romanian Leu
Slovakia	SAX	Euro
Slovenia	SLOETOP	Euro
Spain	IBEX	Euro
Sweden	OMX30	Swedish Krona
Switzerland	SSMI (SMI)	Swiss Franc
Turkey	XU100	Turkish Lira
United Kingdom	FTAS	British Pound

Table 4: List of Non-European Countries' Indices and The Reporting Currencies. List containing which index has been used as the Public Market Equivalent for each country that an investment has been made in, and what currency the index is using, so that all indices could be converted into Euros.

Non-European Indices		
Country	Index	Currency
Argentina	MERVAL	Argentina Peso
Canada	TSX 60	Canadian Dollar
China	Chss300	Chinese Yuan
Israel	ISTA100	Israeli Sheqel
Russian Federation	RSMICEX	Russian Ruble
Singapore	SNGPORI	Singaporean Dollar
United States	S&P COMP	United States Dollar

4.3 Currency Exchange and Inflation Adjustment of the PME

As the funds have not only made investments in countries inside the European Monetary Union, some indices were not reported in Euros. In order to make a proper comparison to the investments' returns, which are all reported in Euros by the funds, all indices were converted into Euro as per the date when investments were made or exited, i.e. the dates when money would have had to be exchanged in order to be invested into our hypothetical portfolio in the index.

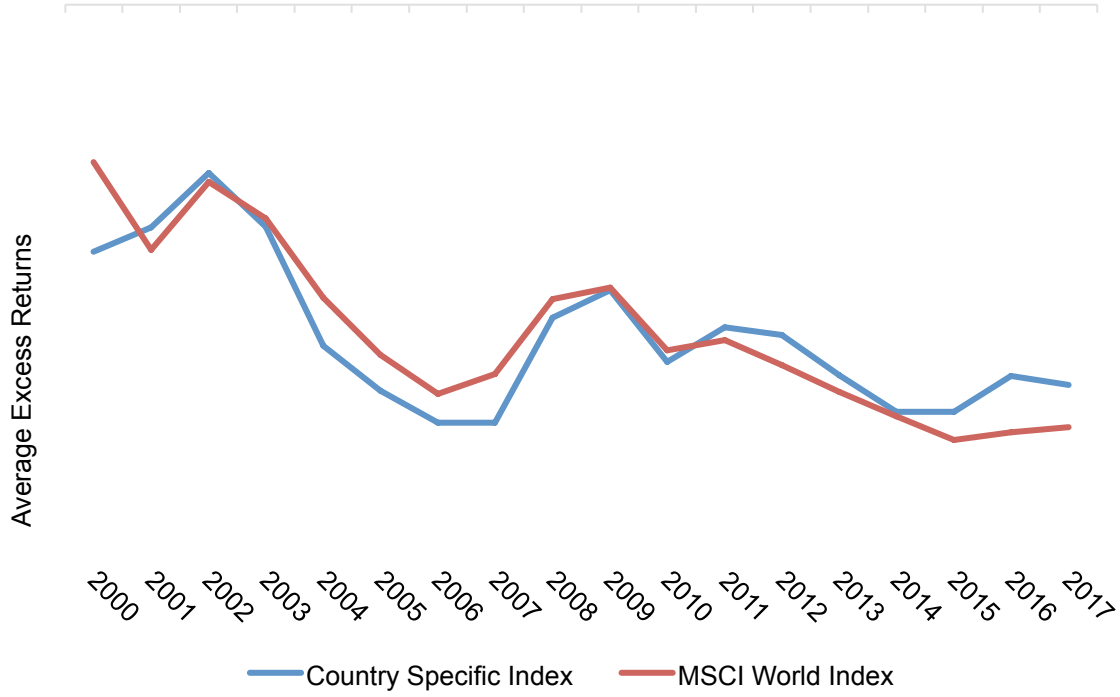
Since we compared the PME indices to inflation-adjusted returns, we also had to inflation-adjust the indices. We used the inflation for the country in which the fund was based to adjust the corresponding index. The reason for this is that it is in this country that investors at first invest their money, and in the end receive whatever proceeds the fund produces. We therefore adjust the index to reflect the changes in purchasing power that might have occurred while the money was invested in the fund. Hence, both the investment entry and exit amounts, and the index used in the excess return calculation were inflation adjusted using the same base country.

4.4 Excess Return Computation

Once we have converted all PME indices and we had adjusted all monetary values for inflation, we computed each deal's excess return. As all investments were made at different dates with different time spans, it was important to annualize the returns of each investment and the PME indices, in order to make any meaningful comparison. As a next step, we calculated the excess return for each deal by subtracting the related country specific or world PME index rate of return. We further used the total excess return of each investment to calculate the annualized return. The annualized return is the annual return required each year in order to achieve the total return, measured at the end of the investment. It was these annualized returns that were then used in our analysis to see whether there is a difference in returns between investments made at the end of the investment cycle and investments made previously.

When comparing the two results – Excess Returns adjusted for in-country PME ($Excess\ Returns_{EUR}$) versus Excess Returns adjusted to the world PME ($Excess\ Returns_{WI}$), we concluded that there was no noticeable difference. We created our econometric model with the dependent variable being only the Excess Return adjusted for country specific PME indices and we used the variable Excess Return adjusted for the world PME for the robustness test.

Figure 2: Average Excess Returns Based on Country PME and World PME per Year. There seems to be only minor differences in excess returns regardless of whether country specific or world PME is used when calculating the excess returns.



4.5 Compute Investment Percentiles and Investment Period Groups

To accommodate for the fact that different funds have differently sized investment cycles, time is measured as a percentile of the entire investment cycle, instead of in years. An investment that happens after 1 year in a 5-year investment cycle, will therefore get the percentile value 0.20, while an investment that takes place at the end of year 4 for the same fund would get the value 0.80. In this way we created a continuous variable, with values between 0 and 1, representing when investments have taken place.

As an additional way to measure the timing of the investments made by different funds, we divided the investment percentiles into buckets. There are 4 buckets of investment periods, as can be seen in Table 5.

Table 5: Buckets of Investment Period Groups. All investments have been divided into 4 groups depending on during which percentile of the investment cycle the investment was made.

Bucket #	1	2	3	4
Period	0-0.25	0.26-0.5	0.51-0.75	0.76-1

5. Descriptive Statistics

5.1 General Characteristics

Tables 6 and 7 show summaries of how our data is distributed geographically over regions and across different stage focuses. Number of funds varies significantly across both of them, while the average number of investments made by these funds remain at about the same level. All funds are based in Europe and most investments are made there as well, with only a small amount of investments being made in the rest of the world (table 8).

Table 6: Number of Funds and Average Number of Investments per Region. Number of funds based in each macro region, and the average number of investments made by a fund based in each region. There are few differences in average number of investments, but the number of funds vary significantly across regions.

Fund's Macro Region	# of Funds	# of Investments on Average
ISL	83	11
CENTER	75	12
DACH	50	12
SOUTH	44	8
NORDICS	30	10
CESEE	8	9

[1]While reporting excess returns, the macro region of Baltics has been removed due to small sample size, thus revealing proprietary data.

Table 7: Number of Funds and Average Number of Investments per Stage Focus. Number of funds investing in each Stage Focus, and the average number of investments made by a fund per Stage Focus. Early stage has the highest average of investments per fund, which is probably due to these early investments being quite small.

Funds Stage Focus	# of Funds	# of Investments on Average
Early Stage	135	12
Mid-Market	46	10
Lower-Mid Market	37	9
Balanced	36	9
Expansion	24	9
Growth	16	11

Table 8: Breakdown of Investments Made Into Each Region and Sector. Total amount of investments made into each sector and percentage of investments made into each sector split across regions. More than half of all investments have been made into the ICT sector. While few investments are made outside of Europe, the majority of them are made in the Life Sciences sector.

Investments Macro Region	Green Technologies	ICT[2]	Life Sciences	Manufacturing	Services
ISL	29.09%	28.19%	18.54%	20.64%	33.18%
CENTER	18.18%	24.77%	21.34%	23.83%	21.50%
DACH	14.55%	17.21%	28.50%	11.74%	7.48%
SOUTH	21.82%	7.44%	4.36%	25.17%	17.76%
NORDICS	5.45%	11.90%	9.03%	11.07%	10.28%
CESEE	3.64%	2.01%	0.31%	4.53%	6.54%
BALTIC	3.64%	0.79%	0.16%	1.01%	2.34%
WORLD	3.64%	7.69%	17.76%	2.01%	0.93%
Total Investments	55	1639	642	596	214

[1]While reporting number of investments made, the macro sector of Others/Missing has been removed due to small sample size, thus revealing proprietary data.
[2]ICT represents the industry Information, Communication and Technology.

5.2 Investment Period Percentile

Table 9: Summary of Invested Capital and Weighted Average Excess Returns per Investment's Percentile. The most capital usage and the highest number of investments have occurred between the 0.1-0.2 percentiles of the investment cycle. However, investing between 0.7th and 0.8th percentile returns the highest weighted average excess returns. Investing either in the first or the last percentiles of the investment cycle results into almost similar weighted average excess returns.

Investment Percentile	# of Total Investments	% of Total Capital Invested	Weighted Average Excess Returns
0-0.1	420	12.26%	-18.81%
0.1-0.2	534	18.15%	-15.67%
0.2-0.3	477	14.04%	-13.62%
0.3-0.4	379	13.63%	-2.33%
0.4-0.5	359	9.35%	-10.51%
0.5-0.6	257	8.65%	-3.25%
0.6-0.7	229	8.54%	-2.45%
0.7-0.8	196	5.24%	1.20%
0.8-0.9	168	6.42%	-7.88%
0.9-1	131	3.73%	-17.51%

As can be seen from table 9, a large portion of investments are made during the beginning of the investment period. By the first half of the investment period, two thirds of all invested capital has been deployed.

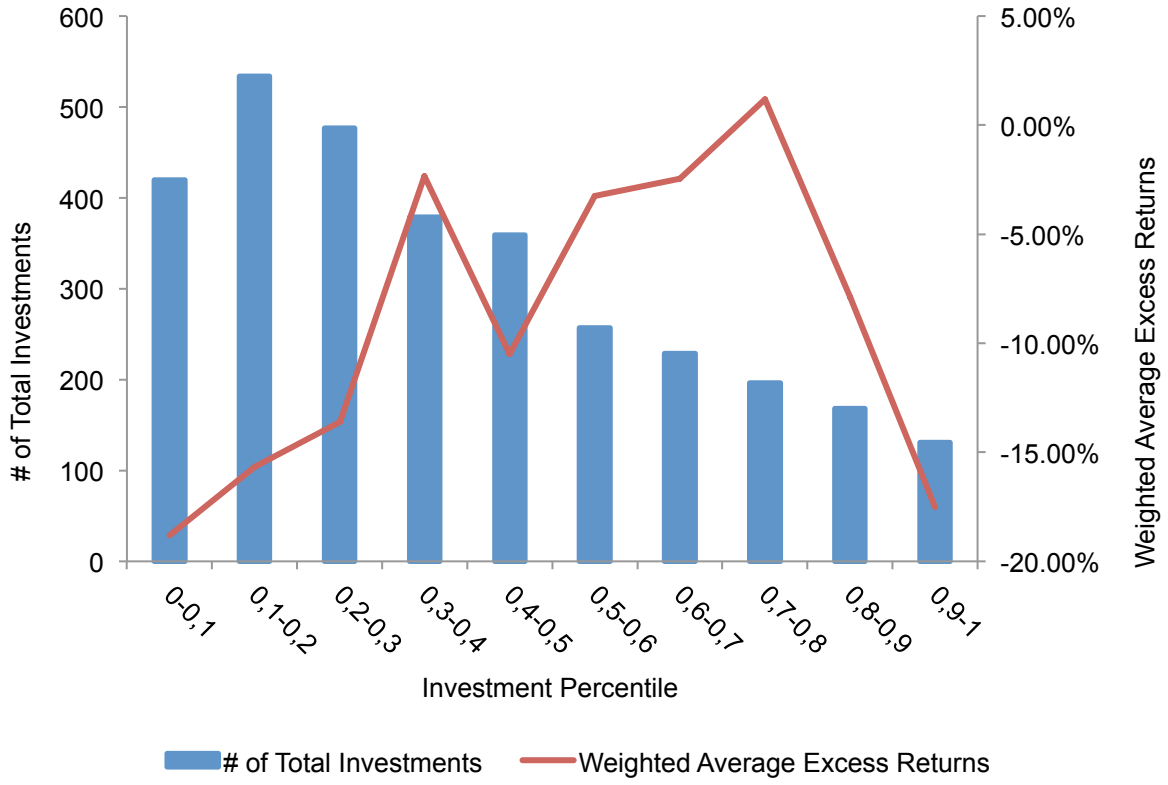
As we would expect, given our main hypothesis, the last decile is performing badly relative to the overall investment cycle. However, what is interesting is that the first third of the investment period is performing as badly

as the last decile. It is especially surprising to see such weighted average excess returns for the first investments, as hypothetically the GPs should have had time to evaluate possible investment objects during the capital raising stage and invest in the ones with promising returns. Therefore, one would expect these first investments to outperform those done later.

Figure 3 shows that, while the number of investments declines after the first part of the investment cycle, the weighted average excess returns increase the later in the cycle an investment is made, with the highest average returns for investments made right before the last part of the investment cycle.

The best investments are made by the funds during the second half of the investment period, but before the very end. This might be due to the additional time that the fund has had to look for good investment targets and evaluate them.

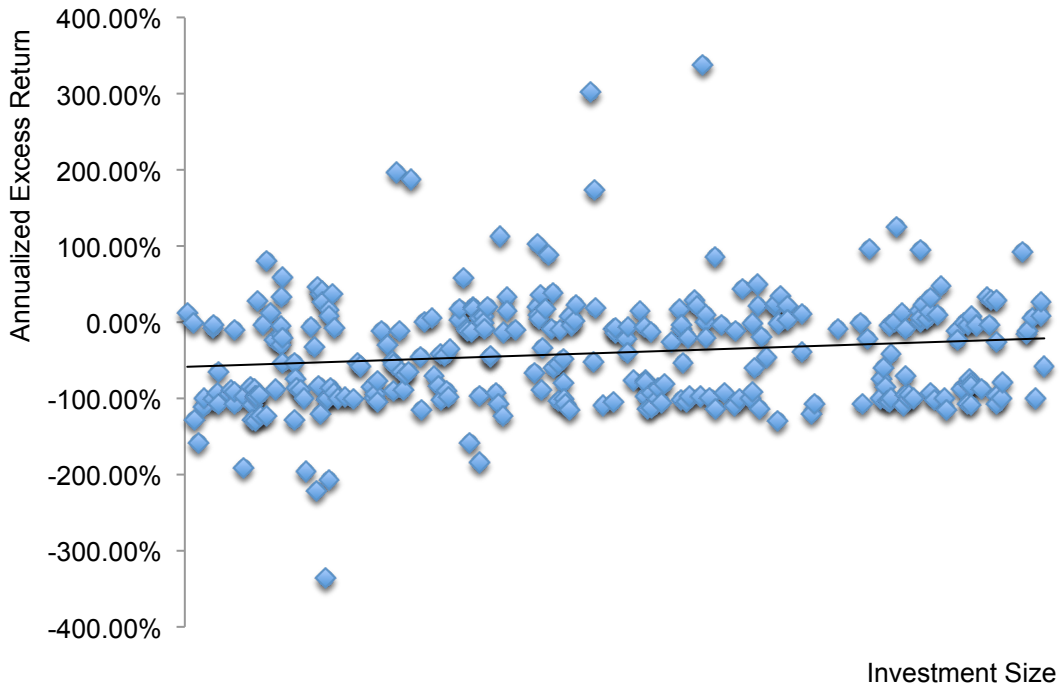
Figure 3: Number of Investments Made and Weighted Average Excess Returns per Investment Percentile. Most investments are made during the beginning of the investment cycle, while the returns vary heavily depending on when in the cycle the investment is made. The first and last decile perform the worst, while the 0.7 decile has the highest average excess returns.



5.3 Total Investment Size

As shown in figure 4, there is a positive relationship between the size of an investment and its excess returns. The bigger the investment in a deal is, the higher the returns are. This could be due to several factors, one of which could be that funds are more careful when they invest a large sum of money, therefore these investments perform better, as the fund manager does not want to take a large risk on a company unless they are sure that it is going to perform well. Another reason could be that if the deal is very large, not all funds can take part in it. This reduction in competition makes it possible for larger investments to generate higher excess returns (Porter, 1979).

Figure 4: Annualized Excess Returns per Investment Size. There is a slight trend that the more capital invested in a deal, the higher the excess return of that deal.



However, the fact that we have different types of investments and industries in the dataset, could also influence the amount of capital invested. The relationship between size and returns could therefore possibly be explained by certain sectors or types of investments having higher average returns, while also demanding a larger amount of capital on average (table 14 and table 16).

5.4 Investment Year and Exit Year

Figure 5: Timeline of Fund's Vintage Year and Investments' Exit and Investment Year. Number of funds started, number of investments made, and number of deals that have been exited for each year. As we have not included funds that have not finished their investment period in our data we show no new funds post 2012. In the same way, the amount of investments made after 2013 goes down due to us excluding information regarding investments that have not been exited before 31st December 2017. Number of investments made is therefore not representative after 2013.

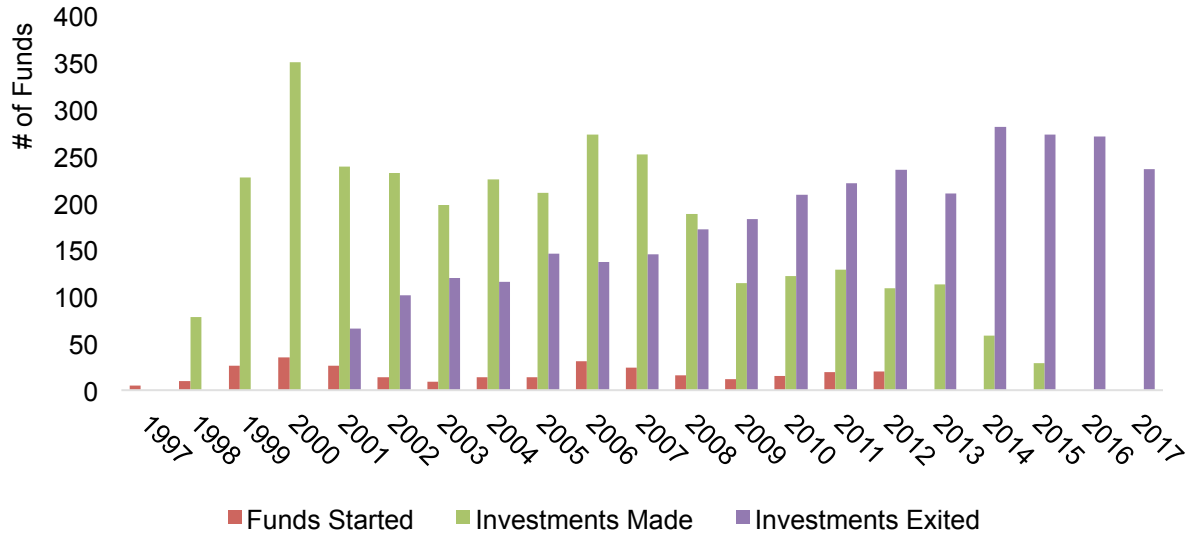
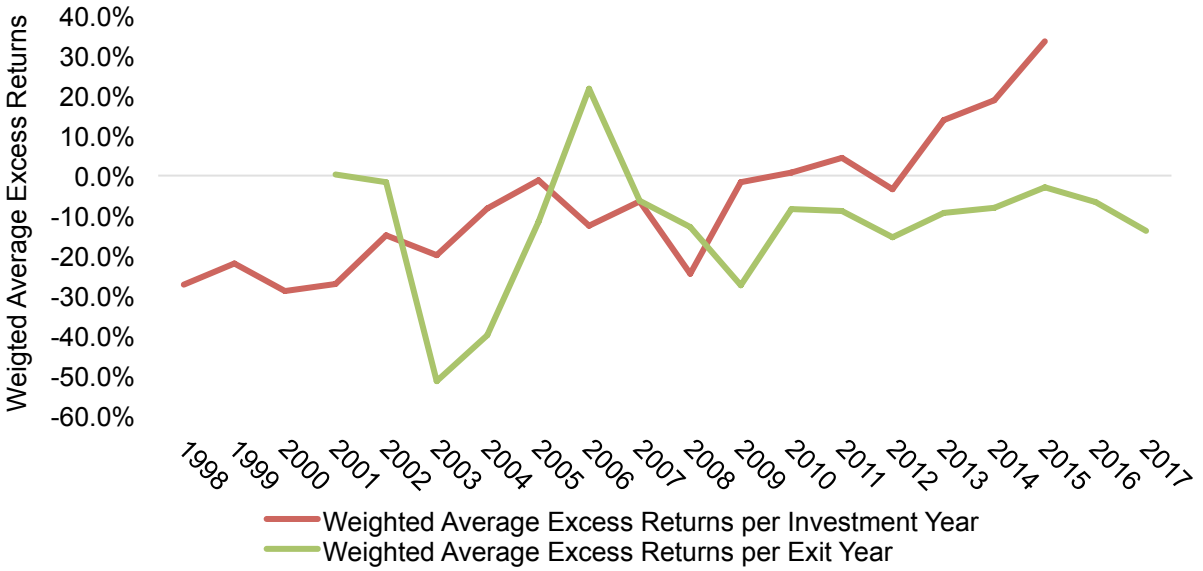


Figure 6: Weighted Average Excess Returns per Investment and Exit Year. Average returns for investments made after the financial crisis have outperformed the average returns for investments entered prior to the crisis.



[1]While reporting number of investments made, some years have been removed due to small sample size, thus revealing proprietary data.

Figure 6 shows the weighted average returns of investments made and exited in each of the years in the dataset. It seems that the best performing investments were those exited during the years before the financial crisis, probably due to the boom in the economy and the high valuations this brought with it.

Furthermore, in line with expectations, investments made after the financial crisis do outperform other years, as PE firms have the possibility to use their capital to scoop up distressed assets. The aftermath years after the crisis, 2009 and 2010 have higher average returns than all but one year prior to it.

5.5 EIF Stake in The Fund

Table 10: Number of Funds, Percentage of Total Capital Invested and Weighted Average Excess Returns per EIF Stake in a Fund. The size of the EIF's stake in each fund it invests in varies between funds. Most funds the EIF invests in receive, less than 30% of their capital from the EIF.

EIF Stake in a Fund *(in percentiles)*	# Funds	Weighted Average Excess Returns
0-0.1	30	38.08%
0.1-0.2	81	-131.29%
0.2-0.3	59	-131.23%
0.3-0.4	40	-50.01%
0.4-0.5	10	-19.01%
>0.5	14	-6.47%

It is usually hard to get large stakes in very well preforming PE funds, as so many investors are willing to offer them capital. Therefore, it is not surprising that we observe that the highest average returns occur in the funds where the EIF has the lowest stake. Funds with a good track record of high performance don't have as hard time finding capital as new funds without a proven record (table 13), therefore institutions with policy objectives like the EIF would be the ones investing in them.

5.6 Annual Management Fee Rate

Table 11: Distribution of Annual Management Fee Rate. A majority of funds have a Management fee rate between 2%-2.5%, with some outliers that have significantly higher or lower fees.

Management Fee	<1.75	2	2,25	2,5	2.5<
% of Total Funds	6.50%	28.52%	9.75%	47.29%	7.94%
Weighted Average Excess Returns	-2.31%	2.91%	-16.40%	-21.57%	-33.66%

As can be seen in table 11, there are some differences in the management fee rate that the different funds charge from the LPs. This is in line with the results found by Metrick and Yasuada (2010), that on average buyout funds tend to have a management fee rate of 2% while Venture Capital funds have an average of about 2.5%. The highest average excess returns are achieved by the funds charging management fees of 2 %. This could be due to early stage funds often charging higher management fees than buyout funds. If there is then a difference in returns between these type of funds, that would influence the average excess returns for funds charging different fees.

5.7 Fund's Stake in Each Company

Table 12: Number of Investments, % of Total Capital Invested and Weighted Average Excess Returns per Fund's Stake in Each Investment. Summary table of how the funds' invest in their portfolio companies. Most capital is invested into companies where the individual fund owns a stake lower than 0.3. However, it seems that the larger portion of the portfolio company that a fund owns, the larger are the excess returns of that deal. This could be due to the characteristics of different funds, as venture capital often take a smaller stake in their portfolio companies, while buyout funds buys up the whole company, either alone or with a consortium of other buyout funds. The differences in returns could therefore be explained by the different types of investments that this represents, if buyout outperforms VC, one would expect larger stakes to generate higher returns.

Fund's Stake in Each Investment	# of Investments	% of Total Capital Invested	Weighted Average Excess Returns
0-0.1	1057	17.45%	-14.89%
0.1-0.2	700	17.59%	-16.80%
0.2-0.3	473	14.56%	-18.69%
0.3-0.4	251	9.29%	-13.67%
0.4-0.5	155	7.40%	-10.44%
0.5-0.6	129	9.15%	4.19%
0.6-0.7	109	8.26%	-4.22%
0.7-0.8	69	5.71%	1.13%
0.8-0.9	56	4.00%	-3.37%
0.9-1	79	6.59%	0.49%

5.8 New and Old Teams

Table 13: Breakdown of Funds and Weighted Average Excess Returns per Old/New Team. Number of funds in which the EIF invests for the first time and GPs that have received capital from the EIF in the past. Teams that already have received financing in the past have higher weighted average excess returns compared to new teams.

Team	# of Funds	Weighted Average Excess Returns
Old	239	-7.51%
New	55	-32.39%

About one fifth of the funds that the EIF invests in have a management team that has not been working together before. While all funds on average have negative excess returns, these funds with new teams seem to be severely underperforming their peers that have been in the business for a longer time. This might be influenced by a survivorship bias, where a partnership is only able to raise a new fund if their previous fund performed well, which means that the group with "old" management teams only contains managers that seem to exhibit some proficiency at investing. These new management teams are an unknown entity that might be good investors, but as they don't have a track record they can't be evaluated. Looking at the dataset it seems like an investor, given the choice, should go with a team that has already run at least one fund earlier, as there would be more information available to select the ones that outperform the market and their competitors. It is probably this information advantage at the selection stage, which makes the group of funds with old teams outperform the funds with new teams.

5.9 Investment's Macro sector

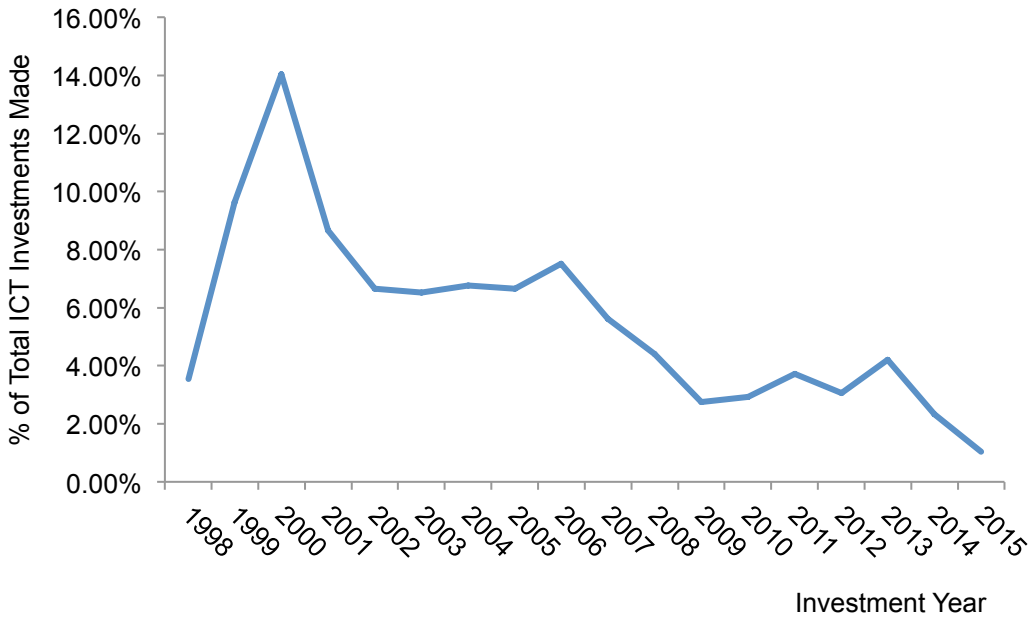
Table 14: Capital Invested and Weighted Average Excess Returns per Macro Sector. The weighted average excess returns for each Macro Sector and what portion of total invested capital has been invested into each sector. "Services" is the best performing sector on average, but only about a tenth of the invested capital has been aimed towards this segment. Interestingly, more than a third of all capital has been invested into the sector that performs the worst on average, "ICT".

Macro Sector of Investment	Total Investments	% of Total Capital Invested	Weighted Average Excess Returns
ICT	1639	36.27%	-20.52%
Life Sciences	642	18.78%	-4.81%
Manufacturing	596	30.73%	-6.05%
Services	214	11.64%	6.40%
Green Technologies	55	2.58%	-18.93%

[1]While reporting number of investments made, the sector Others/Missing has been removed due to small sample size, thus revealing proprietary data.

Studying table 14, it is clear that the ICT sector, which has received the most capital and the most investments, is the one performing the worst. This could be due to high competition within the sector itself, hinted at by the large number of investments made. This result could also be driven by the fact that the dataset captures the technology boom, which occurred between the years 1997 and 2001, also known as the "Dot-com boom". It was a period of excessive speculation and growth in the usage and adaptation of the Internet, and a lot of investments were made in the technology sector. If the funds in the sample happened to invest at the wrong time, this could explain the dismal returns, as the boom quickly turned to a bust. Figure 7, shows percentage of ICT investments made each year, and a majority can be seen to take place during the late 1990's and early 2000's.

Figure 7: ICT Investments per Year. The graph indicates the peak in ICT investments during the period 1998 – 2001, coinciding with the "Dot-com boom".



5.10 Fund's Macro Region Focus

The CESEE region is the only one with positive average returns (as can be seen from table 15 below), this is not due to any region specific factors, but to one big outlier in the dataset, bringing up the whole average. It should be noted, however, that the two regions that receive the most capital invested – ISL and CENTER - are also the ones performing the best, out of all the regions.

Table 15: Summary of Invested Capital and Excess Returns per Funds' Macro Region Focus. Percentage of total capital invested into the regions where funds are based and the regions' weighted average excess returns. The regions receiving the most funding also seem to be the ones to perform the best, on average.

Funds Macro Region Focus	# of Investments	% of Total Capital Invested	Weighted Average Excess Returns
ISL	916	25.30%	-6.88%
CENTER	880	31.97%	-7.48%
DACH	582	13.83%	-24.37%
SOUTH	365	16.33%	-11.23%
NORDICS	314	7.81%	-11.57%
CESEE	69	4.77%	5.71%

[1]While reporting excess returns, the macro region of Baltics has been removed due to small sample size, thus revealing proprietary data.

5.11 Stage Focus

Table 16: Summary of Invested Capital and Excess Returns per Funds' Stage Focus. Percentage of total capital invested into each Stage Focus and their weighted average excess returns. One third of capital is invested into Early stage, the Stage Focus which appears to be performing the worst of all, while another third is invested into the best performing Stage Focus, Mid-Market.

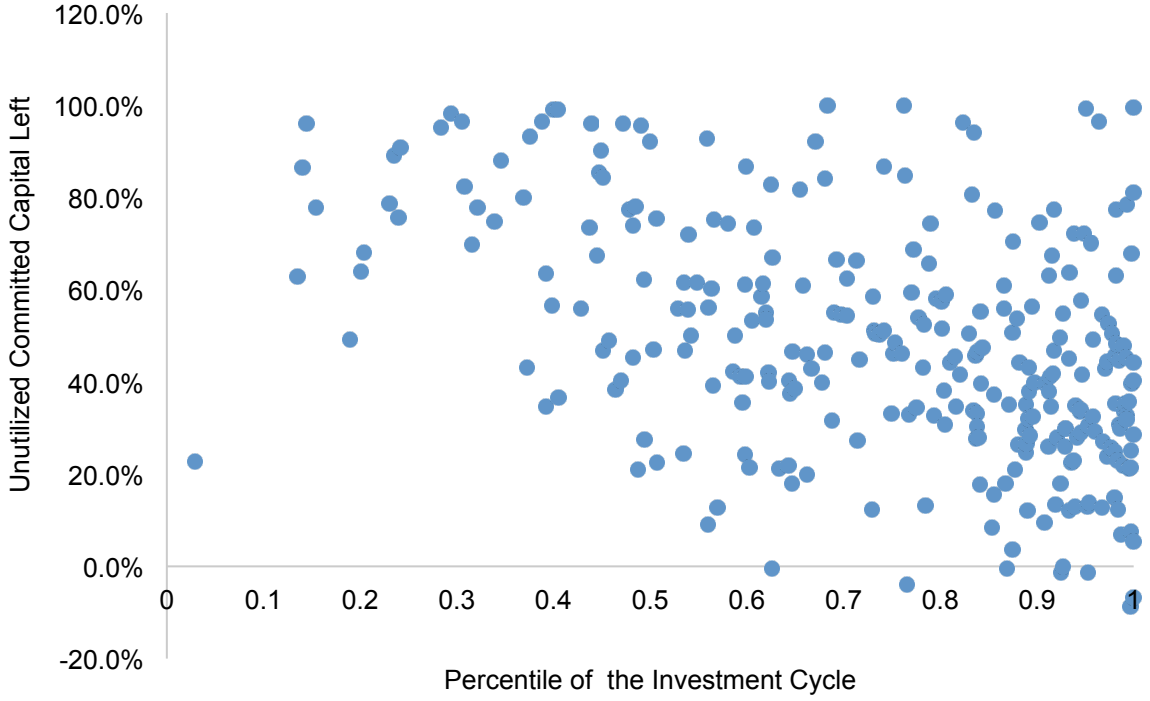
Funds Stage Focus	# of Total Investments	% of Total Capital Invested	Weighted Average Excess Returns
Early Stage	1658	33.13%	-28.22%
Balanced	446	12.56%	-12.79%
Mid-Market	323	30.87%	3.89%
Lower-Mid Market	316	14.41%	1.22%
Expansion	225	5.11%	0.28%
Growth	182	3.92%	-9.91%

The risky early stage investments are the ones that seem to be performing the worst of all fund focuses. As can be seen in Appendix 1, about one third of all investments made into this category go bankrupt. This does not mean in itself that the total average return for this category should be negative, but it does mean that all other investments, or at least a large portion of them, would have to perform extremely well in order to offset the effect of these losses. It seems that the funds that the EIF is investing in cannot find enough high performing companies to compensate for the ones that fail.

Mid-market, on the other hand, is outperforming the market and the other stage focuses. This could be due to the relatively lower risk of these investments, shown in the low number of bankruptcies of only 7% (see Appendix 1), which means that the total returns are not weighed down by as many bad investments as for some of the other stage focuses.

5.12 Unutilized Committed Capital

Figure 8: Unutilized Capital per Each Fund's Last Investment. How much unutilized capital each fund had left after it had made its last investment plotted against when in the investment period this investment took place. Many funds made their last investment before the end of the investment cycle, and they often had a significant amount of their capital left unutilized.



To be able to see whether funds use all of their committed capital during the investment period, we calculated each fund's unutilized committed capital by subtracting all invested capital up to and including the last investment from the total commitments. We then used this to calculate a ratio of how much of total commitments were left, unutilized. Figure 8 shows when in the investment cycle each fund made its last investment and how much committed capital was still left unutilized after this final investment was made.

Table 17: Capital Left After Last Investment Has Been Made for Each Fund. Percentage of funds that have more, or less than half of their committed capital left after making their last investment. Reported for all funds, and depending on if the last investment was made before or during the end of the investment cycle. Out of all funds, 43% made their last investment before the end of the investment period, here set as the 75th percentile. Almost half of all funds, 44%, had more than half of their committed capital left after making their last investment.

	Unutilized Committed Capital		Percentage of Total Funds
	<= 50%	>50%	
All Funds	56%	44%	100%
Last investment made before 75th Percentile	36%	64%	43%
Last investment made after 75th Percentile	72%	28%	57%

Table 18: Unutilized Committed Capital Left and Average Excess Return For Fund's Last Investment, Depending on During Which Quartile of The Investment Period It Took Place. Due to the low number of observations in the first quartile, no conclusions can be drawn regarding those investments. For the remaining quartiles, the average unutilized committed capital decreases the later in the investment cycle the last investment is made. Average excess returns also decrease the later the last investment is made.

	Investment Period Group			
	0-0.25	.26-.5	.51-.75	.76-1
Average Capital Left	0.64	0.71	0.51	0.40
Average Returns	-45%	-7%	-15%	-19%
% of Total Investments	4%	14%	26%	57%

Grouping all of the funds, depending on in which quartile of the investment cycle they made their last investment, shows that more than half made their last investment during the last quartile, while one fourth made it during the third quartile. There is a clear negative trend for both average unutilized committed capital and average excess returns the later in the investment period the last investment is made.

6. Empirical strategy

To identify any significant relation between when an investment was made and its excess return, we ran three different regressions. These intend to determine whether excess returns of investments compared to the in-country PME ($Excess\ Returns_{EUR}$) are dependent on the timing of the investment, as measured through the investment period percentile or the investment period group. All our model specifications assume the following structure for the error term u:

$$u_{fmji}{}^{8} = \eta_f + \lambda_m + \delta_j + \varepsilon_i$$

where η_f is the fund manager-specific component, λ_m the fund macroregion-specific component, δ_j the fund-specific component and ε_i is the randomly distributed investment-specific error. Our baseline specification is as follows:

$$y_{fmji} = \alpha_0 + \beta_1 inv.period\_perc_{fmji} + \beta_2 inv.period\_perc^2_{fmji} + \underline{\beta} X_{fmji} + \eta_j + \lambda_m + \delta_j + \varepsilon_i$$

where X_{fmji} is a matrix of explanatory variables as defined in Table 1 and 2. We test two variations to this model. First, we test for "jumps" in the correlation term of interest by introducing a discretized version of the investment period percentile. Second, we test the coefficient of interest under a different assumption for the structure of the error term: $u = \lambda_m + \varepsilon_i$; in this model we also add an additional set of fund-specific characteristics $\underline{\delta} Z_{fj}$ sought to satisfy the exogeneity assumption. This second approach should theoretically produce results that are less consistent than our baseline model, to the advantage of a less saturated model. The full specifications of the three regressions are outlined below.

[8] Where: f = fund manager; m = fund region; j = fund; i = deal

1. Model 1 (Baseline): Fixed effects on Funds, clustered by Fund Manager, independent variable is Investment Period Percentile

$$\begin{aligned}&\boldsymbol{Excess\ Returns}_{\boldsymbol{EUR},fmji}\\&= \alpha_0 + \beta_1 * Investment\ Period\ Percentile_{fmji} + \beta_2\\&* Investment\ Period\ Percentile^2_{fmji} + \beta_3 * Total\ Investment_{fmji} + \beta_4\\&* Investment\ Year_{fmji} + \beta_5 * Exit\ Year_{fmji} + \beta_6 * EIF\ Stake_{fj} + \beta_7\\&* Fund\ stake\ in\ the\ company_{mji} + \beta_8 * Management\ fee\ rate_{fj} + \beta_9\\&* Fund\ Size_{fj} + \gamma_2 * Macrosector_{fmji} + \delta_j'^{9} + \varepsilon_i\end{aligned}$$

2. Model 2: Fixed effects on Funds, clustered by Fund Manager, independent variable is Investment Period Group

$$\begin{aligned}&\boldsymbol{Excess\ Returns}_{\boldsymbol{EUR},fmji}\\&= \alpha_0 + \beta_1 * Investment\ Period\ Group_{fmji} + \beta_2 * Total\ Investment_{fmji} + \beta_3\\&* Investment\ Year_{fmji} + \beta_4 * Exit\ Year_{fmji} + \beta_5 * EIF\ Stake_f + \beta_6\\&* Fund\ stake\ in\ the\ company_{mji} + \beta_7 * Management\ fee\ rate_{fji} + \beta_8\\&* Fund\ Size_{fj} + \gamma_2 * Macrosector_{fmji} + \delta_j' + \varepsilon_i\end{aligned}$$

3. Model 3: Fixed effects on Funds Region, clustered by Fund Manager, independent variable is Investment Period Percentile

$$\begin{aligned}&\boldsymbol{Excess\ Returns}_{\boldsymbol{EUR},fmji}\\&= \alpha_0 + \beta_1 * Investment\ Period\ Percentile_{fmji} + \beta_2\\&* Investment\ Period\ Percentile^2_{fmji} + \beta_3 * Total\ Investment_{fmji} + \beta_4\\&* Investment\ Year_{fmji} + \beta_5 * Exit\ Year_{fmji} + \beta_6 * EIF\ Stake_f + \beta_7\\&* Fund\ stake\ in\ the\ company_{mji} + \beta_8 * Management\ fee\ rate_{fji} + \beta_9\\&* Fund\ Size_{fj} + \gamma_2 * Macroregion\ Focus_f + \gamma_3 * Stage\ Focus_f + \gamma_4\\&* New\ Team_f + \gamma_5 * MMacrosector_{fmji} + u_{fmji}\end{aligned}$$

[9] $\delta_j' = \eta_f + \lambda_m + \delta_j$

When using fixed effects (FE), we acknowledge that certain factors linked to each investment may impact or bias our estimated coefficients, and we needed to control for them. We used fixed effects as all investments have certain shared characteristics that affect their returns. Each fund in our data has made several investments, and since we were looking at differences in returns within funds, we had to take into account the specific effects that each fund had on its investments when calculating the returns of individual investments.

For instance, assume the proficiency of the fund managing team behind fund 1 to be higher than the competing team for fund 2. Therefore, the returns of the fund's individual investments will differ. In addition, assume that fund 1 typically invests later in the investment period, compared to fund 2. If we were to compare all early investments to all late investments, the results could thus be biased, as maybe the effect of later investments on the return profile is driven by fund 1, which generally outperforms fund 2 regardless of the investment period.

A similar argument could be made to support controlling for the country of focus of each fund. For example, if fund 1 is focusing its investments into a rapidly developing country A with highly volatile investments and fund 2 is focused on a country B with more stable returns, once again the returns of their individual investments will differ. Thus, we employ two set of alternative fixed effects: a first, on funds, and a second, on fund's region. Given that theoretically fund-level fixed effects should also account for fund-region fixed affects, we consider the latter approach as a robustness check to our main fund-level FE specification.

Moreover, all models are fitted using cluster-robust standard errors. A "cluster" is a collection of objects that are similar between them and are different to the objects belonging to other clusters/groups. We know that a fund manager may have raised more than one fund throughout his/her career; therefore we assume that all funds belonging to the same fund manager exhibit the same distribution of excess returns. However, we allow

this distribution to vary *across* different fund managers. This is consistent with the findings of Kaplan and Schoar (2005), who found that returns persist when fund managers raise new funds.

Table 19: Regression Results from the Final Models, Dependent Variable: Excess Returns_EUR. The independent variable in Model 1 and 3 is Investment Period Percentile, whereas for Model 2 it is Investment Period Group. Model 1 and 2 hold the specifications of having fixed effects on Fund, and Model 3 has fixed effects on Fund's Region. For all three models, the clustering is on Fund's Manager. The regressions have been run on a high number of observation, but at most 20% of the total variation in the dependent variable can be explained by all independent and control variables.

VARIABLES	Model 1	Model 2	Model 3
Investment Period Percentile	-0.05567		0.19368
	(0.343)		(0.199)
Investment Period Percentile^2	0.03480		-0.14591
	(0.225)		(0.195)
Investment Period Groups (omitted: Period Group 2)			
Period Group 1		0.01967	
		(0.052)	
Period Group 3		-0.00278	
		(0.061)	
Period Group 4		0.01973	
		(0.113)	
Log of Total Investment in EUR	0.05203**	0.05215**	0.05866***
	(0.022)	(0.022)	(0.017)
First Investment Date	0.04526	0.04282	0.03329***
	(0.048)	(0.035)	(0.008)
Exit Date	-0.03493***	-0.03501***	-0.03833***
	(0.009)	(0.009)	(0.008)
EIF Stake in the Fund	4.02104	4.08293*	-0.13301
	(2.443)	(2.455)	(0.169)
Fee Rate Margin	0.34748**	0.35361**	-0.02347
	(0.146)	(0.146)	(0.031)
Fund Stake in the Company	-0.00068	-0.00069	-0.00111
	(0.001)	(0.001)	(0.001)
Log of Fund Size in EUR	-0.05501	-0.05680	-0.02621
	(0.223)	(0.228)	(0.028)
New Team			-0.03500
			(0.052)
Macro Region of the Fund (omitted: DACH)			
Nordics			-0.21302
			(0.146)
Center			-0.01484
			(0.119)
South			-0.18657
			(0.114)
ISL			-0.11339
			(0.109)
Baltic			-0.19142
			(0.147)
CESEE			-0.40147**
			(0.182)

Table 19: Regression Results from the Final Models, Dependent Variable: Excess Returns_EUR. The independent variable in Model 1 and 3 is Investment Period Percentile, whereas for Model 2 it is Investment Period Group. Model 1 and 2 hold the specifications of having fixed effects on Fund, and Model 3 has fixed effects on Fund's Region. For all three models, the clustering is on Fund's Manager. The regressions have been run on a high number of observation, but at most 20% of the total variation in the dependent variable can be explained by all independent and control variables.

VARIABLES	Model 1	Model 2	Model 3
World			0.00843
			(0.099)
Stage Focus of the Fund (omitted: Early Stage)			
Balanced			0.13133**
			(0.059)
Expansion			0.23373***
			(0.056)
Growth			0.04789
			(0.061)
Lower-Mid market			0.29993***
			(0.056)
Mid-Market			0.35578***
			(0.064)
Macro Sector of the Company (omitted: ICT)			
Life Sciences	0.05779	0.05819	0.06515
	(0.055)	(0.055)	(0.042)
Manufacturing	-0.04124	-0.04113	-0.06868*
	(0.044)	(0.044)	(0.036)
Services	0.03270	0.03410	0.02346
	(0.054)	(0.055)	(0.048)
Green Technologies	-0.26358**	-0.26288**	-0.32255***
	(0.103)	(0.104)	(0.098)
Other/Missing	0.52166	0.51936	0.32734
	(0.404)	(0.404)	(0.454)
Observations	2,667	2,667	2,667
R-squared	0.20	0.20	0.09

*** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses

Studying Model 1, we cannot accept, nor reject the hypothesis that there is no difference in returns depending on when in the investment cycle an investment is made. Due to the fixed effects on Fund, the fund macro regions and stage focus are excluded, as these will always be the same within a fund. We get positive significant results for size of the investment and annual management fees paid to the GPs. Furthermore, we see negative significant results for the year the investment has been exited if the Macro sector is Green Technologies.

The second regression model keeps the main characteristics of Model 1, but instead, uses investment period group as a dependent variable.

As in the first case, we do not get significant results to accept, nor reject our hypothesis. Contrary to Model 1 the EIF stake in the fund shows positive significant results as well.

To test the hypothesis on bigger individual groups, a third regression (Model 3) has been run with fixed effects on Funds' region.

Once again, we do not get significant results to accept, nor reject the main hypothesis. We see similar results to when we ran the regressions with the dependent variable investment percentile. However, several other variables do have significant effects on excess returns, such as the year an investment was started, if the stage focus of the fund is Balanced, Expansion, Lower Mid-Market or Mid-market. We get negative significant results in case the macro sector of the company is Manufacturing or Green Technologies.

6.1 Robustness Checks

In order to confirm the results of our final model, a robustness check has been performed. Robustness checks are a common practice in empirical studies aimed at testing the structural validity of the regression model and the results (see Lu and White, 2014).

When calculating the excess returns of each investment, we have used two different methods – one assuming that an investment in a company is comparable to an investment in that country's public market and a second method – assuming that such investments could have been done in the world's public market (MSCI Index).

We came to the result, that excess returns for in-country specific PME do not show any significant results for the investment percentile period, nor the investment percentile period group. With a robustness check, we would like to test whether our results are sensitive to the Excess Returns for the World Index PME instead.

Appendix 2 shows the regression output.

Following the robustness check, the results remain the same, except the coefficient for fund's stake in each investment. There is a negative significant result between the size of a fund's share in each deal and the excess return of that deal compared to the world public market. The bigger the share, the smaller the excess returns.

7. Discussion

7.1 Main Results

It is interesting that we do not find any significance for the effect of time on excess returns. While this cannot be considered as ultimate proof that this relationship does not exist, our results do not support the idea suggested by Axelsson, Strömberg and Weisbach (2009), that late investments underperform investments made earlier due to the agency problem caused by the fees paid to GPs by LPs, in the case of the EIF.

Degeorge, Martin and Phalippou (2016), who did a similar study, but limited to only looking at Secondary Buyouts, did find significant results that SBOs made late in the investment cycle underperform those made earlier in the cycle. This opens up the question whether there are certain characteristics of SBOs that cause them to exhibit this relationship, while our analysis of predominantly VC investments could not show any significant results. It might be interesting for future research to use a larger sample of funds and investments to see if there is a certain type of deal that is more commonly used at the end of an investment cycle if a fund wants to burn cash in order to increase fees. To test whether the result of Degeorge, Martin and Phalippou (2016) holds across all types of investments or only for SBOs.

Another point that has to be considered, is that all our data pertains to EIF-supported activity. While this does not automatically lower the standard of the data we have, it might mean that all of these funds have something in common, which precludes them from exhibiting the behaviour we are looking for, thereby making it impossible for us to find any significant results.

A possibility is that the EIF is good at screening and selecting funds, meaning that it avoids investing in management teams that would exhibit such behaviour if they have capital left at the end of the investment cycle.
As exhibited in table 13 earlier, only a small part of the funds invested in by the EIF belong to new fund managers that the EIF has not provided capital to in the past. That means that the rest are fund managers with which EIF already engaged with, which would most likely not have been able to raise a

follow-on fund had they "burnt" their cash in their previous fund. This bias of old teams should probably not be underestimated, as Degeorge, Martin and Phalippou (2016) found that in the funds they observed the "burning" cash behaviour, limited partners showed their displeasure by making it harder for these GPs to raise their follow-on funds.

What is more, for all those newly founded funds, EIF can also be the only source of funding and this might lead us to the concept of "Repeated Game"[10].

In a game-theoretical way, the EIF invests with its policy-oriented eye into funds that arguably could make it into the market but are unable to raise enough capital from private investors on their own. Once EIF has stepped in, the given fund is able to raise the remaining capital needed from other sources and invest it in its intended way. In order not to lose the possibility of getting further public support in the future, this fund might not have the solitary objective of maximizing the fees collected by investing all capital, but rather maximizing its returns, in order to make the next capital raising round easier.

While we were unable in our study to find any significant results to accept or reject our main hypothesis, we did however find some results that we believe warrant further analysis in future research. In order to help clarify what this future research could be aimed at and broaden the understanding of how investigating these matters could bring insights into the Private Equity industry, we have performed an extended analysis of these results below.

[10] A repeated game is part of game theory and is played over discrete time periods. In each period a number of players play a static game referred to as the stage game, where they independently and simultaneously choose their actions. The importance here, is that players make their decisions in full knowledge of the history of the game played so far, therefore each player takes into account the repercussions his/her decisions will have on the future repetitions of that game.

7.2 Annual Management Fee Rate

While we did not find significant results for the relationship between excess returns and at what time investments are made, our regression showed a positive relationship between the size of the management fee rate and the excess returns of an investment. There are two main reasons why this might be the case.

First, the managers of a fund that performs better than others might also be able to convey this to investors, and thereby make them pay higher fees for their better services.

Secondly, perhaps funds with higher fees use this additional capital to invest in a bigger team, which can facilitate a better deal flow, of both higher quality and quantity, making it possible for the fund to make better investments.

If either of these explanations holds true, one would assume that a good strategy for investors would be to seek out the funds with the highest fees, as these are the ones that perform best on average.

However, before coming to this conclusion, the causality relationship between excess returns and higher fees should be studied. If the fees are used to increase the team size, it's probably positive for investors, however, if the larger fees are only due to past performance, it is harder to see the benefit for the LPs.

We believe this causal relationship to be an important field for further studies to see what information the management fee can give about a GPs performance. To guide future researchers, we put forward suggested avenues of research, that could shed some more light on the effect of management fees on excess returns.

In order to see whether the higher fees are only due to past performance, it could be tested what influence the performance of GPs previous funds have on the management fee rate for the next fund raised by the same GPs.

To test whether higher fees are used to improve the performance of the team, data regarding the number of employees per fund would be needed, as well as, information regarding the fund's overhead expenses. It would be of interest for the LPs to see what their fees are used for, and how this influences the returns.

7.3 Unutilized Committed Capital

As it was observed in Figure 8, a lot of the funds in the sample had both time in their investment periods and unutilized committed capital left after they had made their last investment. This was a surprising finding, given our main hypothesis, which suggests that funds would want to invest as much capital as possible in order to maximize fees. This result therefore warrants additional analysis.

First of all, more than 44% of all funds had at least half of their committed capital left unutilized after making their last investment, as seen in table 17. While this is surprising, one potential explanation could be that they were unable to find any suitable investments before the investment period ended.

However, 43% of funds actually make their last investment before the last quartile of the investment cycle. This means that for a normal fund, with a 5-year investment cycle, they had more than a year left to find a good investment. Of these funds, making their last investment before the end of the investment period, 64% or almost two thirds, had more than half of their committed capital left unutilized. That means that more than a quarter of total funds had both time and capital left after making their last investment.

While a fund would be expected to keep some of its committed capital uninvested after the investment cycle, in order to be able to pay management fees [11] and make follow on investments into its portfolio

[11] Management fees are paid as a percentage of committed capital, and funds only invest the committed capital exceeding the management fees. Average lifetime management fees for a PE fund is 12% and for a VC fund 17.75%, according to Metrick and Yasuada (2010)-

companies, it seems unlikely that the fund would need to keep this large of a portion of the committed capital for the future.

Furthermore, studying table 18, shows that funds that made their last investment earlier in the investment period had both more unutilized committed capital and higher average returns than the funds that made their last investment during the final quartile. This could support the previously raised idea that the funds that stop investing early do so because they can't find any new suitable investments.

It would be interesting for future research to try and better understand what it is that drives funds to keep this much of their committed capital uninvested and stop their investment activities before the investment period is over.

One avenue of research could be to look closer at how much capital funds expect to need for follow on investments. Another would be to see whether funds that stop investing early, do so because they can't find any new good investment opportunities, and whether this selective investment strategy provides them with higher performance than funds utilizing the whole investment period.

It would also be interesting to test this on a broader range of funds, as these results might be particular to the sample used by us and might not be representative for the PE industry in general.

8. Conclusion

The objective of this research paper was an empirical investigation on whether venture capital (VC) and private equity (PE) investments undertaken at the end of a fund's investment cycle show significantly different returns compared to investments earlier in the said cycle. A potential explanation for this finding might be linked to the way that VC/PE funds are remunerated. During the investment cycle the fund receives fees based on the committed capital, but towards the end of this period fees are paid based on invested capital. This can incentivise VC/PE funds to invest in riskier/lower quality deals towards the end of the cycle, in order to maximise their management fees. We have empirically tested this theory using deal-level data provided by the European Investment Fund. The data has been comprised of 294 unique funds and 3,150 investments (in 2,824 companies) made in the period between 1997 and 2017.

We have performed our study by looking at the returns of VC/PE funds on a deal by deal basis. As investments have been done in different years and market conditions, we have adjusted all monetary values for inflation, as well as calculated the Public Market Equivalent value for all raised investments. This way we have measured how well each investment has performed compared to a similar investment in the public market (either a general index from the country of investment or the MSCI World index), thus adjusting for differences in returns occurring due to an economic boom or a recession.

Annualized returns were calculated both for the market and the individual investments. Subtracting the first from the latter, we have obtained The Annualized Excess Return for each deal.

We have divided the investment period of each fund first into investment period percentiles and later on in investment period groups, in order to measure at which point in time an investment has occurred.

Following this, we have created three regression models, using different fixed effects, to test whether the timing of an investment in the investment cycle had any effect on the excess returns. In the first and the second regression we have used fixed effects on fund and the independent variable being the investment period percentile for Model 1 and investment period group for Model 2. In order to test the results on a bigger group, we have run a third regression with fixed effect on Funds' region and the independent continuous variable – investment period percentile. To account for the fact that some managers have been part of several funds, which might bring with them certain characteristics between these funds, we have clustered all regressions on Fund's Manager.

In all our model specifications we could not find, however, any significant differences between excess returns at the beginning and at the end of the investment cycle. Therefore, our data does not confirm the theoretical model of Axelsson, Stromberg and Weisbach (2009). We believe that this result could be partially driven by EIF specific biases. However, we did observe low returns for investments made both at the beginning and at the end of the investment cycle.

While we could not prove our main hypothesis, we did have other findings that could contribute for further research. We found a positive relationship between the size of management fees and excess returns. We therefore believe it would be of interest for future research to investigate the causality between fee size and returns, whether high performance leads to higher fees, or higher fees are used to improve a fund's performance.

What is more, in our sample, a large number of funds had a significant amount of committed capital left after making their last investment. They also made this investment well before the end of the investment period. It would be of interest to further research what potential reasons the funds could have for not investing all of their committed capital, and also to expand the study and see if this occurs amongst all funds, or whether it is specific to our sample.

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10. Appendix

10.1 Appendix 1 – Bankruptcies

A trend that can be observed in our results is the persistent negative excess returns throughout different industries, geographical regions and investment years. This could be influenced by the amount of bankruptcies in the dataset, which significantly affects the results. Bankruptcies have been defined as all investments that have an absolute exit value equal to or below zero.

Table 20: Number of Bankruptcies per Macro Sector. Number of bankruptcies within each sector. There is a large amount of bankruptcies in every sector, with Green Technologies and ICT having almost one third of investments going bankrupt.

Investments Macro Sector	% Bankruptcies
ICT	28%
Life Sciences	21%
Manufacturing	18%
Services	14%
Green Technologies	29%

[1]While reporting number of investments made, the sector Others/Missing has been removed due to small sample size thus revealing proprietary data.

As can be seen from table 19, almost a quarter of total investments made went bankrupt. This number seems quite high, but should be seen in the light of more than half of the investments being made by VC funds, where you would expect a large number of bankruptcies due to the high-risk nature of these types of early stage investments. As can be seen in table 20 below, almost a third of the investments made into early stage companies went bankrupt. This has a big effect on average returns, as an investor would need a lot of positive investments in order to compensate for one bankruptcy.

Studying the sectors into which the funds invest, it can be seen that ICT, which has the largest amount of investments, is also the one with the worst performance on average. Services, on the other hand, that has performed the best on average, had only 14% bankruptcies. There seems to be a

relationship between outperforming the market, and how risky (here measured in percentage of deals that go bankrupt) an investment strategy or sector is. The less risky, the higher the excess returns. It seems like the losses that the risky investments create are not compensated by high enough returns on the other investments to justify taking the risk.

Table 21: Number of Bankruptcies per Stage Focus. The percentage of investments going bankrupt within each Stage Focus. Most notable are Early stage and Expansion, where almost one third of investments go bankrupt. On the other side of the spectrum we have Mid-Market, where only 7% of investment go bankrupt, a much lower rate than for the other Stage Focuses.

Funds Stage Focus	% Bankruptcies
Early Stage	30%
Balanced	17%
Mid-Market	7%
Lower-Mid Market	12%
Expansion	30%
Growth	20%

About a third of all the capital invested by the EIF goes into funds focusing on Early stage capital (table 16), this contributes to the negative excess returns experience by the fund, as these investments are more prone to go bankrupt than investments into more mature companies.

10.2 Appendix 2 - Robustness Check Results

Table 22: Regression Results from the Final Models, Dependent Variable: Excess Returns_WI. The independent variable in Model 1 and 3 is Investment Period Percentile, whereas for Model 2 it is Investment Period Group. Model 1 and 2 hold the specifications of having fixed effects on Fund, and Model 3 has fixed effects on Fund's Region. For all three models, the clustering is on Fund's Manager. The regressions have been run on a high number of observation, but at most 20% of the total variation in the dependent variable can be explained by all independent and control variables.

VARIABLES	Model 1	Model 2	Model 3
Investment Period Percentile	-0.06901		0.19257
	(0.344)		(0.199)
Investment Period Percentile^2	0.01577		-0.14360
	(0.225)		(0.196)
Investment Period Groups (omitted: Period Group 2)			
Period Groip 1		0.22431	
		(0.052)	
Period Group 3		0.00024	
		(0.061)	
Period Group 4		0.01250	
		(0.114)	
Log of Total Investment in EUR	0.04928**	0.04938**	0.05526***
	(0.022)	(0.022)	(0.017)
First Investment Date	0.04739	0.04095	0.03112***
	(0.048)	(0.036)	(0.008)
Exit Date	-0.03959***	-0.03970***	-0.04277***
	(0.009)	(0.009)	(0.009)
EIF Stake in the Fund	4.18258*	4.23000*	-0.10150
	(2.531)	(2.540)	(0.165)
Fee Rate Margin	0.36491**	0.37269**	-0.03182
	(0.150)	(0.152)	(0.031)
Fund Stake in the Company	-0.00072	-0.00072	-0.00119*
	(0.001)	(0.001)	(0.001)
Log of Fund Size in EUR	-0.04319	-0.04638	-0.02023
	(0.220)	(0.226)	(0.028)
New Team			-0.03092
			(0.051)
Macro Region of the Fund (omitted: DACH)			
Nordics			-0.18224
			(0.143)
Center			0.00228
			(0.117)
South			-0.16030
			(0.111)
ISL			-0.10486
			(0.107)
Baltic			-0.27242*
			(0.146)
CESEE			-0.37654**
			(0.173)
World			0.03051

Table 22: Regression Results from the Final Models, Dependent Variable: Excess Returns_WI. The independent variable in Model 1 and 3 is Investment Period Percentile, whereas for Model 2 it is Investment Period Group. Model 1 and 2 hold the specifications of having fixed effects on Fund, and Model 3 has fixed effects on Fund's Region. For all three models, the clustering is on Fund's Manager. The regressions have been run on a high number of observation, but at most 20% of the total variation in the dependent variable can be explained by all independent and control variables.

VARIABLES	Model 1	Model 2	Model 3
			(0.096)
Stage Focus of the Fund (omitted: Early Stage)			
Balanced			0.13243**
			(0.058)
Expansion			0.23463***
			(0.055)
Growth			0.04847
			(0.060)
Lower-Mid market			0.29411***
			(0.056)
Mid-Market			0.34300***
			(0.064)
Macro Sector of the Company (omitted: ICT)			
Life Sciences	0.06197	0.06222	0.07097*
	(0.054)	(0.054)	(0.043)
Manufacturing	-0.04212	-0.04240	-0.06671*
	(0.044)	(0.044)	(0.036)
Services	0.03662	0.03779	0.03080
	(0.054)	(0.055)	(0.048)
Green Technologies	-0.24765**	-0.24656**	-0.31538***
	(0.102)	(0.103)	(0.097)
Other/Missing	0.61237	0.60851	0.40320
	(0.464)	(0.460)	(0.507)
Observations	2,668	2,668	2,668
R-squared	0.20	0.20	0.09

*** p<0.01, ** p<0.05, * p<0.1. Robust standard errors in parentheses