
Zombies in Private Equity

An Empirical Study of Fundraising Impact on Fund Performance

Stockholm School of Economics
Master Thesis in Finance
May 18, 2015

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Keywords: Private Equity; Zombie Funds; Performance Measurement; Corporate Governance
JEL classification: G23, G24, G30

Abstract

In a maturing private equity industry with more players, larger funds and importantly more data at researchers' disposal, new issues can be both identified and studied. One of these issues surfaced when the sharp drop in fundraising volumes in 2008 rendered many of the General Partners (GPs) unable to successfully raise a follow-on fund, which is considered vital for efficient functioning of the GP's organization. This has created an increasing concern among Limited Partners (LPs) who are stuck with underperforming and disincentivized GPs that are postponing divestments just to "milk" the fund for management fees. Regardless of the increased media attention on these zombie-like situations, relatively little is still known about the phenomenon. Using an extensive dataset of 2,824 private equity funds from Preqin, we identify 436 zombie funds with performance information among vintages from 1996 to 2008. We take a look at the fund performance patterns and observe from regression analysis that zombie funds are providing less value to their LPs over the course of the fund life. More importantly, we note that the performance deterioration of zombie funds is equal to 12% of the initial paid-in-capital compared to non-zombies once the failure to raise a follow-on fund has become clear. This is indicative of both misaligned incentives and that LPs would be better off by taking active measures to find a solution. Furthermore, we identify that zombie funds are slower in making investments as well as report to have more residual value left near the end of the fund's life. Our findings are both statistically and economically significant.

Acknowledgements

We would like to thank Frida Einarson and Per Nordlander from Verdane Capital Advisors for their support in data collection as well as help in reaching out to the Nordic limited partner community. Your insights were very helpful in shaping our approach to the relatively new phenomenon of zombie funds. We would also like to thank Per Strömberg for the valuable comments during the initial stages of the thesis. Foremost, we are grateful to our supervisor Laurent Bach for his guidance and constructive feedback over the course of our work.

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1. Introduction

This paper is currently one of the few academic research attempts to explore a recent issue in the Private Equity industry (PE) of zombie PE funds, run by General Partners (GPs) which are unable to raise a subsequent fund. Using the Preqin dataset, we identify the existing zombie funds and look at the quantitative and to some extent qualitative measures of fund performance to observe the differences between the zombie funds and the “normal” PE funds.

In particular, we research the following questions:

- (a) What are the characteristics influencing a PE fund to become a zombie?
- (b) What are the performance differences between zombie and non-zombie PE funds?
- (c) How do the investment patterns differ between zombie and non-zombie funds?
- (d) How do the divestment patterns differ between zombie and non-zombie funds?
- (e) What is the likely performance of a zombie fund once it becomes clear that the GP was unable to raise a follow-on fund?

To answer these questions we must first set up a background on why and how the zombie funds appeared and why it is a newly “found” topical issue. To begin with, the PE industry is still a relatively young industry. The main industry developments and growth were observed in the past 20-30 years, thus producing a rather limited track record for the industry performance evaluation. However, several key characteristics of the industry were indicated by a number of studies, from tales of superb performance of the best GPs managing secretive funds, to the boom and bust cycles of the industry and the impressive growth of capital raised. These developments paved a way for the PE industry growth in all directions, with diverse selection of strategies and investment targets. Nowadays the funds are attracting billions from a broad pool of Limited Partners (LPs), driving the industry closer to maturity.

At the same time, as a broader range of players became involved in the industry, more information escaped out of the private inners of the PE funds and GPs. Due to this, the PE funds became increasingly more similar in terms of their legal structure and compensation schemes, with some researchers noting the commoditization trend in the industry. Secondly, the increasing amount of information allowed for considerably more research effort being put into identifying not only the stellar returns but also potential and existing PE problems in the rapidly changing and maturing industry. And this is where our research paper steps into light.

One of the main threats to the GP integrity is the inability to raise a follow on fund when the investment period in the previous fund is over. After the 2008 crisis and the subsequent severe drop in fundraising volumes in the PE industry, it became a growing concern for many

LPs that some of their GPs are unable to raise a follow-on fund. A follow-on fund is part of the natural PE cycle and is vital for healthy GP operations and focused motivation to perform. Raising funds in a continuous fashion enables GPs to maintain their team of motivated professionals who are creating value for the LPs. This also provides additional income sources via new flows of GP income, thus reducing the reliance on only the existing flow of management fees and possible carried interest.

In turn, the inability to raise a follow-on fund, in many cases already preceded by underperformance in the existing fund, opens the doors for various issues. One of the largest of these issues is the dependence on the existing flow of management fees to survive and maintain the organization, creating a set of mixed incentives to defer divestment decisions. This potential resource absorbing “living dead” situation became a phenomenon called a zombie fund.

A “zombie fund” term was firstly adopted for PE by the financial media, subsequently being applied throughout the industry. Zombie funds receive various colourful epithets, such as “a little-known horror show in the investment world” from The Wall Street Journal (Eaglesham and Pulliam, 2012). With the growth of the industry, the value locked in the non-performing zombies became more substantial and thus a more common headache for LPs. They also helped in infusing growth in the secondary market, where a willing LP could potentially get rid of the problem at a discount.

But just how bad the zombies actually are was so far not fully explored in the research, partially due to complexity of obtaining reliable information, partially because the problem was not large enough when the industry was still a niche among other investment classes. In this paper we aim to explore the zombie fund phenomenon in depth by providing a clearer understanding of the actual year by year performance in the zombie situations and the differences from the “healthy” PE funds.

This research paper is structured as follows. Section 2 discusses prior research in several fields related to the zombie fund issue. Section 3 presents the methodology used in the paper as well as reviews the data collected over the research process. Section 4 discusses empirical findings of the paper and answers the research questions, followed by our conclusions and further research suggestions in Section 5.

2. Prior Research

This section outlines a number of prior research studies performed around the topics of private equity, corporate governance and behavioural finance, linking to our research on the zombie funds. The research exposure to the zombie funds has been rather limited to overviews from commercial PE data service providers and market players. Therefore, we start by providing an overview of the PE industry developments and issues with PE related information in the hopes of understanding how the problem of zombie funds formed and why it is only now that it is being addressed. We then relate to both the corporate governance frameworks as well as behavioural incentives for Limited Partners (LPs) and General Partners (GPs) to act in certain ways when running a PE fund, particularly focusing on what happens if problems appear on the way. The prior research findings are complemented by qualitative interviews performed with several LPs and GPs¹ in the Nordic PE market.

This section of the paper is divided into two parts: section (2.1) reviews the PE industry development and the apparent issues in the measurement of the performance of the PE funds and how does this relate to the zombie fund issue; whereas section (2.2) leads to a direct discussion on the current research efforts into the zombie fund issues, presenting various problems and potential solutions from the corporate governance and behavioural finance perspectives.

2.1 Private Equity in Brief

2.1.1 Industry Structure and Development

The PE industry has developed significantly over the last three decades, with almost 40-fold growth in fundraising activity from a bit less than \$7 billion in 1990 to close to \$270 billion just before the financial crisis in 2008 (Sensoy et al., 2014). In its early days, the PE industry was only regarded as an exotic alternative investment class, with the most successful GPs being able to limit the access to potential LPs considerably and granting excellent returns to the ones that were able to get in (Sensoy et al., 2014). This, combined with the limited amount of information available in the universe of potential LPs produced a hailed mystification of the PE industry, adding considerable attention to it as an investment class. Influential research, such as the “Eclipse of the Public Corporation,” (Jensen, 1989), highlighting the efficient nature of the PE

¹ The interviewees expressed their wish to talk anonymously due to LP-GP relationship concerns. Since the materials from the interviews are used to complement this section of the paper, the authors agreed to maintain the confidentiality of the interviewees, duly noting the information source as LP/GP Interviews whenever the interviews are used. The names are known to the thesis supervisor and the SSE Department of Finance.

funds and claiming the death of the public corporation, further advanced the capital commitments and numbers of the willing investors and GPs in the industry.

This growth has had a considerable impact to the industry, with Sensoy et al. (2014) noting that PE is entering into the stage of maturity. This means that a much broader LP base is investing considerably larger resources into the industry. To accommodate for this demand for limited partnerships in PE, not only did the existing players expand their funds but also many new GPs appeared, commoditizing the skill set and approach to investments. The quick growth of the GP base combined with the cyclicalities in the PE fundraising volumes (Phalippou and Zollo, 2005; Kaplan and Strömberg, 2009) can partly be blamed for the spike in the number of zombie funds in the recent years. Namely, the fact that capital commitment volumes move in waves rather than a gradual trend creates zombies almost by construction. Refer to **Appendix 1** depicting the PE Industry's capital raising activity over the past two decades. Not all the boom time GPs were able to attract follow-on funds when the fundraising volumes cooled down after 2008. As the failure of a lot of the "boom" time GPs is becoming apparent, the zombie fund phenomenon has started to pick up publicity at a growing pace over the past two years.

As explained by Kaplan and Strömberg (2009), a typical PE vehicle is a closed-end fund with no ability to withdraw capital until the end of the fund's lifetime. The length of the fund's life is usually 10 years with additional one-year extensions, depending on the Limited Partnership Agreement (LPA). This fund is structured as a limited partnership in legal terms.

One of the key features of the PE industry is its constant concern with privacy. As noted by Kaplan and Schoar (2005), the PE industry is largely exempt from public disclosures. Some direct information could be obtained in the US from some of the LPs via the Freedom of Information Act (FOIA) (Brown et al., 2015), but even this comes with a price. A Wall Street Journal article by Maremont and Spector (2014)² has exemplified that some of the GPs prefer to exclude potential LPs just to avoid FOIA reporting. This behaviour has considerable consequences on our research as well. Consequently, we will review some of the information sources for PE related studies to identify potential approaches and trustable sources for our analysis.

2.1.2 Box of Pandora: Private Equity Data

As noted by a handful of scholars (most recently, in Higson and Stucke (2012) and in Harris et al. (2014a)), the access to sufficient and unbiased data is the key issue to correctly assess the

² In their article, Maremont and Spector revealed the threat of limiting investment opportunities in KKR, a superstar PE fund manager, if Iowa Pension Fund, an LP in KKR, reveals the KKR performance information under FOIA (Nov 4, 2014).

performance of the PE industry. It is thus even more challenging for any of its sub-categories, e.g. zombie funds. We start by defining the sources of PE performance data.

Due to the obviously private nature of the PE industry, the reporting of the particular closed-end fund results, let alone cash flows, is usually done on a privately agreed basis between GPs and LPs or third parties. There are several third party data collection companies, with Preqin, Burgiss, Cambridge Associates, and ThomsonOne (previously VentureXpert) among the most prominent in the research. These third party data collection companies collect, consolidate, and present the PE industry data to the market via overviews, studies and data access services. A more detailed description of each of the four abovementioned data providers is presented in the **Appendix 2** of this paper.

In many cases, the GP reporting to the third parties is irregular and voluntary (LP/GP Interviews). Furthermore, the access to the third party PE data is usually charged and considerably restricted for research thus making cross database checks costly and sometimes impossible even for top scholars. For example, Burgiss enabled to use their dataset for the first time ever for Harris et al. (2014a), the same goes for Cambridge Associates, enabling the first ever access to Higson and Stucke (2012).

Furthermore, the data is currently concentrated on certain periods of time – in particular, the vintages in 80s and 90s, as noted by Higson and Stucke (2012). This happens because of the comparatively long fund lifetime (10 years via a usual contract plus 1-2 one-year extensions) compared to the overall industry existence, and the strong development of the industry over the said period, with many new funds entering the market. The combination of relatively young age of the whole industry and its cyclical nature, might lead to conclusions that are applicable mostly to a particular time period.

Consequently, most of the PE performance studies are done using the following options: **(1)** a single third-party data provider, thus exposing the research to the sample collection problems discussed above; **(2)** data provided by LPs, exposing the research to potentially large sample selection bias due to only one or few select LPs; **(3)** combining options (1) and (2), which became more reasonable with the maturing industry and more competing data providers opening up their databases. Overall, with a new year of data added to the datasets each year and so considerably enriching the industry coverage, the cross comparisons among the results and datasets of different data providers become more available in the research, as it is exemplified in the following sub-section.

Finding the True Performance

Somewhat unsurprisingly, the data issues discussed above have caused differing results and conclusions drawn about the industry performance. Most notably, Kaplan and Schoar (2005), using the ThomsonOne (VentureXpert) dataset, found that the buy-out funds in the US underperformed the S&P500 index. This result was later updated by Phalippou and Gottschalg (2009) for the whole PE industry, arguing that the underperformance prevails on a net-of-fund-fees basis. Later research found that the data from VentureXpert has a significant downward bias, as explained by Stucke (2011), and Phalippou (2012), with opposite results reported by both Harris et al. (2014a), using Burgiss, and Higson and Stucke (2012) using Cambridge Associates' expanded dataset. Harris et al. (2014a) also note that the performance of venture capital (VC) funds was lagging the S&P500 in 2000s. All this leads to considerable trouble in selecting and accessing as well as assessing information in PE.

Shedding some light on this issue, Harris et al. (2014a) compared the results they obtained from Burgiss dataset with the results from several other key PE data providers, and concluded that Preqin and Cambridge Associate data was qualitatively in line with their findings from Burgiss, whereas ThomsonOne (VentureXpert) appeared to contain the same bias, as discussed previously. The data availability has a substantial impact on our research as well. As explained in **Section 3** of this paper, we got access to Preqin database via a corporate sponsor.

And the Box Is Open

Historically, the image of the PE industry was built around success stories, where not only the top, but also the median and average funds beat the market indices (Harris et al., 2014a) and the particular types of LPs (e.g. endowments) were particularly successful in generating returns from the funds they invested in (Lerner et al., 2007). However, LPs become increasingly more exposed, even endowments, to the non-performance of the PE funds with the growth of capital flows to the industry as well as more exposure to a wide variety of funds, as evidenced by Sensoy et al. (2014). This leads us to one of the most recent problems of the PE funds and the focus of this paper – the zombie PE funds. While not actually the brain-chewing pieces of fantasy, the zombie funds are PE funds that have their GPs unable to raise a subsequent PE fund in their usual course of business, thus draining the LPs' returns by prolonged management fees.

To our knowledge, there is limited academic research performed on the topic, with a report by Migliorini (2014) available so far, focusing on the actual cases of zombies in the PE industry and bringing out the solutions available to address the issue. The scarce research reflects

the relatively new nature of the issue in the maturing PE industry, as well as data restrictions. Indirectly, the zombie issue was also addressed by Brown et al. (2015), when discussing the potential gaming of returns of GPs. In their research, the authors note that the managers tend to adjust Net Asset Values (NAVs) of their unrealised investments during several periods before the new fund is being raised, with the funds which report higher NAVs than the realization value being on average less able to raise a subsequent fund and thus, in our research terms, becoming a zombie. This can also be referred to some sort of signalling to the market, although false. It has been observed that a vice versa case also holds, as the best funds tend to underreport their NAVs, mainly due to reputational concerns. The key conclusion from this is that LPs become hard to fool twice.

Furthermore, zombie funds have also been discussed by various PE industry players. In its market overviews, Preqin (2013, 2014) estimated that there are over a thousand zombie funds in its dataset, mostly among venture capital funds and funds located in the US. Altogether, the combined unrealized NAV of the zombies was reported to reach over 110 billion US dollars in 2013. A thorough review of the zombie fund³ issue was performed by Custar et al. (2014) from Credit Suisse, reflecting the complexity of the problem as well as outlining potential steps of action for LPs.

The understanding of the zombie funds and potential solutions to the phenomenon may be derived from several fields of research. In the coming sub-section, we review these fields and put the picture together for potential causes and available solutions.

2.2 Zombie Fund Phenomenon

With the strong growth of the PE investments, especially during 2000s, the investments made by GPs were not always successful. Harris et al. (2014b) note that persistence of the returns of a GP after 2000s is notable in VC funds and in the bottom quartile of the buy-out funds, meaning that bad GPs tend to stay bad in the next fund as well. In a maturing industry this also means that the capital gets allocated to better GPs (Sensoy et al., 2014), with an increasing difficulty level for a bad performing GP to raise a new round of funds, opening up for various kinds of issues and internal fund problems, and presenting a zombie-like situation for the LPs to handle. To correctly approach the phenomenon, we firstly overview the increasingly complex nature of GP incentives and the GP-LP relationship

³ Custar et al. (2014) from Credit Suisse refer to the zombie funds as “Sunset funds”, which has a more positive/objective connotation that a fund in that situation might not exactly be a dead monster sucking the life and resources out of its LPs. However, due to a considerably larger prevalence of the “Zombie fund” term, we maintain this term throughout the paper.

2.2.1 General Partner Incentive Puzzle

From an LP perspective, a GP should maximize the value of LP investments in a fund via timely decisions to invest, add capital, or divest. As noted by many scholars (e.g. Bebhuk and Fried, 2003), the value maximization to the owners (i.e. LPs) is dependent on the correct alignment of incentives to perform between the managers (i.e. GPs) and the owners. However, the agreement of what those correct incentives are and whether they remain effective if a PE fund enters a zombie state is not always clear.

So far the PE funds offered a more or less similar incentive schemes, which are usually pre-agreed in the LPAs ex-ante, not knowing whether the fund becomes a zombie or not. To ensure that GPs' incentives are aligned to the LPs incentives, a two-tier compensation structure is prevalent in most of the PE funds, with two substantial parts of the fees consisting of Management Fee; and Carried Interest, with additional fees (e.g. deal fees and monitoring fees) existent in some funds (see the Definitions section of the Appendices). The most frequent terms of the GP compensation are known as “2/20”, meaning:

- (1) Management fee equal to 2% of the committed capital during the investment period or 2% of the investments managed after the investment period. The management fee, collected yearly or quarterly, represents the monetary and direct compensation for day-to-day work of the GP. This compensation is rather fixed over the fund investment period and potentially decreasing at the end of the fund life, when the investments are being divested.
- (2) Carried interest equal to 20% of the successful divestments, where the base for the carried interest calculation is usually adjusted by the sum of LP investments, management fees, and benchmarked against an appropriate pre-agreed index (e.g. S&P 500 or similar, reflecting the market movement). The carried interest part of the compensation provides a long call option-like payoff pattern with an exercise date set at the date of the last divestment and liquidation of the fund (or trending towards the end of the fund, if each divestment triggers a carried interest payment to the GP).

We find that the “2/20” compensation is still consistent with the empirical data presented in the Preqin Fund Terms Advisor (2015) for PE funds operating in the usual⁴ equity investment field. Combining the Sensoy et al. (2014), Metrick and Yasuda (2010), and Custar et

⁴To check the 2/20 rule of thumb, we took all available Preqin sample funds with vintages from 2000 to 2015 excluding the funds focusing on distressed debt, debt, infrastructure, mezzanine, real estate, special situations, timber, as well as funds of funds and secondaries. This selection criteria is further explained in section 3.2 of the paper.

al. (2014) findings, we also note that the carry should usually represent a lion share of the total GP compensation, thus aligning the incentive of a GP to bring the most at the exit stage.

This model of GP compensation works perfectly in “business-as-usual” conditions (as summarized in the **Appendix 3**), however failing these conditions might present considerable challenges for the GP and in turn change the GP’s behaviour, causing a distressed situation for the fund and the LPs’ investments, which brings us to a zombie state. Based on Migliorini (2014), Custar et al. (2014) and LP/GP Interviews, an underperforming GP, unable to raise a new fund to maintain its operations and team, would be:

- (1) Willing to hold on the “option” as long as possible – as it was observed as far back as by Black and Scholes (1973), an out of money option still has some value, thus making a GP willing to maintain the possibility of even a small gain compared to a certain no-gain. This produces an incentive to hold on the current fund investments and hope for value increases.
- (2) Dependent on the management fees of the current fund – as the carried interest part of the GP compensation becomes increasingly uncertain, and there are no management fees coming from a new fund to smooth out the GP operating costs, the incentives to prolong current investments become even stronger.
- (3) Dependent on the contractual agreements with LPs – depending on the legal contracts and potential clauses present for LPs to take action against a GP, the bargaining position of a GP varies. As the PE industry matured, the contracts became more exhaustive, whereas earlier case could see LPs not really having enough power to tame an underperforming GP in a convenient way.
- (4) Reputation-conscious – in general, the GPs prefer to have a pristine and trustworthy reputation. As discussed in the LP/GP Interviews, the strength of this preference might depend on the time left to retire, with older key managers or advisors of the GP possibly less worried about reputational damages.
- (5) Distressed and disincentivized – the common PE fund operating model implies a cyclical nature of the development for a GP and its organization, from fundraising to investment to management and new fundraising, to divestment and new fund investment etc. This cyclicity implies that if a GP is not able to raise a new fund, part of its team becomes less relevant, eroding motivation to work for the GP, and possibly progressively collapsing the organization. The resources become more limited if some further divestments are made but a new fund is not raised, thus deepening the problem.

Furthermore, the zombie fund GP is not able to achieve carried interest part of its compensation, eroding the stellar performance motivation even more.

- (6) Managing complex LP relationships – the relationship between a GP and its LPs is a complex one in a sense that it is not a one-way street. The power-play might depend on the type, experience and reputation of both LPs and GPs, as well as the number of LPs per GP and share of total fund per LP. During the LP/GP Interviews, it was noted that the LP position in the Western Europe and Nordics is deemed to be more powerful against the GPs, especially of the institutional LPs. This is also the cause of LPs being considered to be in the “driver’s seat”. However, the LP power in the US (where most of the funds in our sample are actually based) was described as both weaker than in Europe/Nordics and more diverse, with a specific mention of funds of funds as the LP category willing to maintain good relations with GPs the most and thus slow in any activism relating to GP behaviours.

This brings us to a sad picture of the zombie situation, in which we would expect to see bad GP performance combined with internal problems in a fund and its investments as well as external problems with LP communications, trying to survive via further extending the holding time of investments and thus “milking” the managements fees. It is worth noting that the hold-on of existing investments should not always be a bad option for LPs and their investment returns per se. However, the mix of incentives experienced by a GP is rather strongly biased towards prolonging the divestment decisions and might be problematic to sort out for LPs. We check some of these insights in this paper to see how different the situation between the zombie funds and the non-zombie funds actually is.

2.2.2 Healing the Zombies

As grim as it might sound, it is usually not all lost for the LPs once their investment enters into a zombie state. The industry, as private as it is, has come up with particular sets of solutions, which have been brought out by Migliorini (2014) and Custar et al. (2014). These solutions cover the principal grounds of the LPA and other prior agreements between LPs and GPs, providing for extended transparency of GPs actions, ability to add additional accountability measures and adjust compensation, as well as clear early exit and GP removal options.

The LPA based solutions are mostly ex-ante and preventive in nature, crafted in hindsight of existing issues. Therefore, the key problem remains with the already signed LPAs and realized zombie situations. One of the most discussed and the simplest solution is the LP

exit via a secondary market, with varying degrees of secondary funds' scope of actions and activism. For the existing LPs it also usually involves an NAV discount of 5-15% of their share of the zombie fund. With more LP activism in place, additional solutions, such as the review of GP incentives and compensation, more reporting and control from LPs, or more radical fund restructuring, removal of underperforming LP are possible. What is usually not preferred by the LPs is the distribution of the zombie fund's investments in-kind, especially in non-public equity of the companies owned by the zombie fund. A broader discussion in line with Migliorini (2014) and Custar et al. (2014) is present in **Appendix 4**.

Behavioural Influences in the GP and LP Relationship

Even with the potential solutions in place, the LPs can be slow to act, and GPs might remain convinced on their ability to bring the returns and turn-around. In this sub-section we overview the behavioural incentives of LPs and GPs.

LPs Too Busy to Act?

LPs might be reluctant to act even when they experience problems with the investments into failing PE funds because of several behavioural tendencies.

The endowment effect hypothesis claims that people assign a higher value to the things they own. It was documented by numerous studies, including Kahneman et al. (1991a/b) for assigned value for mugs, Carmon and Ariely (2000) for assigned value to basketball final tickets, and confirmed in a wide range of different settings using different goods (Hoffman and Spitzer, 1993), e.g. with children (Harbaugh et al., 2001), apes (Kanngiesser et al., 2011), and new world monkeys (Lakshminaryanan et al., 2008). Extending these findings to the PE industry might hint that LPs value their existing investments in PE funds higher than other possible alternatives that they do not own. As a result, LPs would be more reluctant to close down or act decisively with their existing positions even if the investment returns have not met their expectations.

A similar behavioural reason for LPs to stick to their existing investments is the familiarity bias. Familiarity bias implies that, when given a choice, on average people prefer familiar over novel places, people, or products (Park and Lessig, 1981), as researched by Cao et al. (2009) for the ownership of listed stocks by investors. In similar fashion, LPs might prefer investing in and keeping their existing GPs over other unknown GPs even though the returns might not fulfil their expectations (LP/GP Interviews).

Furthermore, in usual circumstances, the relationship between LPs and GPs is built to last at least a decade, and potentially more, as the existing LPs are usually the first ones to be offered to invest into a new fund (Sensoy et al., 2014). To avoid the reputation of an undesirable

LP, LPs might often be quite reluctant to raise their voice even if they believe that things are not moving in the right direction. Many LPs, especially funds of funds, prefer not to be considered a “difficult” LP to maintain excellent relationship with the GP (and potentially the whole GP community) as well as access to further investment opportunities (LP/GP Interviews, also reflected in Verdane Capital Advisors, 2014). This is one of the causes of the inactivity and unwillingness to take the lead in the zombie fund situation or even before the situation occurs. Custar et al. (2014) refers to this as a “herding cats” phenomenon among the LPs. Herd behaviour, most directly observed in nature, is also prevalent among people skipping rational decisions during the times of uncertainty and blindly following the majority, as was shown for the investors in the financial markets by Bikhchandani and Sharma (2001) and Shiller (2000).

However, the herd behaviour might also be caused by a time constraint of an LP (LP/GP Interviews). Simply put, if the LP has a very limited exposure to the zombie fund in absolute and/or relative terms compared to its funds under management, the incentives to spend time trying to form a consent among other LPs let alone fixing the zombie fund issues might be very low, and the LP might just go with the flow.

GPs’ Motivation to Perform

In addition to just getting the management fees for survival, there might be more reasons why GPs might also be unwilling to close their fund investments early, even though the future return perspective appears to be quite weak. We refer to the prospect theory and overconfidence bias to hint to some potential explanations.

Kahneman and Tversky's (1979) work found that people tend to under-weight outcomes that are merely probable in comparison with outcomes that are certain. This contributes to the risk aversion in choices involving sure gains and to risk seeking in choices involving sure losses. In terms of GPs’ decisions, this could be one of the reasons why fund managers prefer to close their winning deals quickly while they keep the losing deals open longer, hoping that it will regain its value.

Overconfidence bias implies that people tend to think that they are more skilful than other people around them. Svenson (1980) confirmed this bias in his research on drivers indicating that the majority of the subjects in the study regarded themselves as more skilful and less risky than the average driver in each group respectively. By this logic, it might be possible for a subpar GP to believe that it is better than its competitors in handling a particular situation (e.g. fixing non-performing investments). If a GP genuinely believes that, it might ask for a fund extension or be slower to realize losses as this would give them more time to apply their skills and to make up for the previous “unlucky” periods.

With this background in PE and zombie funds in particular in place, we would like to empirically address the performance questions of the zombie funds. In the following section of the paper we present the methodology and the descriptive data overview of the sample used in this paper.

3. Data Overview and Methodology

In this section we firstly define our understanding of the zombie fund to be used for further analysis. We proceed with the overview of the data used in the study, reflecting on the data collection approach and process. A descriptive analysis of the data collected is provided afterwards. Finally, we overview the methodology used to arrive at the findings of this paper.

3.1 Data Overview

3.1.1 Zombie Fund Definition

For the purposes of this paper, we define a zombie fund as a private equity closed-end fund with the following characteristics:

- (1) The fund is not significantly different from the usual PE funds in terms of a defined life of 10-12 years and a GP-LP structure with the GP compensation mainly present in terms of management fees and carried interest.
- (2) To be able to maintain its structure, the GP would be inclined to start raising a new fund after the pre-defined investment period has finished. We treat the usual investment period of 5 years of the fund operating lifetime.
- (3) We thus make a classification into zombies and non-zombies based on the final result of the fundraising – i.e. if we are able to find a follow-on fund for a fund, we treat it as a non-zombie.
- (4) Due to the structure of the Preqin data, we limit the vintage years of the funds to be included in the sample to as early as 1996 to be able to capture the change in the funds' return patterns. Another issue is not to take too young funds, since the zombie state outcome for them would still be unknown. We limit this to the latest vintage of 2008, allowing for 7 years of fund results (i.e. till the last data point of 2014), to allow enough time for the zombie classification to be done.

The implications of this classification are further discussed in the description of the data sources and collection process part of the paper.

3.1.2 Data Sources and Collection Process

As discussed in the Prior Research section of this paper, data availability in the PE industry is one of the key issues in performing any kind of research. With the maturity of the industry as

well as more previous research effort being put in, more and more direct and indirect sources become available to fully grasp the industry developments. Our research would not have been possible without the support of Verdane Capital Advisors providing access to the Preqin database. As discussed earlier, Preqin is one of the main data providers for the PE industry which tracks and reports the performance data of the funds as well as publishes aggregated analysis (see Prior Research section of the paper). It also identifies funds by name with their performance data, however, not with the fee structure. For the purposes of this research we use the yearly data assembled by Preqin from 1999 to 2014, with additional latest available data points available for 2015. The datasets were obtained in February – April, 2015.

Consistent with our definition of zombie funds, we look for the following types of funds: balanced funds, buyout funds, co-investment funds (incl. multi-manager funds), early stage funds (including seed and start-up funds), expansion/ late stage funds, growth funds, turnaround funds, and the venture capital funds. We consider these types of funds to represent closely the general characteristics of the PE fund in terms of the lifetime, organization, skill set and equity investment.

We do not include funds which could be mainly attributed to the following types: secondaries (incl. direct secondaries, real estate secondaries), funds of funds (incl. funds of funds in infrastructure, real assets), funds focusing on debt (incl. distressed debt, mezzanine, venture debt), infrastructure funds, funds investing into natural resources and timber, funds investing into private investments in public equity (PIPE), real asset funds, real estate funds, real estate co-investment funds, special situation funds. This separation is done to ensure the closest possible match between the funds taken into the sample in terms of strategies (i.e. direct equity investment into businesses at various stages of their cycle) and fund lifetime (10+2 years) among other things but to have still a large enough sample to be able to identify a significant number of zombie funds.

For the included funds we obtain Preqin data for the name of the fund, the managing company, vintage, fundraising status of the fund, value of the fund, type of the fund, geographic focus and GP location, called-in capital (as a percentage of committed capital), Distributed to Paid-In (DPI, % of called-up capital), Residual Value to Paid-In (RVPI, % of called-up capital), net multiple (TVPI, % of called-up capital), net-of-fees IRR (%) for years 1999 to 2014, covering vintages from 1969 to 2014. The funds taken into the sample are the ones that have at least some performance data. We further refine the data by selecting the vintages that have at least 7 years of life and potentially return data available to us in Preqin during the reporting period of 1999-2015, thus we take fund vintages of years 1996 till 2008 into the sample. In this way we ensure

that a fund is mature enough, and it goes in line with our zombie classification, as well as that we have enough data points both before and after the zombie classification takes place. It also solves a selection problem with funds at year 6 or younger, as they simply have too few years to be classified as zombies.

We then find the zombie funds among other PE funds by sorting the sample funds by GP and identifying the latest vintages for each manager. We sort for funds with vintages 2008 or earlier and check if the GPs were able to raise a follow-on fund at all and at least at its 7th year of life (i.e. for 2008 vintage funds in 2014). If they did not or the fund is still at the stage before the first close, we classify it as a potential zombie. To make sure that the funds that we identify as potential zombies are actually zombies, we cross-checked our data sample with the following databases and sources:

- (1) **S&P Capital IQ** – the data provider reports to cover “99% of the world market capitalization” (S&P Capital IQ, 2015, see **Appendix 5** for more information on this data provider), also covering private placements. We used S&P Capital IQ in the following steps: (a) matching our Preqin list of potential zombie fund managers with their legal entity names⁵; (b) checking the information for the funds that the manager has listed in S&P Capital IQ, and if there are any later funds raised after the last fund’s vintage that we have found in Preqin. (c) We accepted that a fund is not a zombie even if it was defined as a zombie using only Preqin data if S&P Capital IQ indicated that the manager has raised a subsequent fund (which had a vintage year available and had a status of “Closed” or “First close” or similar; specifically we did not include the funds that had a status of “Fundraising” or “Launching” or similar). To be sure, we also cross checked every potential non-zombie according to S&P Capital IQ and potential zombie according to Preqin with additional data sources listed below.
- (2) **Bison** – Bison is a relatively new entrant to the PE data market, with its roots dating back to 2012/2013 (Boston Illiquid Securities Offering Network, Inc., 2015, see **Appendix 5** for more information on this data provider). We used Bison data to cross-check with Preqin and S&P Capital IQ and see if the manager has not raised any further funds. We accepted the Bison data on fundraising status if it could be at least partially confirmed by S&P Capital IQ (e.g. if S&P Capital IQ was missing the vintage year for a PE fund and it was present in Bison for the same year, we assumed that it is the fund’s vintage year).

⁵ In our dataset from Preqin, the fund names and the fund manager’s names were not full in a legal sense, whereas S&P Capital IQ usually reported a full legal name. Occasional spelling or other name writing differences occurred between the two databases, thus the matching was manual to the closest possible match.

- (3) **Google search** – finally, we used search engines to search for any available information ourselves. This was done only if matching in S&P Capital IQ and Bison did not indicate any findings for specific points – e.g. vintage year or similar. It was a measure of last resort only, whereas the inclusion into zombie category decisions were made based on (1) Preqin, and (2) S&P Capital IQ and/ or Bison data.

These actions were performed in March-April, 2015. Only the last fund of the manager is classified as a zombie in our selection process. Although it is possible that other GP's funds become affected by the inability to raise a follow-on fund, we deem it more direct and likely, that the greatest effect will be experienced by the last fund that the GP was able to raise.

In the following section we discuss our sample size after the main fund selection steps as well as describe the sample in terms of the qualities of the funds and fund managers discovered in the data analysis process.

3.1.3 Sample Overview and Descriptive Statistics

We start out with 4,357 PE funds after combining the 1999-2014 data from Preqin, matching the fund type and data presence criteria discussed above. The further step of taking vintages 1996 till 2008 (inclusive) reduces the sample to 2,824 funds. After performing the zombie classification process, we obtain 436 zombie funds (i.e. 15% of the sample). The sample composition is presented in **Tables 1 – 4** at the end of this sub-section. At this moment we have to reflect on Preqin note that there are over 1,000 zombie funds (as discussed in Prior Research). The key in our sample is the availability of performance data, thus funds which do not have any performance data available to Preqin are not included in the sample. This might go both ways – the most successful and the most unsuccessful funds might not be in the sample due to GP voluntary reporting and unavailability of FOIA requests (e.g. if LPs are not institutions that are required to report under FOIA). However, we note that the dataset presents a fair benchmark of the situation and that there might be more zombies as well as non-zombies, potentially strengthening the results we are getting. We further note this in the Future Research Suggestions.

Table 1 reviews the sample composition by vintage years. The identified zombie funds represent approximately 15% of the sample by the number of funds. The average number of funds observed per vintage is 217, out of which 34 are on average classified as zombie funds. Funds investing into early stage and late stage deals split the sample in about equal parts (49% in early vs. 51% in late), whereas the zombies are a bit more common in early stage (53% in early vs. 47% in late). Most of the zombies are funds with vintages in 2000 and 2004 – 2008,

displaying 40 or more zombie funds per vintage, which fits the story of industry cyclicity and boom and bust cycles, as explained in the Prior Research section of the paper.

Table 2 further splits the data by fund geographic focus, with unsurprisingly most of the funds focusing on the opportunities in the US (59% of the sample by the number of funds and 66% by the fund value at the end of 2014) and Europe (24% and 26% respectively). Furthermore, with **Table 2** we also note, that by fund value zombie funds constitute almost 10% of the total sample fund value, which is considerably smaller share than by the number of funds, as observed above. In addition, we present the GP location data in **Appendix 6a** of the paper. As with the GP focus, most of the GPs are located in the US (1,718 funds, 61% of the sample) and Europe (675 funds, 24% of the sample).

Table 3 further explains our sample in terms of the fund size categories. We divide the sample into six size categories. It is interesting to note that by size the average funds and the average zombie funds for each category do not differ too significantly, however, the overall difference is rather remarkable – an average zombie fund overall is worth 66% of value of the average fund in the sample.

Table 1. Count of Sample Funds by PE fund type

Vintage	Classification of PE funds in the sample			
	Total	Buyout	VC	Other late stage
1996	106 (6)	41 (2)	53 (3)	12 (1)
1997	160 (9)	67 (7)	78 (2)	15 (0)
1998	191 (18)	80 (7)	86 (9)	25 (2)
1999	211 (26)	79 (10)	118 (12)	14 (4)
2000	315 (45)	108 (12)	181 (28)	26 (5)
2001	195 (20)	57 (5)	119 (15)	19 (0)
2002	154 (23)	56 (5)	88 (16)	10 (2)
2003	140 (21)	62 (7)	65 (12)	13 (2)
2004	170 (26)	71 (10)	79 (13)	20 (3)
2005	269 (40)	131 (15)	104 (20)	34 (5)
2006	308 (74)	141 (35)	136 (33)	31 (6)
2007	326 (61)	138 (23)	147 (34)	41 (4)
2008	279 (67)	110 (25)	138 (35)	31 (7)
Total	2,824 (436)	1,141 (163)	1,392 (232)	291 (41)

This table reviews the sample composition by vintage years. Figures inside brackets represent the number of zombies included in each vintage/type fund count. VC funds include: venture capital funds, early stage funds (including seed and start-up funds), growth funds. Other late stage funds include: balanced funds, co-investment funds (incl. multi-manager funds), expansion/ late stage funds, and turnaround funds.

Sources for data: Preqin, S&P Capital IQ, Bison; author's calculations and classification into zombies.

Table 2. Funds by Geographic Focus by Number and Target Size

Geographic Focus	All sample funds			Zombies		
	No. of Funds		Target Size, MEUR	No. of Funds		Target Size, MEUR
Africa	46	(46)	4,810	10	(10)	704
Americas	54	(54)	11,860	8	(8)	1,733
Asia	222	(220)	65,499	19	(17)	2,843
Australasia	68	(68)	11,896	7	(7)	970
Diversified Multi-Regional	16	(16)	8,040	1	(1)	26
Europe	682	(674)	349,563	81	(79)	27,404
Middle East & Israel	58	(57)	9,025	12	(12)	2,067
US	1,678	(1,642)	902,897	298	(286)	97,818
Total	2,824	(2,777)	1,363,590	436	(420)	133,566

This table splits our sample data by the geographical focus of the funds in the sample with vintages 1996-2008. Figures inside the brackets include the number of funds that had the target size data available. Target size is the figure converted or reported in EUR by Preqin, reflecting the target size the GP is raising for a PE fund. All sample funds include the zombie funds as well.

Sources for data: Preqin, S&P Capital IQ, Bison; Authors' calculations and classification into zombies.

Table 3. Funds by Size Category.

Size Category	All Funds			Zombies		
	Value	# Funds	Size/Fund	Value	# Funds	Size/Fund
Below 50 MEUR	14,415	603	23.9	2,412	94	25.7
50-99	28,378	381	74.5	4,743	63	75.3
100-249	126,256	762	165.7	21,520	131	164.3
250-1,000	394,860	805	490.5	50,528	109	463.6
1,000-2,000	176,492	126	1,400.7	21,330	15	1,422.0
Over 2,000 MEUR	623,190	147	4,239.4	33,032	8	4,129.0
Total	1,363,591	2,824	482.9	133,565	420	318.0

This table overviews our sample in terms of the fund size categories for sample funds with vintages 1996-2008. We divide the sample into six size categories, from smallest funds below 50 MEUR to the largest, over 2 BEUR. Size refers to fund value in MEUR, latest reported. Size/Fund represents the average fund value in a specific category.

Sources for data: Preqin, S&P Capital IQ, Bison; author's calculations and classification into zombies.

Finally, **Table 4** presents the data per GP (manager). In our sample, 1,278 GPs manage 2,824 funds, or 2.2 funds per manager, with most of the GPs in the sample having 1 or 2 funds (889 GPs with 1208 funds or 70% of the sample). The same is applicable to GPs managing zombie funds, as 339 zombie funds or 78% of the sample are managed by GPs with 1 or 2 funds in total.

Table 4. GPs by the Number of Funds Managed.

Funds per GP	No. of GPs	Value of GP	No. of Zombies
1	570	117,156	208
2	319	212,530	131
3	197	232,646	51
4	109	297,140	31
5	38	103,215	8
6	16	91,117	5
7	11	87,261	0
8	6	19,556	1
9	5	45,261	1
10	1	14,458	0
12	1	155	0
13	1	44,585	0
14	1	26,136	0
17	1	30,121	0
18	1	37,740	0
20	1	4,512	0
Total	1,278	1,363,590	436

This table presents the data per GP on the number of funds managed. In our sample, 1,278 GPs manage 2,824 funds with vintages 1996-2008. Value of Manager refers to the value of a group of managers with a particular number of funds under management, in EUR millions.

Sources for data: Preqin, S&P Capital IQ, Bison; author's calculations and classification into zombies.

We present more descriptive statistics in **Appendix 6b**, including the median, I and III quartile results for zombie and non-zombie funds for Called Capital, DPI, RVPI, TVPI and net IRR.

3.1.4 LP/GP Interviews

In addition to the quantitative data collection efforts, we were able to conduct interviews with several PE industry players in investment manager/partner positions at LPs and GPs. The insights were mostly used to comment on the Prior Research and to some extent to explain the results. The interviews were conducted in confidentiality due to LP and GP agreements. Due to this, the authors clearly indicate where the interviews are referred to. The interviews were held as an open discussion around the interview questions presented in **Appendix 7**.

Due to limited time and confidentiality issues, the authors were not able to obtain and incorporate separate LP data into the Preqin sample to further use for the research.

3.2 Methodology

This part of the paper focuses on the methodology and research design that are used for the empirical analysis when studying the zombie fund phenomenon. We firstly introduce the research questions, which will further guide to the selection of the most suitable research design and methodology.

3.2.1 Research Questions and Research Design

Our key research questions can be divided into two clusters.

- (1) Questions that help us understand the differences between the zombie PE funds and rest of the PE industry:
 - (a) What are the characteristics influencing a PE fund to become a zombie?
 - (b) What are the performance differences between zombie and non-zombie PE funds?
 - (c) How do the investment patterns differ between zombie and non-zombie funds?
 - (d) How do the divestment patterns differ between zombie and non-zombie funds?
- (2) Questions looking into changes in performance trends after unsuccessful fundraising:
 - (e) What is the likely performance of a zombie fund for LPs once it becomes clear that the GP was unable to raise a follow-on fund?

For the first cluster of questions, we compare the two groups of funds (zombies vs. non-zombies) to see if the differences between them are statistically significant. The second cluster tries to explain how the fund performance trend changes after the event of not being able to raise a new fund occurs. Both clusters focus on different questions and therefore require different approaches to provide unbiased and reasonable results.

In an ideal setting we would like to observe the same fund in both zombie and non-zombie states, and compare them. However, this is not possible in reality and we can only observe one group of funds that are zombies and another group of funds that are non-zombies. If the assignment of zombie state would be done randomly, then a simple ordinary least squares (OLS) regression with just the zombie dummy variable would give us the unbiased estimates of the average phenomenon. In our case, the outcome of not receiving financing for a follow-on fund is far from random and is in fact strongly influenced by the fund specific fixed effects. In particular, we believe the unobservable variables (e.g. the trust towards the GP) to be correlated with both the decision to provide money for a new fund and the fund return. Unless we take

care of the omitted variables by adding controls to our model or choosing a robust method, we will receive biased estimates of the event we are observing. One of the robust methods for removing the omitted variable bias from fund specific unobservable variables is the fixed-effect (FE) estimator.

The strength of using the FE estimator is the removal of the effect of all the variables that are specific to a fund and that do not change over time. Thus, it will not only get rid of the observable fixed effects, but also any effects that we are unable to observe and take into account separately. However, we need to be mindful that the omitted variables that change within funds over time can still threaten the FE design.

The two key assumptions that we are making under the FE framework are (1) common trends assumption and (2) functional form assumption. In our research, the common trends assumption means that the difference in performance between the zombie funds and the rest of PE funds would have followed a parallel path had the GPs of the zombie funds been able to raise a new fund like their successful peers had. It also implies that all the funds should follow the same trend prior to the event of raising a new fund.

Secondly, we make the functional form assumption, meaning that the effect of the treatment is both linear and additive; it is a necessary assumption for the fixed effects to drop out. If we focus on the effects of time-varying variables, then FE helps in excluding a lot of the non-time varying effects that are not in our focus. This provides more credible estimates of the variables that are of importance in the FE design application in this paper.

Due to the common trends assumption, we are using TVPI (please see the **Appendices** for the explanation of this or any further abbreviations) as the key performance measure in our FE regression. The TVPI measure is influenced by both the gradual increase of DPI and the decrease of RVPI, enabling TVPI fluctuations both up and down over time. This feature makes TVPI a more robust measure of performance for trend analysis as it enables common trends assumption to hold prior to fundraising as opposed to DPI which develops quite differently for zombies and non-zombies. TVPI provides the full picture of the fund performance while DPI can only provide part of the answer while neglecting the remaining value of the open investments. Furthermore, TVPI is a superior performance measure also compared to IRR (which is a time-and-money weighted mean) (Brown et al., 2015). This leads to the overestimation of the zombie effects on IRR from the first years of the fund life and the underestimation at the end of the fund life, giving us a distorted view of the reality. Therefore we use TVPI as our key performance measure over the course of our empirical analysis.

FE estimator mainly helps in determining the change in the fund performance trends over the fund life. It also provides insights on what expectations should the LPs form if they stay invested in a zombie fund. Yet, the FE estimator is not suited to determine the significance of the level differences in fund performance due to precisely the exclusion of all the fixed effects over time.

To be able to answer the questions related to how the zombie funds differ from rest of their peers, we need another method – the ordinary least squares (OLS) and panel data regressions with controls. In terms of comparing the zombie and the non-zombie funds, we are concerned with the average levels of the two groups and therefore a simple panel data regression including the fund fixed-effects makes sense. To reduce the omitted variable bias of the regression as much as possible, we are controlling for various time-invariant fund specific factors that are available in Preqin data (see the Data Overview above). As it was established in the Prior Research section of the paper, in their analysis PE researchers often make the distinction among fund types (mainly buy-out funds vs. VC funds), and different vintage years. In line with this, the control variables in our regressions include the fund size, fund type, vintage and the location of the GP, as was available in Preqin.

In terms of the graphical representation of the key variables, we will be reporting the mean not the median values. This is in line with Harris et al. (2014a) argument that the mean is a more appropriate measure of the LP performance, when LPs are not able to distinguish the outperforming funds before making the investment decisions. The results by Harris et al. (2014b) note that buyout fund persistence has declined post-2000 and Sensoy et al. (2014) confirms that no particular type of LP is able to access or choose better performing buyout funds. This brings us to the conclusion that mean values provide a more realistic view of the actual fund performance.

3.2.2 Regression Analysis

The overview of the regressions that are used to analyse the zombie fund phenomenon in our empirical analysis part of the paper have been brought out in **Table 6** below.

Table 6. Overview of the Regressions Used for Empirical Analysis.

ID	Regression formula	Panel	FE	RQ
(1)	$zomb_f = \alpha + \beta_1 irr6_f + \beta_2 called6_f + \beta_3 crisis_f + \beta_4 large_fund_f + \beta_5 late_stage_f + \beta_6 europe_f + \beta_7 us_f + \varepsilon_f$	No	No	(a)
(2)-(5)	$\{dpi_{tf}; tvpi_{tf}; called_{tf}; rvpi_{tf}\} = \alpha + \beta_1 year_t + \beta_2 zy2_{tf} + \dots + \beta_{12} zy12_{tf} + \beta_{13} crisis_{tf} + \beta_{14} large_fund_{tf} + \beta_{15} late_stage_{tf} + \beta_{16} europe_{tf} + \beta_{17} us_{tf} + \varepsilon_{tf}$	Yes	No	(b),(c),(d)
(6)	$tvpi_{tf} = \alpha + \beta_1 year12_t + \beta_2 zombyear12_{tf} + \varepsilon_{tf}$	Yes	Yes	(e)
(7)-(16)	$\{dpi6_f; tvpi6_f; called6_f; rvpi6_f; irr6_f; dpi12_f; tvpi12_f; called12_f; rvpi12_f; irr12_f\} = \alpha + \beta_1 zomb_f + \beta_2 crisis_f + \beta_3 large_fund_f + \beta_4 late_stage_f + \beta_5 europe_f + \beta_6 us_f + \varepsilon_f$	No	No	(b), (c),(d)

This table reports the regression formulas that are being used to arrive at the results in the empirical part of the paper. The 16 regressions are separated by the regression ID. Regression formula specifies the dependent and independent variables that are included in any particular regression. When the dependent variables are in the brackets, it means that the dependent variable is changing for different regressions, while the independent variables stay the same. Panel column highlights if we use data from a single period or as a panel during various points in time. The final column RQ indicates which research question any particular regression is answering. The alphas signify the base case for all of our regressions while more specific variables like $zomb$ and rest of the control variables enable us to gain a better understanding regarding to special features and to reduce the omitted variable bias in our key variables of interest. The subscript f is a fund identifier varying from 1 to 2824, and t changes from 1 to 12 corresponding to the year in a fund lifecycle that is under observation.

Source: Developed by the authors.

The explanation of all the used variables is brought out in **Table 7**. It is worth noting that the variables that include information at only Year 6 or Year 12 are in some cases extrapolated from the previous years. For example if the GP has not reported their results at Year 6 or Year 12, we will use the latest information up until that point. In case we observe the data both directly before and after Year 6 or Year 12, we assume the missing data point to be the average of these two observation. This method enables us to use as much data as possible for our analysis.

Table 7. Overview of the Variables Included in the Regression Analysis

Variable	Description of the variable
year	Variable that captures the time trend in performance development. Takes on values from 1 to 12 depending on which year of the fund's lifecycle is under observation.
year12	Time dummy variable which takes on a value of 1 in case we are in year 12 of the fund life and 0 otherwise (when we are in year 6).
zomb	Dummy variable that takes a value of 1 in case the fund has been defined as a zombie and 0 for all the other funds.
zombyear12	Combination of dummy variables <i>year</i> and <i>zomb</i> . It is 1 in case the fund has been defined as a zombie and we are in year 12 of the fund life.
zy1 to zy15	Dummy variables that are looking at the combination of being a zombie and the year of operations. For example in case of <i>zy2</i> the dummy would be equal to 1 in case the fund is defined as a zombie and the return corresponds to the 2nd year.
dpi	Distribution to paid-in-capital during years 1 to 12 of the fund lifecycle.
dpi6/ dpi12	Distribution to paid-in-capital in year 6 and year 12 of the fund life respectively.
tpi	Total value to paid-in-capital (also known as multiple) from year 1 to year 12.
tpi_6_12	Total value to paid-in-capital (also known as multiple) during year 6 and year 12.
tpi6/ tpi12	Total value to paid-in-capital up until year 6 and year 12 of the fund life respectively.
irr	Internal rate of return of the fund from year 4 to year 12 of the fund life.
irr6/ irr12	Internal rate of return up until year 6 and year 12 of the fund life respectively.
rvpi	Residual value to paid-in-capital during years 1 to 12 of the fund lifecycle.
rvpi6/ rvpi12	Residual value to paid-in-capital by year 6 and year 12 respectively.
called	Percentage of fund value that has been called-up by the GP during years 1 to 12 of the fund lifecycle.
called6/called12	Percentage of fund value that has been called-up by the GP by year 6 and year 12 respectively.
crisis	A dummy variable that takes on a value of 1 if the fund was established during the years of financial crisis. Financial crisis vintage years are 2000 and 2001 during the dot-com bubble and 2007-2009 during the more recent crisis.
large_fund	Dummy variable that will be 1 if the fund has been defined as large and 0 otherwise. The size of the funds in the 1st quartile of largest PE funds in Preqin are bigger than €425 million. This will be the threshold that is used to separate between large and small private equity funds.
late_stage	Dummy variable that takes on a value of 1 when the type of the fund is consistent with our definition of a late stage fund. In case of an early stage fund, the dummy takes on a value of 0. Balanced, buyout, co-investment, co-investment multi-manager and turnaround are defined as <i>late-stage</i> . Early stage, seed, start-up, expansion growth and venture have been defined as early stage types.
europe	Geographical location dummy that takes on a value of 1 in case the GP of the fund is located in Europe. For other GP locations the dummy is equal to 0.
us	Geographical location dummy that takes on a value of 1 in case the GP of the fund is located in US. For other GP locations the dummy is equal to 0.

This table reports all the dependent and independent variables that are used to arrive at the results that are reported in the empirical part of our paper. The left column defines the name of the variable while the right column defines the variable and what it entails.

Source: Developed by the authors.

Years 6 and 12 of the fund life are often brought out in terms of our analysis. The choice of these two years is directly connected to the most common investment period and fund life lengths in private equity industry and our zombie fund definition. It is a common practice for GPs to be forbidden from raising a new fund before the existing commitments are fully invested. This aims to guarantee that GP's attention is targeted to serve the interests of the existing LPs. According to the Preqin Fund Terms Advisor (2015) the average investment period of a private equity fund is 5.2 years. As referred in the Prior Research section, after the investment period is over, it is expected that the GPs raise capital for the next fund. This should also be done as soon as possible to assure consistent flow of funding to maintain the GPs organization and operations undisturbed.

The common expectation is that the GP will start the fundraising by the end of year 5 of the existing fund's life after the investment period has ended. To provide more time for fundraising we allow for another year for the GP to raise a fund. Therefore, the end of Year 6 becomes effectively the last point in time before the fund enters into a zombie or non-zombie state.

Finally, the most contractually agreed fund length in the PE industry is 10 years. Nevertheless, it is common to have up to two one-year extensions to the contractual fund life for the GP to be able to close the open investments. The agreement of LPs to extend is LPA dependent, and if the LPs disagree, there might be a halt in the flow of management fees to the GP. Taking into account that zombie fund might need more time to be divested, we bring the expected "normal" PE fund life up to 12 years. Funds with a longer than 12 years life are an exception, as confirmed by LP/GP Interviews.

With this regard, the fund performance up until Year 6 provides a good understanding of the performance before becoming a zombie, as the GP is still not aware if the fundraising is successful or not. Year 12 will on the other hand provide an overview of the fund's overall performance at the end of the fund's life, enabling us to isolate the effect of fundraising success in the second half of the fund life. Having laid out the methodology and research design, the focus in the next Section will shift to our empirical findings.

4. Empirical Findings

In this Section we discuss the key findings of our empirical analysis. We compare how the reality as reflected by our dataset corresponds to our expectations formed from the prior research and the LP/GP Interviews.

We divide the overview into three parts. Firstly, we look at the characteristics that influence the GP's success in raising a new fund (research question (a)). We review the dynamics of fundraising which helps us identify the patterns that might lead us to anticipate possible future problems before a fund becomes a zombie. In the second part, we take a step back from the fundraising process and observe the general differences between zombie funds and rest of the sample peers. This will target research questions (b), (c) and (d). The third part focuses on explaining the expected performance after a fund becomes a zombie providing an answer to question (e). The empirical analysis will be concluded by highlighting the key findings of our research.

4.1 Determinants of Becoming a Zombie

What makes some funds become zombies, while others are able to successfully attract LPs to a new fund? The fact that a GP is unable to raise money for its next fund is not a random occurrence and can often be anticipated to some extent based on the prior performance of the fund and the ease of communication with the GP. The GP's track record, both in hard and soft measures combined with its perceived reputation are established over a long time period and these factors play a role in the ability to raise a new fund. Furthermore, the general industry trends like cyclicity, as reflected in the Prior Research, influence the zombie fund development as well.

A better understanding of the factors that determine the likelihood of becoming a zombie provide LPs with the possibility to take early action or precautionary measures before the zombie situation materializes, helping to minimize the negative effects to the LP investments. In our analysis, we focus on the performance measures, investment patterns and fund fixed-effects concerning the size, stage, and the vintage year of the fund, and the GP location. The results from the regression analysis have been brought out in **Table 8**.

Table 8. Characteristics that Explain the GPs Ability to Raise Follow-On Funds

Dependent variable	(1) <i>zomb</i>	Sig.	T-stat
<i>constant</i>	0.770	***	(9.3)
<i>tvpi6</i>	-0.040	***	(-3.4)
<i>called6</i>	-0.006	***	(-7.1)
<i>crisis</i>	0.003	-	(0.2)
<i>large_fund</i>	-0.090	***	(-4.5)
<i>late_stage</i>	-0.002	-	(-0.1)
<i>europe</i>	-0.030	-	(-0.9)
<i>us</i>	0.030	-	(0.9)
Fixed effects		No	
Panel data		No	
Adjusted R-squared		0.08	
Number of funds		2,824	
Number of observations		1,571	

This table reports the regression results. The dependent variable is the dummy variable indicating if the observable fund is a zombie or not. Independent variables include control variables for vintage, size, stage and the location of the GP. The key variables of interest are the TVPI and called-up percentage by the end of year 6 of the fund life. T-statistic values that are based on the robust standard errors have been brought out in the brackets. Coefficient estimates that are reported ***, **, and * indicate significance at the 1%, 5%, and 10% level respectively.

Source: Authors' definitions and calculations based on Preqin, S&P Capital IQ and Bison data.

In terms of the performance measures, we have only added TVPI to the model. All the fund performance measures available to us (TVPI, DPI, and IRR) are strongly correlated and bring us to the same conclusions in the unreported regression analyses.

From this regression analysis it is clear that the most relevant determinants of becoming a zombie are the fund performance and speed in making investments up until year 6, when the GPs are generally expected to be raising their next fund. Another significant characteristic is the size of the fund. The vintage, type of the fund and GP location do not seem to have a significant influence on becoming a zombie. More specifically the regression results imply that the funds that are larger than €425 million are 9% less likely to become zombies; calling up 1% more money in relation to paid-in-capital by the end of Year 6 reduces the likelihood of becoming a zombie by 0.6%; and increasing the value of the fund by the size of paid-in-capital by the end of Year 6 reduces the likelihood of becoming a zombie by 4%.

The finding that stronger fund performance (i.e. higher TVPI) reduces the likelihood of becoming a zombie is in line with Kaplan and Schoar's (2005) conclusion that the funds with worse returns are less likely to raise follow-on funds. This makes sense, as the main selling point of a GP to potential LPs is the GP's ability to provide good returns for LP investments. Weak results, on the other hands, will both decrease the LP trust of the GPs' capabilities and the

likelihood of capital commitments from new investors. In addition, Brown et al. (2015) noted that even if the unrealized returns are overstated to present a better picture of the GP capability, that does not help with raising a new fund, since on average the next fund by these GPs would not be raised, as was discussed in the Prior Research section.

Another factor that seems to determine the GP's ability to attract new LPs is the percentage of the committed capital that is called (invested) by the end of year 6 of the fund's life. We find that the funds that make their investments quicker are statistically significantly less likely to become zombies. This is consistent with the earlier empirical findings regarding fund performance as the GPs are only able to create value by making good investments. In line with Brown et al. (2015), this means that if the GP is slow in finding good-enough investment opportunities and deploy the committed capital, then naturally any successful divestments will be more likely to realise later than by the time a new fund should be raised, impeding the signalling possibilities of the GPs. This makes it difficult to attract new LPs.

Finally, we observe that large funds are significantly less likely to become zombies. As discussed earlier, the size of the PE fund is not a random occurrence and probably indicates GP's success over a longer period of time with larger follow-on funds being raised after successful predecessors. With the longer track record, the short term performance fluctuations might become less of an issue in fundraising, fuelled by an interplay of herd behaviour, trust and reputation. Furthermore, larger GPs might just have a larger pool of LPs that they are able to target, strengthening the previous point and making it more likely that some of the LPs would be interested in extending the relationship even in case of a weak short-term performance. Overall, we consider these observations as helpful in providing the first indications for LPs when viewing available PE investment opportunities and current PE investments.

4.2 Differences in Zombie Performance Patterns

The second part of the empirical analysis takes a step back from the specific process of fundraising and instead focuses on the general differences between the funds that end up being zombies and the rest of the peers in our sample. By doing this, we aim to increase the understanding of the zombie fund phenomenon, and in particular to observe the fund performance patterns. For this, we concentrate on three fund performance measures: DPI, TVPI, IRR; and two investment pattern measures: called-up percentage and RVPI.

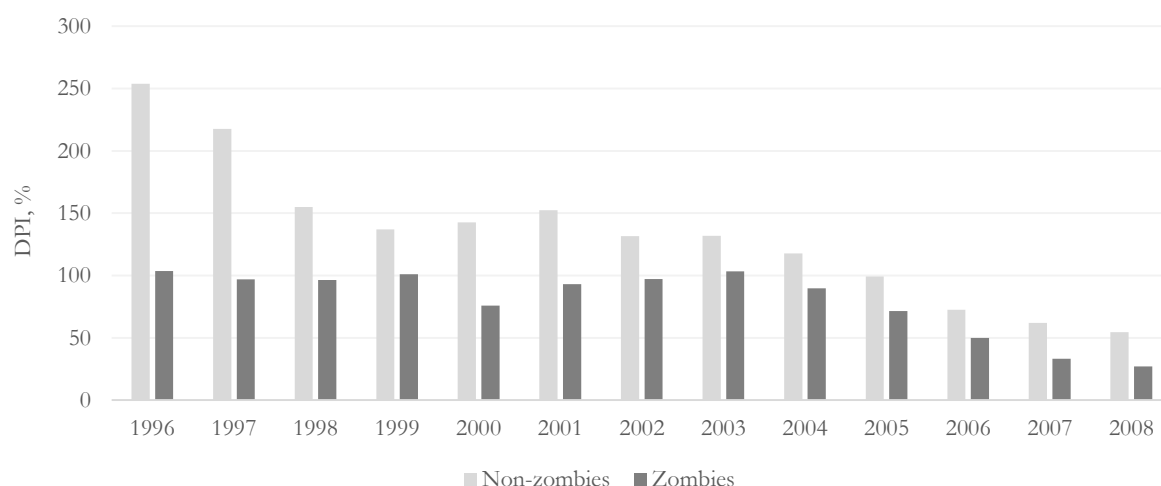
Although it seems to be an obvious conclusion that the worse performing GPs tend to have a harder time raising new funds, it must not necessarily be the case as our definition of being a zombie is directly connected only with the timing of successful fundraising and has no

direct connection to any fund performance measures. **Figure 1** highlights the value that has been distributed back to LPs as a percentage of the paid-in capital by different vintages of the PE funds in our sample. It indicates that the zombie funds have a much lower average DPI compared to their successful peers, meaning much lower returns the LPs of zombie funds have received up until today. Although the differences between zombie and non-zombie funds in our sample tend to vary to a great extent over the years, there is no vintage year where the zombie funds have returned more value to the LPs compared to the peer group. This observation is in line with Preqin (2014), where the vintages 2001 through 2006 were compared.

If we focus on the fund level evolution of DPI, it is possible to see that there is not only a gap in the DPI values between zombies and non-zombies, but this gap is also expected to increase over time (see **Figure 2**). This indicates that the zombie funds tend to keep on underperforming against the rest of the industry over the course of the fund life.

Another important observation we note regarding the DPI is that the zombies are on average unable to return even the initial investment to LPs as observed at the end of the year 12 of fund life. This means that the zombie funds not only underperform in relation to their peers, but are on average destroying value for the LPs over the course of the fund life.

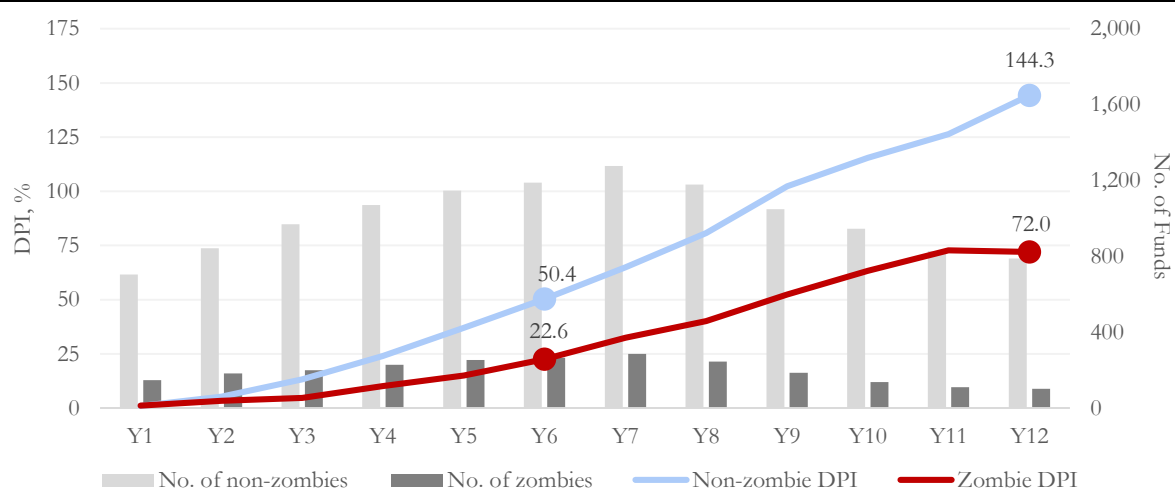
Figure 1. DPI (%) by Vintages among Zombies and Non-Zombies



This figure shows the average DPI per fund vintages from 1996 till 2008. DPI is defined as the net capital distributed to LPs divided by the sum of capital that has been called-up. DPI values are based on the latest available values in Preqin by the end of 2014. The DPI averages have been calculated based on the same 2,824 funds that are used for the rest of the empirical analysis.

Source: Authors' definitions and calculations based on Preqin, S&P Capital IQ and Bison data.

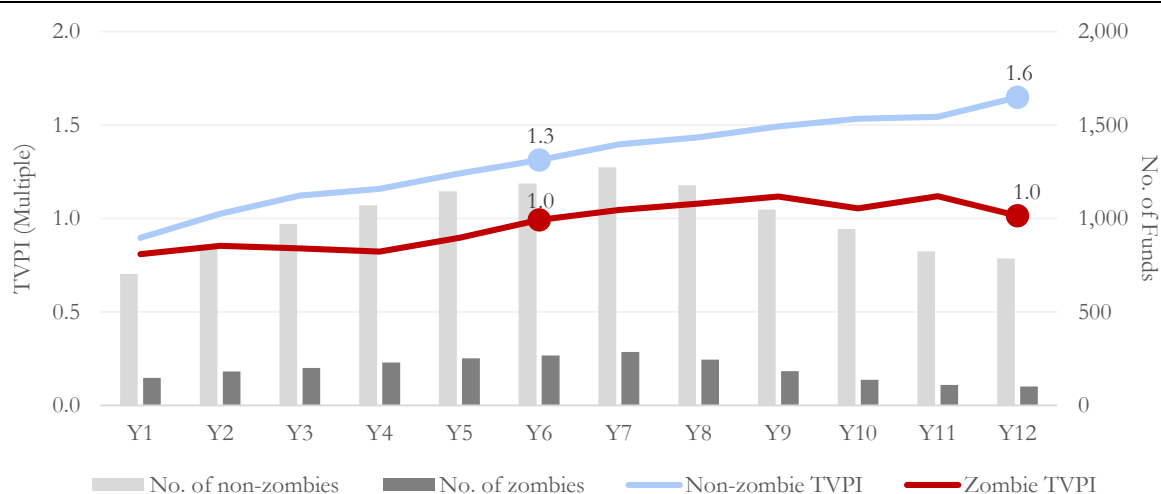
Figure 2. The Development of Average DPI in Zombies and Non-Zombies over the Fund Life



This figure shows the average DPI development over the course of a PE fund life, defined as the net capital distributed to LPs divided by the sum of capital that has been called-up. The average values are based on 2,824 PE funds with vintages from 1996 till 2008 and are shown by the two lines corresponding to the left axis. The columns, corresponding to the right axis, highlight the number of funds that are used to calculate the averages.

Source: Authors' definitions and calculations based on Preqin, S&P Capital IQ and Bison data.

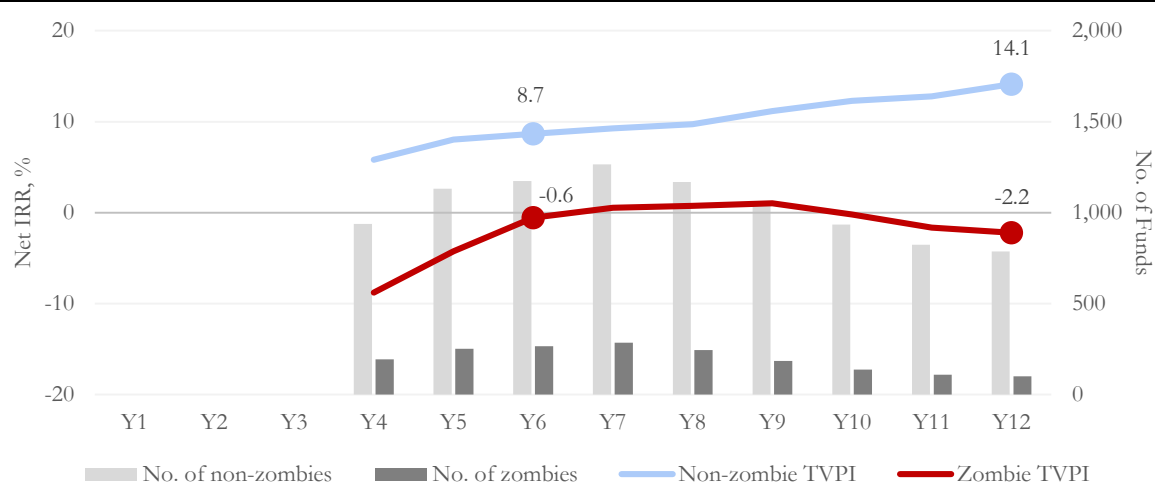
Figure 3. The Development of TVPI in Zombies and Non-Zombies over the Fund Life



This figure shows the average TVPI development over the course of a PE fund life, defined as the sum of the net value distributed over paid-in-capital (DPI) plus the NAV of the open investments divided by the sum of capital invested. The average TVPI values are based on 2,824 PE funds with vintages from 1996 till 2008 and are shown by the two lines corresponding to the left axis. The columns, corresponding to the right axis, highlight the number of funds that are used to calculate the averages.

Source: Authors' definitions and calculations based on Preqin, S&P Capital IQ and Bison data.

Figure 4. The Development of Net IRR in Zombies and Non-Zombies over the Fund Life



This figure shows the average net IRR development over the course of a PE fund life. The net IRR values are influenced by both the sum of the net value distributed over paid-in-capital (DPI) and the NAV of the open investments divided by the sum of capital invested (RVPI). The average IRR values are based on 2,824 PE funds with vintages from 1996 till 2008 and are shown by the two lines corresponding to the left axis. The columns, corresponding to the right axis, highlight the number of funds that are used to calculate the averages for every particular year in a fund lifecycle. No net IRR data was available for Y1-3.

Source: Authors' definitions and calculations based on Preqin, S&P Capital IQ and Bison data.

We note similar performance development patterns for TVPI (see **Figure 3**) and IRR (see **Figure 4**). The value destruction is observable from both a TVPI value being below 1 and a negative net IRR (see **Figure 3**) after Year 11, when normally the fund should already be nearing its end if not liquidated already. **Figure 4** highlights the extremely low zombie returns during the first half of the normal PE fund life, which might partly explain the GP's inability to raise capital for the follow-on fund.

The widening performance gap suggests that it is reasonable for LPs to take action as early as possible to fix the situation. It is strengthened by one noticeable feature that holds for all the performance measures – a gradual deterioration of returns for zombies as opposed to a clear "break" in the pattern after the event of becoming a zombie. This is sensible in our view as (1) the timing for fundraising can vary from fund to fund, and (2) even after the incentive structure in a particular fund breaks down, this will not change the value of fund's investments overnight – it is rather reflected by the lack of effort, skill or other factors, that make a difference over a longer time horizon. This observation was reflected in the LP/GP Interviews.

Looking at the performance at Year 6 (see **Appendix 8**) of the fund life and at Year 12 (see **Appendix 9**), we observe that large funds on average underperform against the smaller funds and that the late stage (e.g. buy-out) funds tend to outperform the early stage (e.g. VC) funds, while the location of the GP does not seem to be connected to the fund performance.

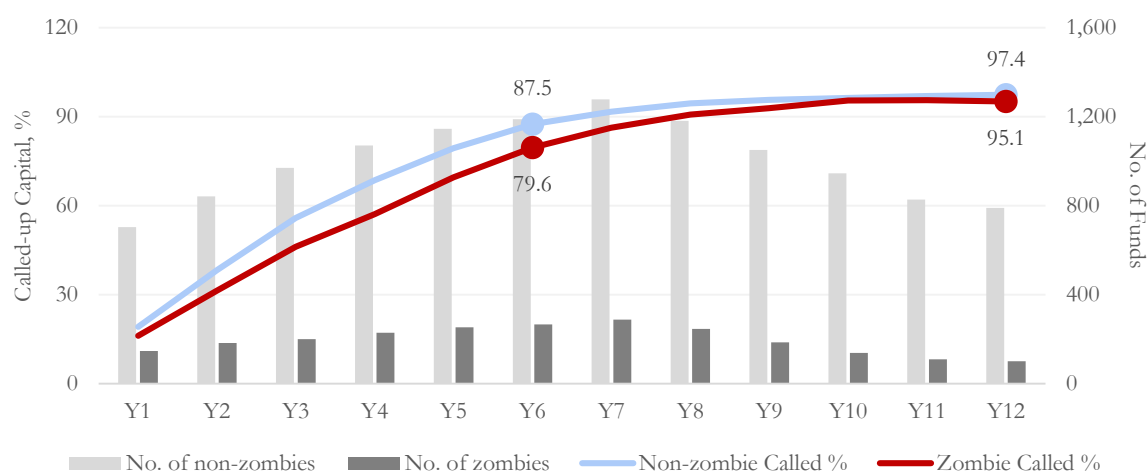
The negative influence of the fund size on the fund performance could be explained by an increasing difficulty to find good investment opportunities that would at the same time fulfil the requirements of the investment size. Smaller funds on the other hand might be able to focus on smaller niche deals with less competition, but big enough in size to make a difference in terms of fund performance. This, together with the prior finding that large funds are also less likely to become zombies (see Section 4.1.1), seems to imply that small funds are taking bigger risks to gain their higher performance. This would explain the higher average performance together with a larger percentage of zombie funds among them.

Besides the performance measures, we also observe the investment and divestment patterns of the zombie funds. For investment patterns we use the measure indicating the called-up capital as the percentage of committed capital, which provides an indication of the speed that the funds make their investments. **Figure 5** highlights the development of called-up percentage of the committed capital for the zombie funds and the successful peers.

We can observe that zombie funds are slower in calling-up capital and making investments at the beginning of their life. As we saw from the previous sub-section, this could be one of the reasons for a fund to become a zombie in the first place. It would be ideal for a GP to have some good divestment opportunities early in the fund life to support the marketing efforts for the next fund. As zombies tend to make their investments later, they might consequently not be able to realize early exits to signal a strong ability to generate returns for the existing and potential new GPs.

In terms of the residual value of the open investments held in the fund, we observe an opposite relationship based on **Figure 6**. Zombie funds tend to report more residual value left in the fund during the last years of the expected fund life. This could be the case for various reasons. First of all, it could just be a timing issue that is partly influenced by the fact that investments were done later in the fund life. So assuming that the GPs of zombie funds tend to keep their investments in the fund's portfolio for a similar period of time as non-zombies, it would make sense for zombie funds to be divesting later just because the investments were made later. The second argument could be that the zombie funds are deliberately keeping their investments open for a longer period of time to keep collecting the management fees. Thirdly, as RVPI is an estimate (see discussion around signalling in the Prior Research section), there could be a conflict of interest for the GP of a zombie fund to lean towards optimism in the valuation of unrealised investments to gain a stronger position when pitching for possible fund extensions. This optimism becomes an increasingly attractive solution for a GP that sees no successful fundraisings in its closest horizon.

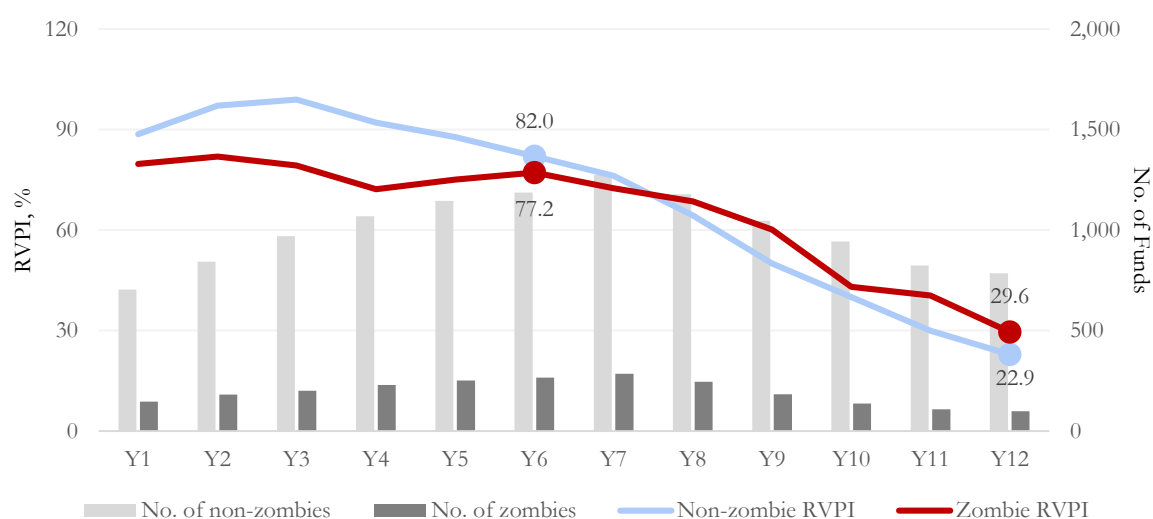
Figure 5. The Development of Called-up Capital in Zombies and Non-Zombies over the Fund Life (as % of Paid-in Capital)



This figure reports the average proportion of the LPs' aggregate commitments that have been contributed to the partnership. The average called-up percentage values are based on 2,824 PE funds with vintages from 1996 till 2008 and are shown by the two lines corresponding to the left axis. The columns, corresponding to the right axis, highlight the number of funds that are used to calculate the averages for every particular year in a fund lifecycle.

Source: Authors' definitions and calculations based on Preqin, S&P Capital IQ and Bison data.

Figure 6. The Development of RVPI in Zombies and Non-Zombies over the Fund Life



This figure shows the average RVPI development over the course of a PE fund life. The RVPI is defined as the value of the LP's remaining interest in the partnership, as derived from the GP's valuation of the unrealized portfolio and its allocation of this to the LP. The valuation of these investments is expressed as a percentage of called up capital. Average RVPI values are based on 2,824 PE funds with vintages from 1996 till 2008 and are shown by the two lines corresponding to the left axis. The columns, corresponding to the right axis, highlight the number of funds that are used to calculate the averages for every particular year in a fund lifecycle.

Source: Authors' definitions and calculations based on Preqin, S&P Capital IQ and Bison data.

From the **Figure 1** through **Figure 6** we observed some differences in the performance patterns between the zombie and non-zombie funds, but it is important to prove that these differences are also statistically significant. For this, we are using a panel data framework to draw conclusions on the differences in the observed patterns during the life of a PE fund. In terms of minimizing the effects of omitted variable bias, the fund fixed-effects like the fund vintage year, size, type, and the location of the GP will be controlled for. The overview of the results from the panel regressions can be seen in **Table 9** below.

Statistical Significance of the Findings

It is worth noting that the yearly compounded net IRR figures for funds have been excluded from our regression analysis due to the problems with the construction of the net IRR measure, making it difficult to draw any reasonable conclusions (see **Section 3.2.1**). This is because the regression analysis does not take into account the time value implicit in IRR calculations, causing the overestimation of the effects from first years of the fund life and underestimation at the end of the fund life.

From **Table 9** we see that most of the visible differences are also statistically significant. The coefficient values for DPI and TVPI clearly indicate significant and widening performance gap over the course of the fund life that was observable from the prior figures. In terms of called-up percentage, we are mostly concerned with the gap in the first couple of years when the investments are made. On the other hand for RVPI we are more interested in the gap between zombie funds and their peers in the latter part of the fund life. One interesting observation is that although we identify a slower reduction of RVPI values by the zombie funds (see **Figure 9**), there seems to be no significant difference between zombie funds and non-zombie funds by the end of Year 12 (see **Appendix 9**). This is understandable as most of the funds are expected to be liquidated by Year 12, meaning that very few investments should be open for any fund at that point in time. Focusing on the control variables we observe a slower investment pattern as well as higher reported residual values from funds raised during crisis years. Good news for the locally oriented LPs is that GP location does not seem to influence neither the performance nor the investment pattern of the fund.

It is worth noting that the t-statistics are often quite high. One reason for the generally high significance levels for the differences relates to the fact that a lot of our variables have a low variance among them. For example, the called-up percentage will mostly lie between 0% and 100% and therefore is not prone to exhibit big outliers.

Table 9. Panel Data Regressions for Level Differences for Zombies and Non-Zombies

Regression Coefficients	(2) dpi			(3) tvpi			(4) called			(5) rvpi		
	Coef.	Sig.	T-Stat.	Coef.	Sig.	T-Stat.	Coef.	Sig.	T-Stat.	Coef.	Sig.	T-Stat.
<i>Constant</i>	4.2	-	(0.7)	1.10	***	(16.2)	37.9	***	(33.4)	110.0	***	(35.2)
<i>Year</i>	11.3	***	(40.0)	0.05	***	(17.6)	6.6	***	(78.3)	-6.2	***	(-26.5)
<i>zv2</i>	-9.6	***	(-7.7)	-0.05	*	(-2.0)	-10	***	(-9.3)	-10.3	***	(-4.5)
<i>zv3</i>	-19.2	***	(-14.5)	-0.13	***	(-4.5)	-2.2	*	(-1.8)	-7.9	***	(-3.7)
<i>zv4</i>	-26.8	***	(-17.4)	-0.17	***	(-5.6)	2.3	*	(1.9)	-5.9	***	(-2.7)
<i>zv5</i>	-33.0	***	(-17.5)	-0.18	***	(-5.1)	8.0	***	(8.1)	1.4	-	(0.6)
<i>zv6</i>	-37.1	***	(-16.9)	-0.15	***	(-4.0)	11.1	***	(12.6)	8.9	***	(3.7)
<i>zv7</i>	-40.1	***	(-15.6)	-0.16	***	(-3.7)	11.3	***	(14.9)	11.8	***	(5.0)
<i>zv8</i>	-42.9	***	(-14.2)	-0.17	***	(-3.8)	8.7	***	(10.5)	13.3	***	(4.8)
<i>zv9</i>	-43.9	***	(-12.3)	-0.19	***	(-4.0)	3.8	***	(4.4)	12.4	***	(4.5)
<i>zv10</i>	-47.1	***	(-10.7)	-0.26	***	(-4.7)	-1.8	**	(-2.0)	6.5	**	(2.2)
<i>zv11</i>	-54.8	***	(-10.6)	-0.28	***	(-4.5)	-9.1	***	(-8.3)	11.8	***	(2.8)
<i>zv12</i>	-58.7	***	(-10.2)	-0.33	***	(-5.2)	-17.1	***	(-13.6)	7.9	**	(2.3)
<i>crisis</i>	-17.4	***	(-4.8)	-0.10	***	(-2.6)	-3.7	***	(-6.5)	5.6	***	(3.6)
<i>large_fund</i>	-17.1	***	(-6.3)	-0.15	***	(-4.9)	1.5	**	(2.5)	0.1	-	(0.1)
<i>late_stage</i>	17.4	***	(4.4)	0.17	***	(4.0)	-0.8	-	(-1.3)	0.1	-	(0.1)
<i>europe</i>	-11.8	**	(-2.2)	-0.19	***	(-3.0)	-3.5	***	(-3.3)	-5.4	*	(-1.7)
<i>us</i>	-6.6	-	(-1.1)	-0.10	-	(-1.5)	-2.3	**	(-2.5)	-1.8	-	(-0.7)
Fixed effects	No			No			No			No		
Panel data	Yes			Yes			Yes			Yes		
Adjusted R-squared	0.18			0.05			0.59			0.16		
Number of observations	14,164			14,136			14,170			14,133		
Funds under observation	2,824			2,824			2,824			2,824		

This table reports the panel-data regression results. The dependent variables include performance measures DPI and TVPI together with called-up percentage and RVPI to describe the investment patterns. Independent variables include zombie fund dummies to assess the effect of being a zombie during any particular year of the fund life. Rest of the independent variables have been added to the cross-section regression to control for the time trend, vintage, size and stage of the fund as well as the location of the GP. The results are based on a dataset of 2,824 PE funds with vintages from 1996 till 2008. More specific information regarding the dataset can be found in the Data Overview part of the paper in (3.1.3). T-statistic values that are based on the robust standard errors have been brought out in the brackets. Coefficient estimates that are reported ***, **, and * indicate significance at the 1%, 5%, and 10% level respectively.

Source: Authors' definitions and calculations based on Preqin, S&P Capital IQ and Bison data.

4.3 Impact of Fundraising on Fund Performance

As touched upon in the Prior Research section, the uncertainty around the zombie funds often leads to the indecisiveness among the LPs vs a GP. As the LPs often lack the understanding of the actual amplitude of the phenomenon as well as are usually under the information disadvantage, it becomes tricky for them to form reasonable cost-benefit analysis of potential actions. Combining this with the wish to maintain good relations with the GP community (Verdane Capital Advisors, 2014), especially by some types of LPs, and the lack of motivation due to free-riding and time constraints to manage small exposures (LP/GP Interviews) make LPs lean towards inactivity. Perhaps the performance of the zombie funds in the later stages is in line with the rest of the industry, or maybe the underperformance is so negligible that LPs would be better-off by focusing on increasing the value of their well-performing investments or new investment opportunities. This part of the empirical analysis sheds some light on these questions and provides a better understanding of the zombie fund performance.

Table 10. FE regression results

Dependent variable	(6) tvpi		
	<i>Coef.</i>	<i>Sig.</i>	<i>T-Stat</i>
<i>constant</i>	1.30	***	(190.2)
<i>year12</i>	0.22	***	(11.0)
<i>zombyear12</i>	-0.12	***	(-2.8)
Fixed effects		Yes	
Panel data		Yes	
Adjusted R-squared		0.02	
Number of funds		2,824	
Number of observations		2,662	

This table reports the regression results. The dependent variable is the performance measure TVPI. Independent variables include a time dependent dummy *year12* and the zombie fund dummy in Year 12 to assess the effect of being a zombie in the latter part of the fund life. Due to the FE framework, no control variables have been added. The results are based on a dataset of 2,824 PE funds with vintages from 1996 till 2008. More specific information regarding the dataset can be found in the Data Overview part of the paper in (3.1.3). T-statistic values that are based on the robust standard errors have been brought out in the brackets. Coefficient estimates that are reported ***, **, and * indicate significance at the 1%, 5%, and 10% level respectively

Source: Authors' definitions and calculations based on Preqin, S&P Capital IQ and Bison data.

With regards to the fund performance, our focus remains on the TVPI as the key performance measure. The overview of the FE regression results are brought out in **Table 10** above. In this regression, we are looking at the fund performance at two different points in time: Year 6, when it is still unclear which funds fall into the zombie state, and Year 12, when the

event of not raising a subsequent fund has taken effect. One of the key questions from the LPs' perspective is how the performance patterns develop for the zombie funds later in the fund life.

After controlling for all the time-invariant fixed-effects of the specific funds, zombie funds are on average expected to relatively underperform against the rest of the peers between Year 6 and Year 12. More specifically, the results indicate that although on average all funds in our sample are adding value up until Year 12, the zombie funds are expected to increase the TVPI of the fund by 12 percentage points less than non-zombie funds over the course of the last six years (i.e. Year 7 through Year 12 inclusive). We see this relative underperformance of the zombie funds as both statistically and economically significant. Importantly, this implies that on average the present LPs would be better off by seeking for a solution in a zombie situation (see **Appendix 4** for potential solutions).

We stress that the TVPI consists of both DPI and (possibly positively biased for bad performers) RVPI, as discussed in the Prior Research section. This positive bias in the measure would increase the performance of zombie funds and effectively reduce the return gap between zombie and non-zombie fund. Therefore, the fact that zombie funds are significantly underperforming proves just how big the performance gap in the second half of the fund life is.

4.4 Key Takeaways from Our Findings

Overall, the results that we obtain in this paper can be summarized as answers to our research questions (a) to (e):

- (a) Funds are more likely to become zombies if: (1) they are comparatively small; (2) display bad performance up until Year 6; (3) are slow in investing up until Year 6.
- (b) Zombie funds distribute less value to the investors over the course of the fund life. The performance of zombies is statistically significantly lower than the rest of the industry and the gap is widening over the course of the fund life.
- (c) Zombie funds are slower in calling-up capital and making investments.
- (d) Zombies tend to report more value left by the end of the fund life. However, by Year 12 the gap in RVPI for zombies and non-zombies is not statistically significant.
- (e) After controlling for fund fixed-effects, zombie funds are expected to return 12% less value per initial paid-in-capital during the second half of the fund life. This underperformance is both statistically and economically significant.

Both from Prior Research and LP/GP Interviews we can note that each zombie situation is rather unique and any particular LP is not likely to experience too many of these situations,

however, with the maturity of the industry they will nevertheless become more common and presenting more value at stake. Consequently, we believe that this research and the answers we provide are thus beneficial for LPs to have a reasonable starting point to form more educated expectations when observing zombie fund situations. Our dataset allows for some general conclusions to be formed and thus might enable LPs to better understand the characteristics of the zombie funds and more importantly the impact of keeping such investments without taking action.

This paper also sets potential negotiation points in the LP-GP conversation for both sides, as usually becoming a zombie is not a one-sided conscious decision, but rather a collection of reactions, decisions and behaviours as well as environmental impacts. With the potential investment impact being measured, the GPs and LPs could have grounds to renegotiate the LPAs, set up additional controls or fee structures. The best exit practices out of the zombie situation are, however, a subject for future academic research, once the availability of in-depth information not only for select few cases becomes available.

5. Conclusions

The Private Equity market in the last fifteen years was all but a slow walk. The recovery after the dot-com crash quickly turned into a boom with record high fundraising activity just to face the 2008 financial crisis severely impeding the general partners' (GPs') ability to generate returns as well as limited partners' (LPs') ability to commit capital. The effects of both the maturing industry and increased competition for the lesser amount of LPs' capital commitments has rendered many of the less successful GPs unable to raise financing for their next vintages of funds.

The inability to raise a further round of funding has blurred the usual GP financing model as well as incentives to act in certain ways, with increasing reliance on the management fees as means for survival. This semi-live fund state, in its worst causing the LPs see their returns disappear as the GPs delay their exits to the maximum has been richly labelled by financial media as the "horror show" of zombie funds. We note that both the numbers and the visibility of the zombie funds over the course of a couple of years increased significantly, yet it has contributed relatively little to the understanding of the phenomenon or the activism from the LPs. This has partly to do with the lack of research into this field, as the relatively short timeframe of the problem as well as the general data privacy and collection issues in the PE industry leave little room to explore the zombies.

In this paper, we take a closer look at the economics of the zombie funds to provide an overview of the differences in patterns between the living dead and their more successful peers, where GPs have successfully raised a follow-on fund. In particular, we look at the performance trends before and after fundraising to estimate the returns that LPs can expect in the zombie situations. For this, we have gathered a data sample on 2,824 private equity funds with vintages from 1996 to 2008 from Preqin, a PE data provider. This data was complemented with the fund level information from S&P Capital IQ and Bison databases where applicable. This has led us to five key conclusions, in line with our research questions:

- (a) First, we establish that funds are significantly more likely to become zombies if they: (1) are small in size; (2) are slow in making investments at the beginning of the fund life; (3) provide LPs with poor performance up until Year 6. These findings go in line with earlier research from Kaplan and Shoar (2005) on the ability to attract capital. We deem that these findings on zombie funds might provide the early warnings for LPs to take timely action or preventive measures not to arrive in a zombie situation.
- (b) Second, all the performance measures confirm that zombie funds significantly underperform against non-zombies throughout the fund life. We note that the value gap

gradually increases over the fund lifecycle. The gradual deterioration of the fund performance instead of a clear break is rather good news for the LPs as it enables them to take action towards solving performance and incentive issues in a zombie situation. Nevertheless, the widening performance gap acts as a ticking time-bomb, meaning that the LPs are better off finding a solution as early as possible to minimize the negative effects.

- (c) Third, throughout their fund life, the zombie funds are found to be significantly slower in calling-up capital and making investments compared to the non-zombies. The slow pace of making investments is probably one of the key reasons why the fundraising ends up being a failure. It becomes difficult to market the next fund without successful early exits and a strong track-record.
- (d) Fourth, zombies report to have more value left in the fund (i.e. higher RVPI) during the second half of the fund life. One possible explanation can be linked to the later investment cycle. Some more negative interpretations include GP's wish to postpone divestments to "milk" the existing fund for management fees, or inflating valuations to argue for fund extensions for similar reasons. The latter explanations would be worrisome for the LPs and call for caution in terms of the alignment of incentives in the later stages of a PE fund.
- (e) Fifth, and most importantly, we determine that the zombie fund performance is expected to deteriorate compared to non-zombies after the GP's inability to raise a follow-on fund has become clear. In particular, we find that the value that LPs are giving up when staying with a zombie is equal to 12% of the initial paid-in-capital. Unless the direct and indirect costs of activism are higher than this potential value difference, it makes sense for the LPs to take active steps towards finding a reasonable solution.

Limitations and Future Research Suggestions

There are considerable limitations to our research paper thus bringing many ideas for future research. Perhaps the most demanding limitation is the data availability. Scarcely available for successful cases, the unsuccessful ones might be "forgotten" by the GPs just not providing the data to third party data collection services or simply ceasing to exist. The access to primary sources is thus of high value and unfortunately due to time constraints was only to a very limited extent available to us via LP/GP Interviews. We relied on the use of Preqin data for this research. Whereas considered one of the top data providers in the PE industry, it still relies mostly on the FOIA information, GP inquiries (on voluntary basis), and public information and

fund filings where necessary. A natural extension to this research would be a cross-database analysis and complementation of the data provider data with LP datasets, to account for funds with no performance data in Preqin.

Furthermore, the dataset we use is already processed to reflect the most common fund performance measures – TVPI (Multiple), RVPI, DPI, and net IRR. A more robust measurement of the fund performance would be possible with the availability of the precise cash flow data at a fund level, enabling to calculate exact PME and benchmark the zombies against the market. We have further relied on general notions of the PE fund operation characteristics, which, with a more detailed dataset would be good to check. These assumptions include the LPA details, such as the compensation scheme, the agreed fund lifetime, the agreed fund investment period, available extension options, clauses for LPs' actions regarding the GP's operations, to other fund characteristics, that might have influence on the behavioural patterns. An extension of the study in any of these directions could be a feasible way of enriching the understanding of the zombie fund phenomenon.

In line with Migliorini (2014) and Custar et al. (2014), we see a further possibility of broader case study set of the actions available and actually done by the LPs on a broader geographic space and sector. While researching for this paper, we have heard the LPs' views on their weaker position in the US as opposed to “driver seat” in the Western Europe, and Nordics in particular once the GP runs into trouble. A further study viewing the LP action differences towards the zombie fund situations combined with their location, type or other characteristics would also serve as enriching the understanding of the zombie funds and the outcomes these situations generate.

We have only paid limited attention to the actual GP ability to pick investments and the types of problems they experience with these investments. A further research into the distress level of the GPs managing the zombies could be beneficial in showing the actual effort requirements and to what extent additional motivation measures should be granted by the LPs.

Finally, we have narrowly and rather conservatively defined the zombie funds as the one managed by a GP who was unable to raise a follow-on fund. We allow for seven years at least for the capital raising as of the vintage year, taking the vintages 1996 through 2008. An expansion of the zombie and the overall fund list both in terms of vintage years and the definition, taking in the ones that have raised follow-on funds but took a longer than usual time to raise a new one would also be natural study extensions enriching the understanding of the phenomenon.

Overall, the PE industry has been defined by a constant change and maturing nature. This requires both the GPs and LPs to keep growing with the increased complexity to target new

issues in a timely fashion and stay competitive in the face of change. With SEC taking more active stance and ILPA uniting the LPs for best practices to commercial data providers opening their data to further research allow for more transparency and ability to address the issues. We see that there are plenty. Zombie fund phenomenon is a good example of an issue that has become a reality for many LPs just over the course of a few recent years. In turn, we hope that this paper adds value to the private equity community and enables LPs to make more informed decisions in managing their investments in zombie situations in a more efficient way, benefitting the society as a whole.

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Appendices

Abbreviations and Definitions

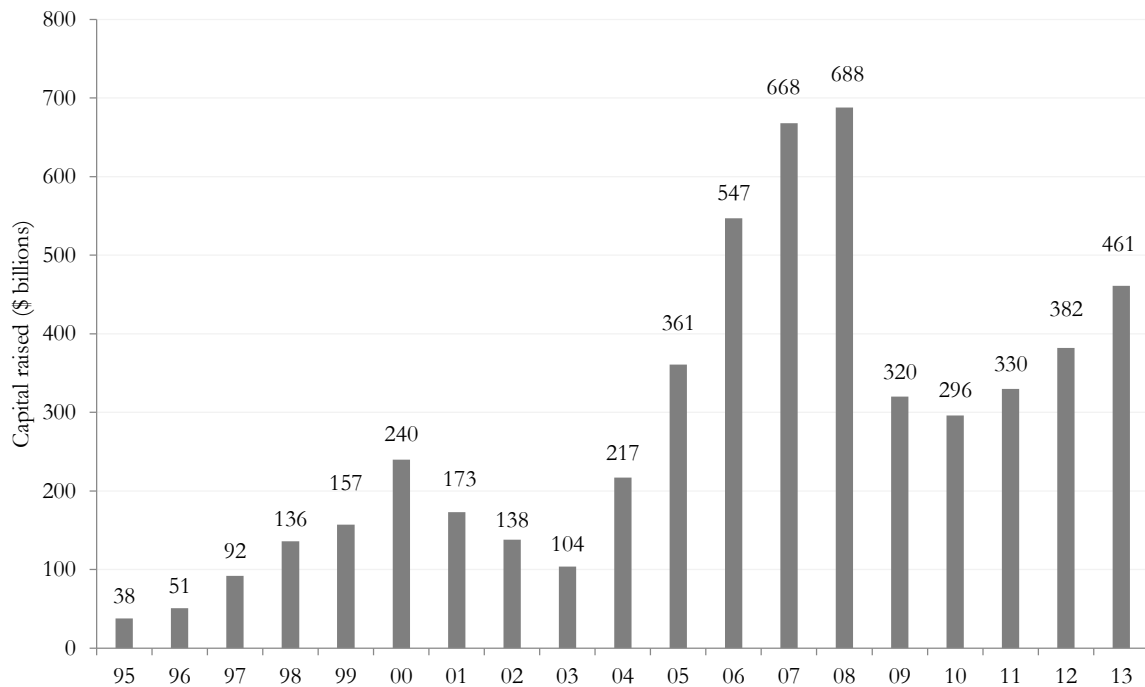
Term	Definition
Deal Fees	A Deal Fee could be charged by the General Partners to finance fund's acquisitions and exits. The Deal Fee depends on the Limited Partnership Agreement and is typically between 0.5% and 1.5% of the value of the deal. According to Migliorini (2014) it has become increasingly less popular to charge the Deal Fee.
DPI	Distribution to paid in (%). It is the proportion of the called up capital that has been distributed or returned back to LPs. This will include cash and stock distributions, with the latter being valued as at the date of distribution and treated in the same way as a cash distribution. Distributed % is one measure of the cash performance of the partnership that is not subject to judgemental factors (as for value and IRR).
FE	Fixed-effect model. A statistical model that treats all variables as non-random values. Therefore controlling for all the observable and unobservable time-invariant variables.
FOIA	The Freedom of Information Act. It is a federal freedom of information law in the U.S. that allows for the full or partial disclosure of information held by some institutions, such as pension funds. FOIA was applied in several cases for LPs investing into PE funds to get the PE investment return information.
Gross IRR %	The gross internal rate of return earned by the fund in total, combining both the LP and GP compensations.
GP	General Partner. General Partner is usually one of the owners and operators of a partnership, which is a joint business entered into for profit, in which responsibility for management, profits, and, most importantly, the liability for debts is shared by the general partners. The general partners usually receive a management fee and share in profits.
ILPA	Institutional Limited Partners Association. It is a global, member-driven organization to advance the interests of Limited Partners by providing education, independent research and global collaboration.
LP	Limited Partner. A partner in a partnership whose liability is limited to the extent of the partner's share of ownership. Limited partners generally do not have any management responsibility in the partnership in which they invest and are not responsible for its debt obligations.
LPA	Limited Partnership Agreement. Defines the terms of the partnership and the profit-sharing.
Money Multiple or TVPI	Total value to paid-in (%) or Money Multiple. The ratio between the total value that the LP has derived from its interest in the partnership - i.e. distributed cash and securities plus the value of the LP's remaining interest in the partnership – and its total cash investment in the partnership, expressed as a multiple. It is important to note that this measure does not reflect the time value of money, and therefore will not show whether one partnership has returned value to LPs more quickly or more slowly than another. However, it is one measure of “profit” or “loss” for the LP.
<i>Table continues on the next page...</i>	

Term	Definition
Monitoring Fees	A monitoring fee is a fee charged by a General Partner and paid by the portfolio companies for consultancy and advisory services. This fee accrues directly to the GP or affiliated companies. Monitoring fees are usually charged annually throughout the holding period of the particular investment. Monitoring fees can reduce the net returns experienced by LPs.
NAV	Net asset value. The total value of assets, less any liabilities, divided by the number of fund shares outstanding.
Net IRR %	The net internal rate of return earned by an LP to date after fees & carry. The internal rate of return is based upon the realized cash flows and the valuation of the remaining interest in the partnership. IRR is an estimated figure, given that it relies upon not only cash flows but also the valuation of unrealized assets. The IRR estimates shown are both those as reported by the LP and / or GP, and those that Preqin has calculated internally, based upon cash flows and valuations, provided for individual partnerships.
OLS	Ordinary least squares. A method of determining the curve that best describes the relationship between expected and observed sets of data by minimizing the sums of the squares of deviation between observed and expected values.
RVPI	Remaining value or the residual value to paid in (%). The value of the LPs' remaining interest in the partnership, as derived from the GP's valuation of the unrealized portfolio and its allocation of this to the LP. Valuation of unrealized investments expressed as a percentage of called capital.
SEC	U.S: Securities and Exchange Commission. It is an agency of the United States federal government. It holds primary responsibility for enforcing the federal securities laws, proposing securities rules, and regulating the securities industry, the nation's stock and options exchanges, and other activities and organizations, including the electronic securities markets in the United States

This table brings out the definitions and abbreviations that have been used over the course of the paper. Some of the definitions are taken directly from the sources, while others were compiled by the authors.
Sources: Preqin (2015); U.S. Securities and Exchange Commission (2015); Institutional Limited Partners Association (2015); Legal Dictionary (2015), Migliorini (2014).

Appendix 1.

Figure A1. Global capital raised by the PE industry over years 1995 – 2013



This figure shows the global capital raised by the PE industry over years 1995 – 2013. The considerable growth of the industry can be seen both from the numbers of deals and the value of deals. The graph also hints the cyclicity of the PE industry, with considerable growth before the IT bubble and the 2008 financial crisis.

Source: Bain & Company Global Private Equity Report 2014, replicated by the authors.

Appendix 2

Short Descriptions of the Key Databases Used in Research in the PE Industry

Burgiss – a US based data, decision support analysis tools provider for “over a thousand institutions representing over \$2 trillion of committed capital” (Burgiss, 2015). The company was established in 1987, with its key advantage relying on the data sourced directly from the LPs, enabling a dataset of “1400 private equity funds derived from the holdings of over 200 institutional investors” (Harris, Jenkinson and Kaplan, 2013).

Cambridge Associates – a US based data provider, mainly active in the investment advisory and research services to institutions. Cambridge Associates was established in 1973 and provides services to more than 1000 clients (Cambridge Associates, 2015). According to Higson and Stucke (2012), Cambridge Associated covered 60% of the US buy-out fund data (based on the fund value) at the time of their research, sourcing from LPs.

Preqin – a UK registered data provider on alternative assets was established in 2003. Preqin sources its data mainly from direct contact with GPs, by monitoring regulatory filings and via FOIA (Freedom of Information Act) as well as public sources (Preqin, 2015). Due to these data collection techniques, Harris, Jenkinson and Kaplan (2013) question the dataset in terms of some high-performing funds who tend to avoid LPs which are under FOIA being non-covered by Preqin. However, the number of funds covered by Preqin is one of the largest among the data providers and overtaken only by ThomsonOne (VentureXpert) (Harris, Jenkinson, Stucke, 2010).

ThomsonOne (VentureXpert) – a part of the global data provider Thomson Reuters, which has its roots dating back to 1851 and was created in a merger in 2008. Thomson Reuters is based in the US and Canada. ThomsonOne (VentureXpert) was one of the main data sources for PE related research, mainly because of its accessibility. Retaining the data from mainly from LPs, ThomsonOne has been noted to have a selection bias due to relying only on the voluntary reporting (Phalippou and Gottschalg, 2009).

Source: Public webpages of the respective data providers and scholars noted in the text. All sources are referred to in the reference list of this paper. Compiled by the authors of this paper.

Appendix 3

Short Description of the “Business-as-Usual” PE Fund Conditions

This model of GP compensation works perfectly in “normal” conditions, which consist of:

- (1) GP has raised and is able to timely deploy the fund during the investment period (when it is usually also prohibited to raise new funds to limit the GP’s attention);
- (2) GP is able to create value with the investments made by the fund, with continuous understanding that the key compensation will indeed come from the carry, and the management fees are meant for day-to-day activities;
- (3) therefore, GP has an incentive to exit as early as feasible for the GPs and LPs best interest, maximizing the returns of the fund;
- (4) GP has an efficient structure, which is suitable and able to manage funds throughout all stages of the fund life, from fundraising to exits and liquidation;
- (5) combining conditions (1) and (4), GP is able to maintain its structure, meaning that after the investment period with the current fund is over, GP can successfully raise a new fund to use its investment team, and keep the organization rolling.

Source: Compiled by the authors of this paper from the LP/GP Interviews.

Appendix 4

Table A4. Potential Solutions to the Zombie Fund Problem for LPs

Principles for Action and Solutions

Following the ILPA recommendations:

- (1) Aligning the interests between GPs and LPs, so the motivations behind GP actions are clear to LPs
- (2) Effective governance of the fund reached via using well-prepared LP Agreement, experienced and transparent GPs with fitting management style and proven skill.
- (3) Transparency of communication, already touched upon in (1) and (2), cannot be understated, especially if the GP wishes to prolong the fund.

These principles are best established ex-ante and might be trickier to switch in a zombie situation. Once in a situation, it is key to:

- (1) Understand what actually is in the LPA and other fund governing agreements, especially in terms of the action limitations and rights of the LPs.
- (2) Frequently communicate with other LPs in the fund, form the LP Advisory Committee (LPAC) to steer the communication with GP as well as align LP interests.
- (3) Explore all alternative options to extension with an extensive input from the GP, including closing the fund at its current state.
- (4) Decisions in favour of GP mandate extensions should be coupled with increased GP accountability via more thorough reporting, additional targets, smaller but more frequent milestones etc.
- (5) External advisory might be necessary for more complex cases.

Potential Hands-On Solutions

LPs have been noted to drive the following alternative zombie solutions:

- (1) Extending the fund and/or restructuring the LPA. This may include the re-alignment of the GP incentives to performance targets (e.g. the carried interest part), as well as slimming down the GP organization. This solution requires the most trust of the GP ability by the LPs.
- (2) Scanning the exit alternatives in the secondary market. The exits can become costly, since they typically involve a sale at an NAV discount of 5-15%. The sale can be done on an individual LP basis or as a collective to a willing secondary fund overtaking the zombie fund for further restructuring.
- (3) Weighing the in-kind distribution of the remaining zombie fund assets alternative. This alternative is usually more attractive when the remaining assets are liquid post-IPO holdings of shares.
- (4) Replacing the GP, usually done as a last resort. Might require a substantial majority of LPs agreeing on this and the coming manager. Most effective in cases of mistrust or misconduct.

GPs can also be active in seeking to solve the zombie issue by:

- (1) Providing suitable exit alternatives for willing LPs via (a) organizing the sale of fund shares to secondaries or (b) organizing a new fund, which takes over the assets of the existing fund. These actions require a substantial amount of effort from a GP, close to the same level as raising a new fund, which the GP has failed. Thus both the ability and reputation to deliver should be weighed in this option.
- (2) Issuing preferred securities at the fund level, also providing LP exit options for willing LPs. Might be difficult to structure and agree with existing LPs.

Table continues on the next page...

Table A4. Potential Solutions to the Zombie Fund Problem for LPs

Principles for Action and Solutions

Some of these solutions were partially reflected by Preqin (2013, 2014) and Verdane Capital Advisors (2014), mainly the exit via secondary market. Overall, the solutions on the more general level might work very well before a potential LP enters an LPA, however, in many cases, due to the relatively young age of the industry and even younger stage of the zombie situation, the LPAs signed a decade ago might not be suitable for the situation, prolonging the potential LP action (LP/GP Interviews).

Source: Migliorini (2014) and Custar et al. (2014), as compiled, summarized and explained by the authors of this paper.

Appendix 5

Additional data sources in detail:

(1) S&P Capital IQ

Excerpt from the S&P Capital IQ press release about the company:

“S&P Capital IQ, a part of McGraw Hill Financial (NYSE:MHI), is a leading provider of multi-asset class and real time data, research and analytics to institutional investors, investment and commercial banks, investment advisors and wealth managers, corporations and universities around the world. S&P Capital IQ provides a broad suite of capabilities designed to help track performance, generate alpha, and identify new trading and investment ideas, and perform risk analysis and mitigation strategies. Through leading desktop solutions such as the S&P Capital IQ, Global Credit Portal and MarketScope Advisor desktops; enterprise solutions, such as S&P Capital IQ Valuations; and research offerings, including Leveraged Commentary & Data, Global Markets Intelligence, and company and funds research, S&P Capital IQ sharpens financial intelligence into the wisdom today’s investors need.”

Source: S&P Capital IQ (2015).

(2) Bison

Excerpt from the Bison:

“Bison is the private equity and venture capital ("PE/VC") market's first technology monitor. Covering only public data, Bison tracks PE/VC firms and any related fundraising, performance, portfolio, manager, and industry activity. Gain access to over 4,000 firm profiles, monitor activity in the firms you care about, and use our powerful analytics to pick winners.”

Source: Boston Illiquid Securities Offering Network, Inc. (2015).

Appendix 6a

Table A6a. Funds by GP Location

GP Location	No. of Funds	GP Location	No. of Funds
Argentina	11 (2)	Luxembourg	16 (2)
Australia	64 (6)	Malaysia	5 (0)
Austria	5 (1)	Mauritius	3 (0)
Bahrain	1 (1)	Mexico	6 (1)
Barbados	1 (1)	Morocco	3 (1)
Belgium	4 (0)	Netherlands	18 (1)
Bermuda	3 (0)	New Zealand	6 (1)
Brazil	13 (1)	Nigeria	2 (0)
Bulgaria	1 (0)	Norway	18 (3)
Canada	53 (8)	Peru	3 (0)
China	29 (5)	Philippines	4 (1)
Colombia	1 (0)	Poland	12 (2)
Croatia	1 (1)	Portugal	4 (0)
Czech Republic	2 (1)	Romania	1 (0)
Denmark	16 (1)	Russia	9 (0)
Egypt	4 (0)	Saudi Arabia	2 (1)
Estonia	2 (2)	Singapore	12 (2)
Finland	33 (2)	Slovakia	4 (0)
France	88 (12)	South Africa	18 (8)
Germany	44 (7)	South Korea	11 (0)
Greece	2 (1)	Spain	26 (6)
Guernsey	1 (0)	Sweden	43 (3)
Hong Kong	46 (2)	Switzerland	26 (4)
Hungary	1 (0)	Taiwan	6 (0)
India	17 (3)	Thailand	2 (1)
Ireland	2 (1)	Togo	2 (0)
Israel	40 (8)	Tunisia	8 (0)
Italy	39 (9)	Turkey	3 (1)
Japan	32 (0)	Uganda	1 (0)
Jersey	2 (0)	UK	247 (17)
Jordan	1 (0)	Ukraine	4 (2)
Kazakhstan	1 (1)	United Arab Emirates	2 (1)
Kenya	1 (0)	US	1,718 (299)
Kuwait	6 (1)	Vietnam	8 (1)
Latvia	4 (1)	Total	2,824 (436)

This table presents the geographical split by country of our sample funds with vintages 1996-2008. The figures inside the brackets include the number of zombie funds.

Sources for data: Preqin, S&P Capital IQ, Bison; author's calculations and classification into zombies.

Appendix 6b

Table A6b. Descriptive Statistics of the Sample

		Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
Called Capital as % of the Committed Capital													
Zombie funds	Average	16.1	31.3	46.1	57.1	69.6	79.6	86.2	90.7	92.8	95.5	95.6	95.1
	Median	11.8	28.9	43.2	55.1	70.0	80.0	88.4	92.8	95.2	97.0	98.3	98.9
	III Quartile	5.8	19.9	31.9	43.2	58.2	70.2	79.2	86.5	89.7	91.9	92.4	93.8
	I Quartile	20.0	36.2	54.1	70.4	81.6	90.0	95.1	98.9	99.5	100.0	100.0	100.0
Non-zombie funds	Average	19.1	38.3	55.8	68.5	79.3	87.5	91.6	94.4	95.7	96.3	96.9	97.4
	Median	15.0	33.6	53.1	70.1	81.0	89.5	93.4	96.0	98.0	99.0	100.0	100.0
	III Quartile	8.1	22.7	39.2	52.9	69.5	80.7	87.0	91.0	93.0	95.0	95.8	96.5
	I Quartile	24.9	50.0	71.5	84.9	92.6	96.4	99.4	100.0	100.0	100.0	100.0	100.0
Zombie funds	#	147	182	200	229	253	266	287	246	186	138	110	101
Non-zombie funds	#	704	842	970	1,071	1,146	1,189	1,277	1,181	1,050	945	827	790
DPI, %													
Zombie funds	Average	1.1	3.4	4.7	10.2	15.0	22.6	32.5	40.2	52.4	63.4	72.8	72.0
	Median	0.0	0.0	0.0	0.6	4.4	12.3	21.8	30.9	41.7	47.4	47.4	55.6
	III Quartile	0.0	0.0	0.0	0.0	0.0	0.7	7.3	12.5	20.0	24.4	27.1	29.6
	I Quartile	0.0	0.4	5.1	9.5	18.9	31.1	47.7	61.0	74.9	95.6	96.4	105.8
Non-zombie funds	Average	1.0	5.2	13.2	24.1	37.0	50.4	64.9	80.7	102.4	115.5	126.4	144.3
	Median	0.0	0.0	1.2	7.3	15.9	29.8	43.5	61.1	80.0	91.6	107.0	117.4
	III Quartile	0.0	0.0	0.0	0.0	2.7	10.1	18.2	28.1	39.9	47.6	51.3	63.2
	I Quartile	0.0	1.0	13.0	24.4	41.5	61.3	79.1	106.5	132.0	149.8	167.8	180.4
Zombie funds	#	147	182	200	229	253	266	286	246	186	138	110	101
Non-zombie funds	#	704	842	970	1,070	1,146	1,189	1,277	1,179	1,049	945	827	789

		Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12
RVPI, %													
Zombie funds	Average	79.8	82.0	79.2	72.2	75.1	77.2	72.5	68.6	60.2	43.1	40.5	29.6
	Median	87.2	82.4	79.0	75.6	75.7	76.0	72.4	64.7	53.6	38.8	26.9	21.5
	III Quartile	71.6	70.4	65.0	59.0	59.4	55.8	49.2	40.5	35.1	21.0	13.3	2.7
	I Quartile	96.8	92.4	91.2	89.6	92.7	97.6	98.0	94.8	79.9	58.3	55.2	39.5
Non-zombie funds	Average	88.7	97.1	99.0	92.1	87.8	82.0	76.2	64.4	50.0	40.0	30.0	22.9
	Median	91.6	90.8	90.6	88.2	86.5	80.7	73.0	61.2	45.1	33.4	23.9	13.9
	III Quartile	81.1	79.3	76.1	69.8	65.1	60.4	49.9	37.5	24.4	15.2	8.0	2.1
	I Quartile	98.7	101.6	106.3	106.8	106.5	101.1	96.1	85.0	68.0	54.2	43.6	33.2
Zombie funds	#	147	182	200	229	252	266	285	245	183	137	108	99
Non-zombie funds	#	704	842	970	1,069	1,145	1,187	1,274	1,178	1,046	943	823	785
TVPI, %													
Zombie funds	Average	0.81	0.85	0.84	0.82	0.90	0.99	1.04	1.08	1.12	1.05	1.12	1.01
	Median	0.88	0.85	0.84	0.83	0.88	0.99	1.07	1.08	1.11	0.99	0.93	0.88
	III Quartile	0.74	0.73	0.71	0.66	0.71	0.71	0.72	0.67	0.67	0.59	0.53	0.48
	I Quartile	0.97	0.95	0.97	0.95	1.08	1.22	1.32	1.44	1.52	1.49	1.46	1.46
Non-zombie funds	Average	0.90	1.02	1.12	1.16	1.24	1.31	1.40	1.43	1.49	1.53	1.54	1.65
	Median	0.92	0.94	0.98	1.03	1.11	1.20	1.28	1.34	1.35	1.37	1.40	1.44
	III Quartile	0.82	0.82	0.82	0.82	0.87	0.90	0.93	0.94	0.90	0.89	0.89	0.90
	I Quartile	0.99	1.08	1.18	1.25	1.37	1.51	1.62	1.72	1.80	1.89	2.00	2.04
Zombie funds	#	147	182	200	229	252	266	285	245	183	137	109	100
Non-zombie funds	#	704	842	970	1,069	1,145	1,187	1,274	1,177	1,048	943	823	786
Net IRR, %													
Zombie funds	Average				-8.78	-4.24	-0.57	0.55	0.75	1.02	-0.21	-1.64	-2.20
	Median				-7.50	-3.10	0.00	1.45	1.90	2.05	0.00	0.00	0.00
	III Quartile				-17.10	-11.20	-7.78	-6.15	-5.38	-6.20	-6.15	-9.18	-9.20
	I Quartile				0.00	2.90	7.95	9.53	9.10	10.40	9.80	7.80	8.30
Non-zombie funds	Average				5.81	8.04	8.69	9.28	9.73	11.17	12.30	12.78	14.12
	Median				0.00	3.40	5.50	7.20	7.10	7.10	7.30	7.20	8.00
	III Quartile				-7.45	-1.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	I Quartile				11.80	13.70	15.60	15.00	14.93	15.83	16.55	18.70	20.00
Zombie funds	#				195	253	266	286	246	186	138	110	101
Non-zombie funds	#				939	1,132	1,174	1,266	1,168	1,040	935	824	787

This table presents the sample descriptive data over the years of fund life for 2,824 funds in our sample with vintages 1996-2008.

Source: Sources for data: Preqin, S&P Capital IQ, Bison; author's calculations and classification into zombies

Appendix 7

LP/GP Interview Questionnaire

We are conducting interviews with Limited Partners to gain a better understanding of the best practices and difficulties in dealing with tail-end funds. There is a growing concern in the private equity industry for some of the funds becoming tail-end funds, as General Partners, who fail to raise new funds in due course, may jeopardize the interests of the existing Limited Partners by unnecessarily prolonging the fund life and living-off of the management fees. This in turn may affect the performance of the PE fund.

Please find below the preliminary list of questions that we would be interested in discussing during the interview:

- (1) Have you experienced a tail-end situation among the investments you manage(-d)?
- (2) What are the warning signs that you start noticing in the GP or fund behaviour in potential tail-end funds?
- (3) When and how did/ would you react to these signs?
- (4) What are the most common means/ways to target the non-performance problems? Could you bring some examples of the problems you have experienced?
- (5) Have you ever been influenced by GPs in any ways in order to react/ not react to the tail-end situation? What were these ways (e.g. performance promises, fee reductions, distribution or threat of distribution of investments' shares directly to LPs, etc.)?
- (6) Have you ever sold your stakes on the secondary market or joined forces together with other LPs to oust GPs/dissolve the fund earlier?

The addition of your perspective on the tail-end situations would provide us with a more detailed understanding of the problems faced by LPs, as well as help us understand the best practices in the PE industry. We would be happy to share the results from this research once it is finished in the beginning of June.

Appendix 8

Table A8. Regression Results on Level Differences between Zombies and Non-Zombies at Year 6

Dependent variable	(7) dpi6			(8) tvpi6			(9) rvpi6			(10) called6			(11) irr6		
	Coef.	Sig.	T-stat	Coef.	Sig.	T-stat	Coef.	Sig.	T-stat	Coef.	Sig.	T-stat	Coef.	Sig.	T-stat
<i>constant</i>	51.0	***	(8.0)	1.23	***	(16.5)	74.0	***	(15.5)	88.9	***	(75.8)	6.8	***	(3.3)
<i>zomb</i>	-29.8	***	(-7.8)	-0.34	***	(-7.7)	-5.4	**	(-2.0)	-7.6	***	(-7.9)	-9.4	***	(-7.7)
<i>crisis</i>	-9.0	***	(-2.2)	0.05	-	(1.2)	13.0	***	(5.6)	-2.9	***	(-4.3)	1.3	-	(1.2)
<i>large_fund</i>	-15.0	***	(-4.5)	-0.15	***	(-4.0)	-0.5	-	(-0.2)	1.8	**	(2.5)	-3.0	***	(-2.8)
<i>late_stage</i>	12.9	***	(3.2)	0.20	***	(4.5)	7.4	***	(3.1)	-0.2	-	(-0.3)	7.6	***	(6.8)
<i>europe</i>	2.8	-	(0.5)	0.05	-	(0.6)	1.0	-	(0.2)	-2.3	*	(-1.7)	-1.1	-	(-0.6)
<i>us</i>	3.7	-	(0.7)	0.01	-	(0.2)	-3.5	-	(-0.7)	-1.0	-	(-0.9)	-1.5	-	(-0.8)
Fixed effects	No			No			No			No			No		
Panel data	No			No			No			No			No		
Adj. R-squared	0.02			0.03			0.03			0.07			0.05		
No. of funds	2,824			2,824			2,824			2,824			2,824		
No. of observations	1,620			1,618			1,547			1,573			1,650		

This table reports the regression results. The dependent variables include performance measures DPI, TVPI and IRR together with called-up percentage and RVPI at the end of Year 6. Independent variables include variables controlling for the vintage, size and type of the fund as well as the location of the GP. The results are based on a dataset of 2,824 PE funds with vintages from 1996 till 2008. More specific information regarding the dataset can be found in the Data Overview part of the paper. T-statistic values that are based on the robust standard errors have been brought out in the brackets. Coefficient estimates that are reported ***, **, and * indicate significance at the 1%, 5%, and 10% level respectively

Source: Authors' definitions and calculations based on Preqin, S&P Capital IQ and Bison data.

Appendix 9

Table A9. Regression Results on Level Differences between Zombies and Non-Zombies at Year 12

Dependent variable	(12) dpi12			(13) tvpi12			(14) rvpi12			(15) called12			(16) irr12		
	Coef.	Sig.	T-stat	Coef.	Sig.	T-stat	Coef.	Sig.	T-stat	Coef.	Sig.	T-stat	Coef.	Sig.	T-stat
<i>constant</i>	179.2	***	(10.5)	2.0	***	(11.6)	21.7	***	(3.3)	98.1	***	(87.0)	19.6	***	(3.2)
<i>zomb</i>	-71.0	***	(-8.2)	-0.7	***	(-7.3)	3.4	-	(1.1)	-2.0	**	(-2.0)	-11.5	***	(-7.3)
<i>crisis</i>	-26.2	***	(-2.9)	-0.2	-	(-1.6)	10.1	***	(5.1)	-1.2	**	(-2.0)	-2.8	*	(-1.9)
<i>large_fund</i>	-26.2	***	(-3.7)	-0.3	***	(-3.6)	3.7	**	(2.0)	2.1	***	(3.4)	-3.3	***	(-3.2)
<i>late_stage</i>	34.6	***	(3.7)	0.3	***	(2.9)	-6.6	***	(-3.4)	-1.8	***	(-3.0)	4.7	***	(2.8)
<i>europe</i>	-33.4	*	(-1.9)	-0.4	**	(-2.4)	-4.9	-	(-0.8)	-2.0	-	(-1.5)	-7.9	-	(-1.5)
<i>us</i>	-35.8	*	(-1.9)	-0.4	*	(-2.0)	1.1	-	(0.2)	0.1	-	(0.1)	-9.0	-	(-1.6)
Fixed effects	No			No			No			No			No		
Panel data	No			No			No			No			No		
Adj. R-squared	0.04			0.03			0.06			0.04			0.02		
No. of funds	2,824			2,824			2,824			2,824			2,824		
No. of observations	988			1,003			940			1,006			1,671		

This table reports the regression results. The dependent variables include performance measures DPI, TVPI and IRR together with called-up percentage and RVPI at the end of Year 12. Independent variables include variables controlling for the vintage, size and type of the fund as well as the location of the GP. The results are based on a dataset of 2,824 PE funds with vintages from 1996 till 2008. More specific information regarding the dataset can be found in the Data Overview part of the paper. T-statistic values that are based on the robust standard errors have been brought out in the brackets. Coefficient estimates that are reported ***, **, and * indicate significance at the 1%, 5%, and 10% level respectively.

Source: Authors' definitions and calculations based on Preqin, S&P Capital IQ and Bison data.