Is There a Size Disadvantage in the European Private Equity Market? Measuring the Impact of Committed Capital on Net Buyout Fund Returns

Emil Mahjoub (23004)* Filiph Nilsson (23038)**

Tutor: Assistant Professor Daniel Metzger Ph.D.,
Department of Finance Stockholm School of Economics

Abstract: This paper investigates whether a size disadvantage exists in Private Equity. Previous literature that deals with fund level performance and fund size has largely found that performance declines with fund size, but has worked almost exclusively with US data. This paper hypothesises that the same conditions apply in Europe and also aims to compare the magnitude of the size disadvantage in Europe and North America. Using a unique and high-quality data set consisting of 406 European and 857 North American buyout funds, the results of a regression analysis confirm that a size disadvantage exists in Europe and also, surprisingly, that differences in performance between larger and smaller funds are more distinct in Europe than in North America.

Keywords: *Private Equity, Buyout, Performance, Size, IRR*

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* 23004@student.hhs.se **23038@student.hhs.se

1 Introduction

Private Equity (PE) was one of the hardest hit industries in the financial crisis beginning in late 2007. Since then, though, it has rallied; in June 2014, total assets under management amounted to $3.8 trillion globally (Preqin Ltd., 2015). The largest component of private equity is buyout (BO) funds, which comprise approximately 40% of total capital commitments to PE (Preqin Ltd., 2015). Yet despite the ubiquity of PE in today's economy and its importance (see for example Strömberg (2007)), the industry receives much less scrutiny than does for example the mutual funds industry. There is not a great amount of research overall and new studies are infrequent.

Over time, the returns of PE funds have been up for discussion. Research regarding, for instance, PE fund returns and performance compared to that of the public stock market (Harris, et al., 2014) and what average level of debt in its investments a fund should use in order to maximize returns (Knauer, et al., 2014) have been conducted. Perhaps the most important issue faced by the management of a PE fund is that of fund size. The size of a fund will have major implications for strategy and operations. Yet, only a limited number of papers have been written that concern fund performance in relation to size. These studies mostly share the view that the largest funds underperform when comparing them to smaller funds (see Section 2.4). However, many papers touching the subject are outdated and regard the pre-crisis era and oftentimes make use of databases that are now discontinued. Most importantly, nearly all of them examine the US PE industry exclusively. In order to be able to confidently assert that fund size is an important factor when it comes to PE fund performance, a current study on European PE funds, including post-crisis data, is highly relevant. Key differences between the US and European markets, such as less homogenous markets between states and regulation, suggest that making an immediate analogy may be rash. A study that confirms previous findings on European data would thus open up for further examination of an industry of growing importance and constitute a contribution to current research. Including also comparable North American data in the study permits comparison and discussion of differing market conditions that may affect the way size affects returns.

One of the main difficulties with examining the PE industry is the availability of data. Private equity is largely exempt from public disclosure requirements and is notoriously secretive in its nature. Especially performance data is only provided by a few private databases. Previous research has often relied on the now discontinued Venture Economics or VentureXpert databases. This paper makes use of a data set of individual fund performance and fund size,

provided by Preqin. The data set stretches back to 1985 and includes funds as recent as from 2013. The data set is sourced from public filings of pension funds and other investors through Freedom of Information Act legislation and via direct contact with professionals in the industry.

This data set was used to study an issue that has only been examined in the US but never before in Europe: underperformance of large funds in terms of net returns delivered to investors over a fund's lifetime. US studies have looked at the PE industry as including both buyout funds and venture capital funds (VC), sometimes running subsample tests to showcase differences. However, these business models are vastly different as are the investor bases. Furthermore, the variation in returns is considerably higher for VC funds than for BO (Kaplan & Schoar, 2005). Therefore, this study uses PE and BO interchangeably and only includes BO funds in the data set.

In order to test the hypothesis of underperformance among large funds, tests were carried out on data obtained from Preqin: a differences-in-means analysis (t-test) and a linear regression model were used to test for a size disadvantage on net returns.

The study finds that there is a substantial size disadvantage for funds operating in the European private equity market. The results are statistically significant at the 1% level. An increase of the fund size by 1% will, on average, decrease fund returns by 0.023 percentage points. The results on North American data are less robust and, to some extent, disagree with previous findings, but are still significant at the 5% level in certain cases. For North American PE funds, a 1% increase in fund size will reduce returns by 0.012 percentage points. The results are (largely) robust also when accounting for year fixed effects.

As previous studies on PE performance data have been conducted solely on US data, a confirmatory result in both markets using comparable data is thought to constitute an important contribution to research within PE. This paper also discusses one important characteristic of the private equity business model that may contribute to the discrepancies in returns for funds of different sizes. Namely, that LPs are focused on percentage returns, while GPs have incentives to focus on dollar amount returns, on which they receive fees and carried interest.

2 Previous literature and background on the industry

2.1 The private equity business model

The concept of private equity can be summarised as funds owning companies whose shares are not publicly traded on a stock exchange. Either the fund purchases a private company from its previous owners or it purchases the company's outstanding shares on an exchange, proceeding to delist it (a buyout). The fund is advised on which investments to pursue by a PE firm, the General Partner (GP). The GP is effectively a fund manager, also raising capital for subsequent funds. When a PE firm is looking to start a new fund, considerable time is allocated to fundraising. Investors that allocate their capital to the fund are known as Limited Partners (LPs) and such capital providers include pension funds, (ultra) high net worth individuals and university endowments. The investment is made through committing capital that can be drawn upon (called) by the GP when investments are made and at any point in the funds lifetime. PE funds' lifetimes are usually eight to ten years, where investments are typically made during the first four to five years. Investment horizons are usually also four to five years, so that the fund liquidates its positions (makes exits) during the latter half of the lifetime of the fund. Returns are usually paid out to LPs as exits are made. Hence, PE is an illiquid asset class and the timing of payouts affect the annualised internal rate of return (IRR).

The GP charges the LPs various fees for managing the fund. Firstly, there is a management fee that usually ranges in the interval 1.5-2% of the total fund size and is paid annually. The management fee goes towards paying salaries for the employees of the GP and other administration costs such as legal fees and due diligence work. Second, when PE fund performance is good (defined as returns above a pre-determined hurdle rate), the GP charges an additional fee (carried interest) which is usually approximately 20% of the profits above the hurdle. Carried interest is the main component of income for GPs and is why PE can be a highly lucrative career even though personal investments in the funds by professionals are typically small. Carried interest is discussed further in Section 6.1.1. GPs also charge their portfolio companies certain fees, such as a transaction fee of approximately 4% on successful acquisitions and various monitoring and consultancy fees.

2.2 Private equity today

Since its inception in the 1980s, the PE industry has grown to become a crucial part of the financial sector. As of June 2014, private equity and venture capital assets under management amounted to approximately $3.8 trillion, up 11.9% (Preqin Ltd., 2015) on the previous year

and equivalent to roughly 4.9% of the world's combined domestic production (based on 2014 gross world product of $77.85 trillion, (The World Bank Group, 2016)). The current state of the industry follows significant volatility and transformation during the past decade. 2006 and 2007 saw the highest PE deal-making activity in the history of the industry and leverage reaching exceptionally high levels (Cross, 2013). In stark contrast, two years later, the global financial crisis resulted in the worst economic recession since the Great Depression of the 1930s. In the environment that followed, with the virtual stand-still of debt capital markets, there were concerns that portfolio companies and, indeed, PE firms themselves would default due to being unable to refinance unsustainable levels of debt.

In the years that followed, however, the PE industry proved its resilience, paying down debt and, eventually, exiting investments at better than expected rates of return. 2015 was the fifth consecutive year in which cash distributions to LPs were greater than capital calls, generating strong net positive cash flows. Consequently, LPs have substantially increased its allocations to PE and reinvested money back into PE funds. Since 2013, PE funds have raised $500 billion annually worldwide and uninvested capital, so-called dry powder, today amounts to a record $1.3 trillion. 2015 was the best environment for fund-raising since 2006. (Bain & Company, Inc., 2016)

Another trend, especially in Europe, is that LPs are preferring large-cap buyout funds to their smaller peers. 73% of capital raised by European buyout funds in 2015 was allocated to vehicles with a fund size of more than $1 billion, compared to 32% in 2010 (PEI Media Group Ltd., 2016). This is discussed in Section 6.

2.3 Measuring performance of private equity funds

2.3.1 IRR and investment multiples

Measuring PE performance can be approached in a variety of ways. The industry standard and most widely used metrics among GPs and LPs alike are the fund internal rate of return (IRR) and investment multiple (also referred to as money multiple, cash-on-cash, CoC, or money-on-money, MoM). IRR measures the LPs' annualised IRR based on fund contributions and distributions, net of fees and profit shares (carried interest) paid to the GP. In an active fund, in which all investments are not yet realised, the IRR calculation includes the estimated value of unrealised investments (referred to as the residual net asset value NAV) as at the most recent reporting date as a final "cash flow". The money multiple is the sum of all fund distributions expressed as a factor of all fund contributions and the NAV of unrealised investments, net of fees and carried interest.

Clearly, assumptions about NAV are an important source of uncertainty in performance evaluation of active funds. The practice of previous research with regard to the treatment of NAV varies. This paper uses stated NAVs in its analysis, as do Kaplan & Schoar (2005) and Harris, et al., (2014). Although Harris, et al., (2014) urge caution before including residual values in return calculations, excluding them, as Phalippou & Gottschalg (2009) do in certain cases, understates the returns. Furthermore, on average, NAVs have historically been conservative estimates of the final distribution to LPs (Brown, et al., (2015) and Jenkinson, et al., (2013)). Therefore, using the net IRR figures from Preqin for active funds (which includes NAV) may, in fact, be lower than future actual returns.

2.4 Previous literature

Literature on PE is a growing field, but studies at the fund level are quite rare, mainly due to the difficulty in obtaining data sets. Research concerning PE performance has largely been centred on PE as an asset class compared to public markets. Existing studies have, interestingly, come up with divided results. Despite the large and growing importance of PE, as discussed earlier, its success in delivering returns to investors remains controversial; in the research universe, there is no conclusive evidence of whether or not PE outperforms the market. The views on buyout funds' performance, especially, differ between studies. Recent studies, tending to be more reliable due to improved data quality, generally favour the view that PE outperforms the market (see Harris, et al., (2014), Robinson & Sensoy (2013), and Higson & Stucke (2012)), although there are criticisms of the benchmark used in these studies (Phalippou, 2012). Whatever the case, many authors note that there is a strong variation between funds. Higson & Stucke (2012), using a sample of 1,169 funds, found that capital-weighted IRR for buyout funds outperformed the S&P500 index by 5.44 percentage points annually but noted that only three of five funds performed better than the index. Efforts to explain the drivers of PE fund performance have been centred on a number of variables (see Aigner, et al., (2008)), as discussed by Di Lorenzo (2012). One of these variables, and also one of the few reliably measurable ones, is size.

2.4.1 Size and performance

While there is some research on the relation of PE performance and aggregate capital commitments to PE (fund flows) (see Kaplan & Schoar (2005), Kaplan & Strömberg (2008), and Robinson & Sensoy (2013)), previous research on the subject of PE performance in relation to fund size is quite limited.

The results of such studies are somewhat ambiguous. Kaplan & Schoar (2005) and Aigner, et al., (2008) find a negative effect of size, Gottschalg, et al., (2004) and Phalippou & Zollo (2005) suggest a positive influence, and Brigl, et al. (2008) manage to find no significant causation at all, neither do Ljungqvist & Richardson (2003) for BO funds. Yet there are some key studies, which shed light on potential relationships and showcase useful methodologies.

Kaplan & Schoar (2005) use a regression model to find a negative size effect on PE performance measured as public market equivalent (PME). Using also a quadratic specification of their model, the authors find a concave relationship between fund size and performance, with an ideal fund size of $90 million. That is, larger funds have higher PMEs but for funds larger than $90 million performance declines. The authors also account for the sequence number of funds. While these findings are interesting, the data set is comprised of both VC and BO funds and is more than a decade old, covering the years 1980-2001. Furthermore, the data is comprised only of American partnerships.

Aigner, et al., (2008) find that both gross PME and gross IRR decrease with fund size (expressed as a logarithm) and also find evidence for the concave relationship in Kaplan & Schoar (2005), yet with a smaller optimal fund size of €24 million.

Humphery-Jenner (2012) studies 1,222 US VC and BO funds, finding a negative relationship between size and performance (measured as IRR). The theoretical model presented focuses on investment size as a driver of returns and how large funds are ill-suited to making investments in small companies. Another paper by the same author, referenced in this paper, describes the benefits of diversification in private equity (Humphery-Jenner, 2013).

Higson & Stucke (2012) find a weak positive relationship between fund size and performance when using a (merged) data set of 1,169 US buyout funds from 1980 to 2008.

Harris, et al., (2014) study the performance of almost 1,400 US buyout and VC funds. For buyout funds, the authors do not find a significant relationship between performance and size.

3 Theory and hypotheses

From a theoretical standpoint, two opposing forces with regard to fund size affect returns.

3.1 Motivation for a size advantage in Private Equity

First, skilled GPs will attract more investors and be able to raise larger funds. Larger funds benefit from scale benefits, such as in screening investment opportunities, and enjoy higher bargaining power in transactions. Also, returns of larger funds, by nature, are less impacted by costs and management fees. Finally, large funds will often have superior relationships

with capital providers (viz. banks), which allow them to obtain better financing terms. These factors combined suggest that there must exist a positive relation between fund size and performance.

Another important consideration is the foci of the funds. Industry and geographic diversification can be a source of increased returns (Humphery-Jenner, 2013). Larger funds may be more suited to these types of diversification strategies, being able to invest in more companies, and hence achieve better performance.

It could be argued that large PE funds in Europe should be better able to capture the size advantages than their North American counterparts. Larger heterogeneity between different European countries than between US states could be a reason for why such things as regional offices (which only large funds have) and more analytical capacity would impact returns positively to a greater extent than in the US. This could prove especially useful when merging companies from different countries or rolling out businesses in different geographies.

3.2 Motivation for a size disadvantage in Private Equity

Yet there are other effects that stem from fund size. Larger funds have to either make bigger transactions or more transactions in order to invest the higher amount of capital raised. In the first case, larger companies tend to be more professional and efficient (Taymaz, 2005) so there are naturally less improvement opportunities for the fund to execute on. In the second case, the fund will be impaired by a lack of profitable transactions.

Furthermore, Humphery-Jenner (2012) suggest that small funds have a first-mover advantage in acquiring small companies. Because small funds are not capable of as large acquisitions as large funds, their set of potential investments is much smaller than for the larger funds. Thus, the small funds need to look for potential targets in the pool of small companies before the large funds do so, which results in picking the best investments and leaving less attractive investments in small companies for the larger funds. In other words, large funds will gain lower returns from their investments in small companies than small funds.

Another disadvantage of size is that small funds will have fewer portfolio companies. Thus, for large funds, staff and especially partners are assumed to spend less time on each portfolio company (Aigner, et al., 2008); average number of staff per dollar under management decreases significantly with size (see Table B.1 in Appendix B). Staff levels are a key reason for potential underperformance, since the entire raison-d'être of PE is the claim that skilled professionals are able to improve businesses and deliver better returns than the public market.

A further potential source of underperformance is wasteful spending. For non-financial companies, anyway, higher cash flows tend to lead to more of wasteful spending, which is referred to as the free cash flow hypothesis (Jensen, 1986). It stands to reason that a fund that has raised a lot of capital has to make use of all the money, thus risking suboptimal investment decisions.

3.3 Summary and hypotheses

As mentioned, there are both advantages and disadvantages to size in PE. Still, earlier research has found that the disadvantages outweigh the advantages (see Section 2). The objective of this paper is to ascertain whether these results can be replicated on European data and, as far as the data permits, compare these effects between the European and North American markets. Due to some benefits of scale specific to Europe, such as rolling out businesses across geographies (discussed above), differences in performance is hypothesised to be less pronounced in European data than in US data. The key focus of this paper, however, and its main contribution to research will be to investigate the existence of a size disadvantage in the European market.

In summary, the main hypothesis to be tested in the analysis below is that:

H1: Larger buyout funds are outperformed by smaller funds.

and the second hypothesis to be tested is that:

H2: Outperformance is less pronounced in Europe than in North America.

4 Data and methodology

4.1 Empirical analysis

The purpose of this paper is to examine PE fund performance in relation to fund size. To fulfil such an aim, careful data analysis is required. The data set necessary for the project has been compiled through thorough research and is described below. For statistics, Microsoft Excel and STATA have been used for data analysis.

4.2 Data set

Performance measures and fund features for this study have been collected from the Preqin database. Preqin is the most cited source of data in alternative assets and has won a number of industry awards, including a 2016 CAIA Corporate Recognition Award. Preqin includes both aggregated and individual data on PE fund performance, such as IRRs and money multiples, as well as fund features such as vintage year and size. Preqin uses the Freedom of Infor-

mation Act legislation in the UK and US to collect performance data from public pension funds that invest in PE vehicles, also sourcing information via direct contact with industry professionals. Preqin's data includes full metrics for more than 7,600 named vehicles and in terms of capital raised covers 70% of all funds raised historically.

When using databases such as Preqin, it is of high importance to reflect upon whether or not risks for selection biases are a threat to the credibility of the information. For many databases on PE, an industry known for its secrecy, the information is gathered by the voluntary contribution of information by the funds. In such cases, selection bias would occur if, for instance, only the funds satisfied with their returns chose to disclose their information. (Kaplan & Schoar, 2005), for example, discuss the potential biases inherent in private databases of fund performance. The authors use data from the discontinued database Venture Economics and the study includes a discussion of a bias towards underreporting by worse-performing funds and, consequently, a downward bias on persistence. Since Preqin is not solely dependent on information provided by PE funds themselves, but also retrieves its data in accordance with public disclosure requirements, the risk of such selection biases is minimised.

The sample covers the years 1985-2013. In the years up to 1989, the number of funds is very limited. The Preqin data for each fund includes performance measures and for the fund's lifetime. These measures are: distributed total value to paid-in capital (DPI), residual value to paid-in capital (RVPI), net multiple on invested capital (MoM), internal rate of return (IRR), benchmark net IRR (based on fund type, geography and vintage year), quartile (determined by performance in relation to benchmark IRR). Note that all these metrics are presented net of fees and carried interest. This study uses the net IRR as this metric is comparable across funds and includes a time factor. Using IRR is connected with certain difficulties (see Lerner et al., 2012), but two things in particular support using it: (1) It is by far the most commonly used performance metric among LPs and GPs (2) A number of previous studies use IRR as a measure of performance (see for example Humphery-Jenner (2012)).

The data set also includes fund size, which has been converted to US dollars where applicable, and sequence number, which is inferred from the fund name or calculated according to the number of previous occurrences of a certain GP's name.

4.2.1 European sample

The Preqin database contains a total of 7,936 funds. When limiting the sample to buyout funds only, the number is reduced to 1,782. The number of European funds, excluding those whose main geographic focus is not Europe, is 532. In line with other research, funds whose

main industry focus is real estate or infrastructure are excluded from the analysis. Finally, funds without data regarding IRR and/or fund size were removed from the sample, resulting in a data set containing 406 funds. The vintages (the year in which the first investment of a fund is made) of the funds included were in the range 1985-2013.

The data set is novel and important for a number of reasons: (1) Preqin is a paid subscription service, to which very few people in the research field have access (2) Preqin has reliable and comprehensive data for most years, appropriate for research (3) A data set consisting of European funds has never been assembled and tested in the way proposed below and confirmatory results of the hypothesis would constitute an important starting point for further research and understanding of the European PE industry.

4.2.2 North American sample

Applying the same selection criteria to funds whose geographical focus is North America yields a total number of 857 funds. The larger number of North American funds is due to a number of reasons. First, the US private equity market (which makes up almost the entire North American market) is in a more mature stage compared to Europe. Also, small partnerships are more prevalent in the US than in Europe, where large firms dominate, which is believed to contribute to the higher number of funds. Finally, the total size of the market is larger in North America than in Europe. As an illustrative example, the aggregate value of private equity-backed buyout deals in 2014 was $181 billion in North America and only $94 billion in Europe (Preqin Ltd., 2015).

4.3 Methodology

In order to test the main hypothesis, the data set described above is subjected to various statistical methods of testing.

If a size disadvantage exists, results should indicate that larger funds underperform smaller. Funds are classified according to their size expressed as the logarithm of committed capital in US dollars. The analysis is performed both on the entire data set and sub samples split by quartile and various time periods.

While some studies (see for example Kaplan & Schoar (2005)) use public market equivalent (PME) as a benchmark of performance, there are three key reasons why this paper uses IRR instead: (1) The purpose of this paper is not to investigate private equity's relative performance to other asset classes (2) While US performance data lends itself well to using PME since a nationwide stock market exists (the S&P 500 index is widely used), defining an appropriate European PME is less straightforward (3) As mentioned above, IRR is the primary

metric by which industry professionals measure performance. Thus, findings denoted in IRR are likely to have a stronger resonance with industry practitioners.

4.3.1 Regression model specification

The regression model method is used in most previous literature on PE fund performance (see for example Kaplan & Schoar (2005) and Harris, et al., (2014)). Some authors (see for example Humphery-Jenner (2012)) include as many factors as possible in an attempt to model performance. Due to the limitations of the data set and the aim of this paper, this paper includes only as many as are needed to confirm the significance of one of these factors: fund size. In other words, the model presented below is not concerned with a high explanatory power and does not attempt to explain all variations in a fund's performance. The model specification includes sequence number as a variable, which is an attempt to separate some of the effects embedded in the observation of fund size. These effects include potentially greater cumulative experience among staff in high-sequence funds, which are almost exclusively larger. This is a similar approach to the one taken by Kaplan & Schoar (2005) and also lessens the risk of omitted variable bias.

The regression is run on the entire sample using the following regression specification:

$$IRR_i = \beta_0 + \beta_1(\log Fund\ size_i) + \beta_2(\log Sequence\ number_i) + \varepsilon_i$$

where IRR is the annualised return to investors net of fees (as defined above), log Fund size is the logarithm of committed capital in millions of dollars and log Sequence number is the logarithm of the sequence number of the fund. Using the logarithm of the sequence number, first funds (i.e. where the sequence number is one) do not affect the metric. All specifications include heteroscedasticity-consistent standard errors.

Section 5.3 includes variations of this specification that take into account vintage year fixed effects and explores non-linear variations of the regression model specification. Specifically, it includes the logarithm of size squared, i.e. a quadratic regression.

5 Results

5.1 Descriptive statistics

5.1.1 European sample

The general descriptive statistics of the sample exhibit quite large cross-sectional variation (see Table 1). Of the 406 funds included in the sample, the smallest fund had raised $8 million and the largest fund had raised $15,728 million. Average fund size was $1,207 million,

but standard deviation is large at $2,121. On average, investors received 1.76x their original investment with an average net annualised return of 17.1%. Again, standard deviation is high at 20.0% for net IRR. The most successful fund returned 5.88x the investors' original investments and yielded 239.8% annually. The worst performing fund returned only 0.18x the original investments and had -43.0% annual returns. Clearly, the variation in the sample is very high both when it comes to performance and size.

Segmenting the funds according to their size (see Table 2), trends begin to appear. The first quartile (smallest 102 funds), with an average size of $81 million, had an average net IRR of 24.4% and an average net multiple of 2.07x. The fourth quartile, on the other hand, with an average size of $3,803 million, had an average net IRR of only 14.0% and an average net multiple of 1.60x. Since average fund size has grown over time (see Table 3), it is instructive to compare returns across years as well as size.

The seven funds in the sample of vintages between 1985-1989 had an average fund size of $280 million, average returns of 21.3%, and an average net multiple of 2.35x. While the 1980 subsample is small, and hence care should be taken not to draw any far-reaching conclusions, there is still a clear trend in terms of size, IRR, and multiple in the following decades. In the 1990s, average fund size was $589 million, average IRR was 19.8%, and average multiple was 2.02x. In the 2000s, average fund size rises to $1,354 million, average IRR falls to 17.6%, and average multiple to 1.77x. Finally, in the 2010s, average fund size rises to $1,628 million, average IRR falls to 10.1% and the average multiple falls to 1.44x. While these results certainly could indicate that larger funds may have a harder time delivering high returns, it could also be that the market has changed; a large part of the 2000s saw a roaring bull market, which would have driven up average returns, while the 2010s (funds with vintages between 2010-2013 in this sample) were mostly dismal years characterised by the aftermath of the financial crisis and the European debt crisis.[1] This cyclicality is the main reason why the analysis needs to include year fixed effects (see Section 5.3.2).

Nevertheless, there is a clear difference between the largest funds and the rest. Table 4 illustrates this clearly: average net IRR for the largest 25% of funds is 4.2% lower than for the rest. When comparing the largest half of the sample to the rest, the differences are even larger. This is interesting because it implicates that the decline in performance is high also for the

[1] Another factor, which may have lowered average returns, is the more mature stage the PE market has entered in recent years. Industry professionals refer to "low-hanging fruit", simple fixes that yield high returns. These low-hanging fruits are no longer as prevalent and competition between funds has increased.

second quartile (the second largest group of funds) and thus it is not only the largest group of funds that underperform, rather it seems that the smallest funds outperform

5.1.2 North American sample

Table 1 contains the general descriptive statistics of the North American sample. Mean size is $1,101 million and standard deviation is of a similar size to the European sample at $2,152 million. Average net IRR is 15.1% for the entire sample with a standard deviation of 17.5%.

Dividing the sample into size quartiles (see Table 2) does not result in the same clear-cut trends as were evident in European data. The same is true when dividing the sample by decade (see Table 3). However, comparing the differences in average returns between the top 25% and the rest and the top and bottom halves, as above (see Table 5), small funds seem to still perform better on average. The differences are not as large as in the European data, however.

5.1.3 Summary

Comparing the two sets of data, European funds are on average larger with slightly higher returns, albeit with a higher standard deviation. This is unsurprising and most likely reflects the more mature stage of the North American market. In such conditions, one would expect returns to be somewhat lower and more contracted towards the mean

Interestingly, the trends in terms of returns and size over the decades is much less clear (if it even exists at all) in the North American data. Also, while the comparison made above between the top 25% and the rest and the top and bottom halves certainly indicate the size disadvantage hypothesised, the differences are smaller in North America than in Europe. This is not supportive of the second hypothesis presented above and could potentially indicate that the link between size and returns is not as robust in North America. The regression model below quantifies this relationship further.

Table 1

General descriptive statistics

	European sample						North American sample					
	Mean	*Median*	*SD*	*Min*	*Max*	*N*	*Mean*	*Median*	*SD*	*Min*	*Max*	*N*
Size ($m)	1,206.558	417.264	2,120.79	7.805	15,727.890	406	1,101.462	418.000	2,152.06	2.485	20,365.000	857
Net multiple (x)	1.755	1.620	0.778	0.180	5.880	398	1.778	1.620	0.850	0.020	8.550	828
Net IRR (%)	17.136	13.100	19.962	-43.000	239.800	406	15.095	13.100	17.493	-69.000	221.500	857

Note: The table above shows the general descriptive statistics of the buyout funds included in the two geographical samples. Both samples exhibit large cross-sectional variation, both in terms of size and performance.

Table 2

Means by fund size

	European sample					North American sample				
	All	*1st quartile*	*2nd quartile*	*3rd quartile*	*4th quartile*	*All*	*1st quartile*	*2nd quartile*	*3rd quartile*	*4th quartile*
Size ($m)	1,206.558	81.308	278.607	680.140	3,802.530	1,101.558	115.033	308.339	656.613	3,330.472
Net multiple (x)	1.755	2.074	1.697	1.653	1.602	1.778	2.046	1.789	1.617	1.665
Net IRR (%)	17.136	24.405	15.474	14.661	13.955	15.095	16.241	16.686	16.686	14.218
N	406	102	101	102	101	857	215	214	214	214

Note: The table above shows the mean size and performance statistics of the buyout funds included in the two geographical samples, divided into quartiles. There is a greater distribution of fund size in Europe; the smallest quartile value is lower and the largest is higher than in North America. In Europe, at least, performance seems to worsen with size. In North America, the trend is not obvious.

Table 3

Means by vintage year grouped into decades

	European sample				North American sample			
	1980s	*1990s*	*2000s*	*2010s*	*1980s*	*1990s*	*2000s*	*2010s*
Size ($m)	279.523	589.275	1,353.641	1,627.588	631.370	658.796	1,370.246	1,097.531
Net multiple (x)	2.350	2.023	1.767	1.220	3.177	1.854	1.798	1.339
Net IRR (%)	21.300	19.841	17.607	10.084	24.656	14.876	14.425	15.706
N	7	88	256	55	27	239	443	148

Note: The table above shows the mean size and performance statistics of the buyout funds included in the two geographical samples, divided by the decade in which the fund began to invest. Average fund size in Europe was smaller up until the 2010s. In Europe, average performance has decreased dramatically over the years. In America, average performance is relatively flat since the 1990s.

Table 4

Differences in means by fund size in the European sample

	Total (1)	*Top 25% (2)*	*Bottom 75% (3)*	*(4 = 2 – 3)*	*Top 50% (5)*	*Bottom (50%) (6)*	*(7 = 5 – 6)*
Size ($m)	1,206.558***	3,802.530***	346.908***	3,455.622***	2,233.644***	179.472***	2,054.173***
Net multiple (x)	1.755***	1.602***	1.806***	-0.204**	1.628***	1.884***	-0.257***
Net IRR (%)	17.136***	13.955***	18.189***	-4.233*	14.310***	19.962***	-5.652***

Note: The table above shows the average values of size and performance. Column 1 contains all funds. Column 2 (Column 5) contains funds whose size is in the top 25% (top 50%) of all funds. Column 3 (Column 6) contains funds whose size is in the bottom 75% (bottom 50%) of all funds. Columns 4 and 7 contain the differences between Columns 2 and 3 and Columns 5 and 6, respectively. ***, **, and * denote significance at 1%, 5%, and 10%, respectively, using a t-test for means or a two-sample t test for difference in means. Smaller funds outperform larger funds on average, both when comparing the top 25% with the bottom 75% and when comparing the top and bottom halves.

Table 5

Differences in means by fund size in the North American sample

	Total (1)	*Top 25% (2)*	*Bottom 75% (3)*	*(4 = 2 – 3)*	*Top 50% (5)*	*Bottom (50%) (6)*	*(7 = 5 – 6)*
Size ($m)	1,101.462***	3,330.472***	359.614***	2,970.858***	1,993.542***	211.461***	1,782.081***
Net multiple (x)	1.778***	1.665***	1.816***	-0.151**	1.642***	1.917***	-0.275***
Net IRR (%)	15.095***	14.218***	15.386***	-1.169	13.723***	16.463***	-2.741**

Note: The table above shows the average values of size and performance. Column 1 contains all funds. Column 2 (Column 5) contains funds whose size is in the top 25% (top 50%) of all funds. Column 3 (Column 6) contains funds whose size is in the bottom 75% (bottom 50%) of all funds. Columns 4 and 7 contain the differences between Columns 2 and 3 and Columns 5 and 6, respectively. ***, **, and * denote significance at 1%, 5%, and 10%, respectively, using a t-test for means or a two-sample t test for difference in means. Smaller funds outperform larger funds on average, both when comparing the top 25% with the bottom 75% and when comparing the top and bottom halves, but the differences are much less pronounced than in the European sample and there is no acceptable level of significance when comparing the IRR of the top 25% against the rest.

5.2 Statistical tests

5.2.1 European sample

The main regression results, applying the simple linear regression (defined in Section 4.3), supports the first hypothesis. The results show that performance does indeed decrease with size (see Column 1 in Table 6). The coefficient of interest is -2.301 and is significant at the 1% level. This is an important result. The interpretation of the results in Table 6 is that a 1% increase in fund size decreases net IRR by 0.023 percentage points. The sign and t-value of the coefficient of interest is encouraging. With regards to magnitude, while the coefficient may seem small, it is important to reflect on the large variation in fund size. A GP managing a successful $200 million fund might conceivably raise a second $1,000 million fund, increasing fund size by 400% and rendering large negative effects on returns. Note that the model specification by no means explains the majority of the variation in returns between funds. With an R-squared value of just 4.30%, it is only useful for testing the hypothesis as described. Clearly, there are countless variables that impact buyout fund returns but identifying these are beyond the scope of this paper. What the results of this regression confirm, though, is that size is indeed one of these variables.

While size has been shown to have a significant negative impact on results, the independent variable sequence number does not show significance at either the 1%, 5% or 10% level. The logarithm of the sequence number is proposed by Kaplan & Schoar (2005) as a proxy for GP experience. Including the variable in its logarithmic form ensures that the first fund (sequence number one) has no effect on returns. Intuitively, this seems a good approach. Judging by the results, however, it would seem that the sequence number does not manage to capture any significant higher returns due to GP experience. The sample, when looking at sequence number, is heavily skewed to the lower end since many firms only raise one or two funds (see Table A.1 in Appendix A).

Another possible effect captured by sequence number could be differences in risk-taking between new and established partnerships. Funds that are new to the industry might take excessive risks in an attempt to generate higher returns and establish themselves in the market. Giot, et al., (2014) do not find any evidence of this for buyout funds. Hence, this variable does not deliver any information about risk-taking.

Further results of variations on the model specification are discussed in Section 5.3. The negative impact of size is significant also when including year fixed effects.

5.2.2 North American sample

With the same model specification as above (see Column 1 in Table 7), the logarithm of size has a significant negative impact at the 1% level also in the North American data. The coefficient is -1.303, roughly half that of the European sample. This is a surprising result and contradictory to the second hypothesis. The model fit is also much lower than for the European sample. This could be due to the larger sample size, but might also indicate that other factors play a larger role in North America.

Again, sequence number is not significant and the results permit no immediate conclusions to be drawn. Therefore, no heed should be paid to the fact that the coefficient for the logarithm of the sequence number is negative in Europe and positive in North America.

Further results of variations on the model specification are presented in Section 5.3. At the 5% level, the negative impact of size is no longer significant when absorbing each vintage year but significant when absorbing by decade.

5.3 Robustness tests

5.3.1 Regression model test statistics and assumptions

The simple linear regression on the European data yields a low P-value of 0.2% for Log(Size). This means that even at the 1% level the null hypothesis (i.e. that size has no effect on returns) can be rejected. The P-value of the same regression on the North American data is 2.0%. Hence, the robustness is not as strong as for the European data but the P-value is still lower than the critical value of 5% and the results are thus acceptable from this standpoint.

5.3.2 Vintage year fixed effects

The sample exhibits large intra-year variations. As discussed, year fixed effects are one key reason why one would expect IRR to become lower with time and, as shown, fund size increases in parallel to this. In order to control for cyclical differences between the years and diminishing returns as the industry matured, the model presented in Section 4.3.1 is run with absorbing indicators for each individual vintage year and also for the vintage years grouped into decades. The results of these regressions are presented in Columns 2 and 3 in Tables 6 and 7.

In the European sample, importantly, the coefficient of the size variable is negative and significantly separated from zero at the 1% and 5% levels when absorbing by decade and by vintage year, respectively. Remembering that the t-statistic of the main regression model

(simple linear) was -3.050 (1% level), the t-statistic drops to -2.090 (5% level) when absorbing each vintage year and to -2.850 (1% level) when absorbing decades.

The results of the regression on the North American sample were slightly weaker in the simple regression, with a t-statistic of -2.340, but still significant at the 1% level. Absorbing by decades, the results are still significant at the 5% level with a t-statistic of -2.250. When absorbing vintage years, however, the results are no longer significant even at the 10% level. These findings indicate that the result of the main regression may in part be the result of year effects. Specifically, average fund size was smaller in the earliest years in the sample while average returns were higher (as mentioned).

These results show that the results of the main regression are still robust, at least in Europe and to a certain extent also in North America. The confidence intervals are separated from zero and overlap, hence the negative impact of size on return is independent of vintage year fixed effects (bar when absorbing vintage years in the North American sample). The likely reason for the higher level of significance achieved when absorbing by decade rather than year is that the sample size is too small to allow for such a high number of absorbing indicators. Grouping vintages into decades when running a fixed effects regression reduces the number of categories and hence the effect on degrees of freedom.

5.3.3 Cyclicality in fund raising and performance

The regression specification above is one way of accounting for the differences in economic climate between the years. Another is to include a dummy variable for years with a booming economic climate and inflated valuations, "bubble years". Such a variable is included in the model presented by Humphery-Jenner (2012). Funds essentially must invest their capital in the first few years of their life, in order to generate high enough returns. Since PE targets are largely valued according to public market sentiment[2], funds that start investing in a bubble will suffer due to buying into high valuations and selling once the bubble has burst. Incidentally, fundraising activity tends to be high during such bubbles. Additionally, this indicator captures some differences in risk-taking since leverage and the share of highly-levered transactions spike heavily during bubbles. In the period which this sample covers, there were two distinct bubbles that affected the PE industry: the Internet bubble of 1999 to 2000 and the so-called 'Golden Age of Private Equity' 2006 to 2008.

[2] For the target firm, an initial public offering (IPO) is an alternative to being acquired and for the acquirer an IPO is a possible way to exit the investment.

The new regression model specification becomes:

$$IRR_i = \beta_0 + \beta_1(\log Fund\ size_i) + \beta_2(\log Sequence\ number_i) + \beta_3(Bubble_i) + \varepsilon_i$$

where Bubble is an indicator that equals 1 if the fund's vintage is from 1999 to 2000 or from 2006 to 2008. Note that Humphery-Jenner (2012) only includes an indicator for the earlier of the two periods.

The results of this regression are presented in Column 4 in Tables 6 and 7 and show that, in the European sample, there is a large and significant negative impact of beginning to invest in bubble years. In the North American sample, the coefficient is much smaller and the results are significant only at the 5% level. This is a surprising result, since both the Internet and Golden Age bubbles for all intents and purposes originated in the US. One would expect to see a larger impact in the North American data for this reason. On the other hand, if the US were hit harder than Europe, funds may have been discontinued or gone bust (hence not included in the data set), resulting in selection bias.

5.3.4 Potential non-linear relationships

The results described in section 5.2 show that size, indeed, has a significant negative impact on returns. However, Kaplan & Schoar (2005) and Aigner, et al., (2008) found a concave relationship. That is, the largest funds will perform worse than a linear model predicts. As can be seen from the specification of the model in Column 5 in Tables 6 and 7, no such relationship exists in this study. In fact, the opposite is true. The coefficient of the squared logarithm of fund size is positive and significant (5% level in the European data and 10% level in the North American data). This suggests a convex relationship between fund size and returns. Larger funds perform worse, but when funds become very large, performance improves. The results of the quadratic regression allow for a calculation of the scale necessary to enjoy size advantages. Solving for the global minimum yields a fund size of $2,526 million in Europe and $1,406 million in North America. That is, funds with a size above roughly $2.5 billion and $1.4 billion in Europe and North America, respectively, begin to perform better than their slightly smaller peers. Note that these results, while statistically significant, are difficult to reconcile with the descriptive statistics presented in Tables 1-5.

The probable reason for not finding the concave relationship discovered by Kaplan & Schoar (2005) is that their study includes VC funds in their data and VC is a much less scalable business model than buyout (Di Lorenzo, 2012). Indeed, the authors do not find significant results in evidence for the concave relationship when testing only the buyout funds in

their sample. Aigner, et al., (2008), who also find a concave relationship, also include various types of private equity funds in their sample.

It is important to note that including only size, and hence omitting a large number of potential explanatory variables, make the results unreliable and one must be careful to draw conclusions.

Table 6

Fund performance and fund characteristics (European sample)

	Dependent variable: Net IRR (Internal Rate of Returns)				
Log(Size)	-2.301***	-1.700**	-2.259***	-2.007***	-12.206**
	(0.754)	(0.814)	(0.793)	(0.719)	(5.026)
$Log(Size)^2$					0.779**
					(0.367)
Log(Sequence)	-1.932	-0.617	-0.962	-2.450	
	(1.648)	(1.715)	(1.772)	(1.625)	
Bubble dummy				-9.089***	
				(1.671)	
Year F.E.	No	Yes	Yes (decades)	No	No
(Adjusted) R^2	0.0430	0.1426	0.0414	0.0918	0.052
No. of observations	406	406	406	406	406

Note: The dependent variable is cumulative annualised IRR (Internal Rate of Return), net of fees. Size is the dollar amount of committed capital of a fund. Sequence is the sequence number of a fund. The value of Bubble dummy is equal to 1 for funds with vintages between 1999 and 2000 and 2006 and 2008.
Standard errors are shown in parentheses adjusted for heteroscedasticity. ***, **, and * denote significance at 1%, 5%, and 10%, respectively, using a t-test.

Table 7

Fund performance and fund characteristics (North American sample)

	Dependent variable: Net IRR (Internal Rate of Returns)				
Log(Size)	-1.303***	-0.786	-1.232**	-1.189**	-6.301**
	(0.558)	(0.519)	(0.548)	(0.550)	(3.141)
$Log(Size)^2$					0.421*
					(0.233)
Log(Sequence)	0.771	-1.370	0.850	-0.655	
	(0.999)	(0.934)	(0.999)	(0.993)	
Bubble dummy				-2.096**	
				(1.042)	
Year F.E.	No	Yes	Yes (decades)	No	No
(Adjusted) R^2	0.0077	0.0814	0.0112	0.0110	0.0110
No. of observations	857	857	857	857	857

Note: The dependent variable is cumulative annualised IRR (Internal Rate of Return), net of fees. Size is the dollar amount of committed capital of a fund. Sequence is the sequence number of a fund. The value of Bubble dummy is equal to 1 for funds with vintages between 1999 and 2000 and 2006 and 2008.
Standard errors are shown in parentheses adjusted for heteroscedasticity. ***, **, and * denote significance at 1%, 5%, and 10%, respectively, using a t-test.

6 Implications and conclusions

6.1 Discussion

The PE industry is an important part of the global financial system and, naturally, the European sector is an important part of the European one. Despite this, the amount of research, especially on European PE data, is very limited. This study has analysed reliable and extensive data on PE fund performance in both Europe and North America and shown that larger fund size has a statistically significant negative effect on returns. The results are in accordance with the main hypothesis presented earlier in this paper and hold up to a number of checks. Previous US studies have discussed conditions and factors that make fund size affect returns (see for example Humphery-Jenner (2012)). The results in this study suggest that similar market conditions exist also in Europe.

Nevertheless, the European market has its own unique characteristics. Hence, it was argued earlier in this paper that the negative impact of fund size would be smaller in Europe than in North America. For example, a US PE fund would probably have little trouble rolling out a business across state lines, while a successful roll-out in Europe requires significant experience and knowledge of specific geographical markets. This knowledge was believed to be more likely to be found at a large fund. Comparing the results of the regression models (see Tables 6 and 7), however, this is not the case. Thus, the second hypothesis is rejected. The same conclusion is evident from comparing the differences in mean net returns between the top 25% funds and the rest in the different geographies (see Tables 4 and 5). The results indicate that the opposite is true; European buyout funds suffer more from size disadvantages than their North American counterparts. Future research that investigates the conditions that make size disadvantages larger in Europe would be highly interesting. Possibly, there are local advantages in Europe that smaller funds enjoy to a greater extent. Heel & Kehoe (2005) discuss informational advantages enjoyed by local investors investing in local companies, for example. The occurrence of such an advantage would worsen the situation for large international PE firms in cross-border transactions, given that they do not have a local office in every market.

While the aim of this paper was to analyse the European PE industry in an attempt to find a size disadvantage, the findings on the North American market are also important. Some previous studies that separate their results into BO and VC (such as Kaplan & Schoar (2005)) have found results in favour of a size disadvantage in both types of funds. The findings of this study show that concluding that such a disadvantage exists within North American BO is

more problematic. With certain controls, there is a lack of significant coefficients and the results in the European sample are generally more robust. This is more in line with the findings of Harris, et al., (2014).

In order to check for cyclical effects in another way than using a regression with absorbing indicators, a bubble indicator was added to capture the effects of starting the fund in an overheated market. The benefit of using such an approach to absorbing indicators is that the added variable also works as a proxy for (excessive) risk-taking. In addition, market activity in terms of the number of funds in the market spikes during these bubble periods, which confirms the usefulness of including such an indicator. The results of the regression including the bubble indicator (see Column 4 in Tables 6 and 7) still confirmed the size disadvantage observed in previous model specifications.

6.1.1 Conflict of interest between GPs and LPs concerning fund size

The private equity business model (described in Section 1.1) has an inherent conflict between investors (LPs) and fund managers (GPs). The LPs' primary concern is a high percentage return on invested capital. GPs, on the other hand, are concerned with high IRRs but only in order to attract investors.[3] GPs often invest in (and earn returns from) their own funds, but the majority of their income derives from management fees and carry. Since both carry and management fees are based on actual capital and not return rates, GPs have an incentive to increase fund size even at the expense of returns. This is corroborated by Lopez-de-Silanes, et al., (2015) who make the interesting observation that high-performing funds exhibit a tendency to remain smaller and low-performing funds to raise more capital in subsequent funds in order to compensate for their lower returns through higher management fees.

The findings of this study (and previous studies too, see Section 2.2) suggest that LPs should invest in small funds, since these deliver higher returns. But since most investors in PE are sizeable institutions (such as pension funds, sovereign wealth funds, and university endowments etc.), it is not surprising that they continue to invest in large funds. These institutions need large ticket sizes (the amount invested) in order to allocate their capital under management and simply do not have the capacity to research and perform diligence checks on enough small funds to make up for the smaller ticket sizes. Also, larger funds are more likely to have strong IR teams with access to investors. Hence, one should not expect to see a

[3] Investment relations teams at PE firms will typically go 'on the road', promoting their funds through showcasing IRR delivered to investors compared to benchmarks rates.

large shift in allocation towards smaller funds anytime soon. Note that the comments in this section are the views of the authors of this study.

6.2 Limitations to this study and suggestions for future research

This study makes a contribution to research primarily because of the extensive and high quality data set used. The results confirm the findings of earlier studies, that a size disadvantage exists, but also show that there are differences in the magnitude of this disadvantage between the European and US markets. Nevertheless, there are drawbacks to the data used and also limitations to the methodology.

First, some studies include a large set of control variables (including industry focus, investment size, and regional GDP growth rates among others). With regard to the economic climate, the varying economic performance of different European markets make this approach less straight forward than for US data. This is especially true for large funds, which invest in many different geographies. Further, the data to which this study has had access does not include information about investment size and industry focus, making this approach impossible. Future research could make use of e.g. CapitalIQ in order to find and control for such characteristics. This paper includes a dummy variable for the bubble economies of 1999-2000 and 2006-2008 to capture the most obvious effects.

Especially industry focus is thought to be an important driver of returns (Phalippou & Zollo, 2005). Furthermore, it may be the case that larger funds tend to have a specific industry focus (for example refraining from investments in certain industries). This would cause some endogeneity, violating the assumptions underlying the linear regression model. However, most buyout funds in Europe do not focus exclusively on one industry but rather four or five or even lack an industry focus altogether. This is true also for many mid-market funds. For instance, Procuritas Partners, the Swedish mid-market buyout firm, invests in a wide range of companies in sectors including business services, retail and distribution, general industrials and healthcare. PAI Partners, the French large-cap buyout firm, also invests in all of these sectors – as do EQT and Triton, two other large-cap buyout firms, based in Sweden. Hence, while controlling for industry focus is certainly preferable, it may not yield very different results to the ones presented above.

Another factor, which is not accounted for, is the main geographical focus of the funds in terms of country. Previous research views Europe as one homogenous market although there are sure to be differences between the countries. However, most funds have a pan-European

or regional focus and financial markets are highly interconnected.[4] Yet research that separated any potential local advantage and the size effect would be a valued addition to the field.

Second, the Preqin performance data includes only cumulative return metrics. Most importantly, net IRR is presented only in the form of annualised cumulative returns over the funds' lives. Panel data, including year-by-year returns, would permit time series analysis measuring abnormal returns. Also, cyclicality issues could be better captured with such data. This would be an interesting angle on future research. It is very unlikely, though, that a large and reliable data set of this description even exists or would be made available for researchers.

6.3 Summary

The initial aim of this paper was to confirm the presence of a size disadvantage in European data, as observed by a number of previous studies in the US. The hypothesis that a size disadvantage exists in the European private equity market was successfully confirmed and held up to a number of checks. A secondary aim of the paper was to investigate the relative magnitude of the size disadvantage in the European and North American data. Due to European market being less homogenous, it was hypothesised that differences in performance between funds of different sizes would be less pronounced in Europe than in North America. The results of this study were in contradiction to this hypothesis. In fact, there seem to be larger size disadvantages in Europe as well as a larger variation in performance overall. These results are novel and interesting and should provide a basis for future research on the subject.

[4] Financing is oftentimes provided by banks not native to the fund's country and many LPs are based abroad.

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Appendix A: Sample data set

Table A.1

European PE firms included in the sample

Firm	*Funds*	*Firm*	*Funds*	*Firm*	*Funds*
3i	6	Egeria	2	Murray Johnstone	2
Accent	2	Electra	1	MUST	3
Actera Partners	1	Emerging	1	N+1	1
Advent	5	EQT	5	Nash Sells	1
Aksia	1	Equistone	4	NBGI	1
Aliante	2	Erhvervsinvest	2	NiXEN	1
Alpha	5	Euroknights	3	Nordic Capital	7
Altor	3	European Acquisition Capital	1	NorthEdge Capital	1
AnaCap Financial Partners	2	Excel Capital Partners	1	PAI	4
Apax	7	Exponent Private Equity	1	Partenaires	1
Arcadia	1	Fenno Skandia	1	Partners Group	3
ARX	1	FSN Capital	3	Pechel Industries	3
Astorg	2	GEM	2	Perfectis	1
AtriA	1	German Equity Partners	1	Permira	12
Auctus	3	Gilde	3	PHD Equity Partners	1
August Equity Partners	2	GMT Communications Partners	2	Phildrew Ventures	2
Avallon	2	Graphite Capital Partners	5	Phoenix Equity Partners	5
AXA	8	Gresham	2	Polaris	3
Axcel	4	Growth Capital Partners	1	Polish Enterprise	6
Bain Capital	3	Halder	3	Portobello Capital	1
Baird Capital Partners	1	HarbourVest	1	Pragma Capital	2
BaltCap	1	Herkules	3	Primary Capital	3
Bancroft	1	HEV	1	Private Equity Partners	1
Baring Vostok	2	HgCapital	3	ProA Capital	1
BC	6	Hickory	1	Procuritas	4
Bencis	1	Hicks,	1	Progressio Investimenti	1
Bowmark Capital Partners	2	HitecVision	2	Prospect	1
Bridgepoint	4	HSBC	2	Qualitas	1
Butler	1	I&F	2	Quartus Capital Partners	1
Candover	6	ILP	3	Rhone	3
Capiton	3	Inflexion	3	Riverside	4
CapMan	4	Innova	4	RJD	1
CapVest	1	Inter-Risco	1	Segulah	4
Capvis	3	Intera	1	Sentica	3
Caravela	1	Investitori Associati	1	Sinergia con Imprenditori	1
Carlyle	4	ISIS	2	South Eastern Europe	2
CBPE	3	Italian Private Equity	3	STAR	1
Change Capital	2	Kairos Partners	1	SU	1
Charterhouse Capital Partners	6	Kings Park Capital	1	Syntegra Capital	3
Chequers Capital	2	KKR	4	TDR Capital	3
Ciclad	4	LBO	2	Terra Firma Capital Partners	3
Cinven	5	Lead Equitites	2	Third Causeway	1
Clessidra Capital Partners	2	LGV	5	TowerBrook	1
Close Brothers	2	LHV	1	Trident	2
Clyde Blowers	1	Lion Capital	3	Trilantic Capital Partners	1
Compass Partners	1	Litorina Kapital	3	Triton	2
Consilium	1	Livingbridge	2	Turkish Private Equity	2
Constellation	1	Lyceum Capital	1	UFG	1
Corpfin Capital	1	Magnum Capital	1	V4C	1
Credit Suisse First Boston	1	Main Capital Partners	2	Vaaka Partners	2
CVC	6	Mandarin Capital Partners	1	VDCapital	1
Darwin	1	MBO Capital	2	Vision Capital Partners	1
DBG	1	MCH Iberian Capital	2	Vitruvian	1
Deutsche	1	Mid Europa	4	Waterland	5
DGPA Capital	1	Middle Market	1	White Knight	3
DKB	1	Midinvest	2	Xenon	1
Doughty Hansen & Co	5	Milestone	1	Zeus	1
Duke Street Capital	3	Montagu	2		
ECI	5	Morgan Grenfell Equity Partners	1		

Note: The table reports the names of the 175 PE firms in the Preqin database with active buyout funds in Europe between 1985 and 2013, with the number of funds per firm. The total number of funds is 406 and the average number of funds per GP is 2.3.

Table A.2

North American PE firms included in the sample

Firm	*Funds*	*Firm*	*Funds*	*Firm*	*Funds*
1818	2	Founders Equity	1	Novacap Industries	2
Riverside	10	Fox Paine Capital	2	Oak Hill	4
21st Century Group	1	FPC	1	Oaktree	1
ABRY	7	Francisco Partners	3	OCM/GFI	2
Accel-KKR	2	Fremont Partners	2	Odyssey Investment Partners	2
ACI Capital	1	Friedman Fleischer & Loewe	3	OFS	1
ACON	2	Frontenac	6	Olympus	5
Acon-Bastion	1	FS Equity Partners	4	ONCAP	3
Advent	7	Fulcrum Capital Partners	3	Onex Partners	2
AEA	7	Furman Selz Investors	2	Palladium Equity Partners	3
AG	2	GEAM	1	Parallax Capital	1
Allsop	1	Generation Capital Partners	1	Parthenon Investors	4
Alpine Investors	1	GenNx360	2	Performance Direct Investments	1
Altaris	1	Genstar Capital Partners	3	Perseus	3
Altus	2	GF Capital	1	Persistence Capital Partners	1
American Industrial Partners	9	GI Partners	4	Pfingsten	1
Apax	1	Gilbert	1	Platinum Equity	3
Apollo	6	GKH Investments	1	PNC Equity Partners	1
Aquiline	2	Glencoe Capital	3	Progress-Lovell Minnick	1
Arbor	1	Golder Thoma Cressey	8	Providence	7
Ares	4	Goldner Hawn	1	Quad Partners	4
Arlington Capital Partners	1	Goode	1	Quad-C Partners	4
Arsenal Capital Partners	3	Gores Capital	4	Quadrangle	2
Artemis Capital Partners	1	Graham Partners	5	Relativity	1
Atlantic	1	Great Point Partners	1	Reliant Equity Partners	1
Audax	4	Green Equity Investors	9	Renovus	1
Aurora	4	Greenhill	3	RFE Investment Partners	4
Avista Capital Partners	3	Grey Mountain Partners	1	Ridgemont	1
Azalea	2	Gridiron Capital	1	Ripplewood Partners	2
Bain Capital	7	Gryphon Partners	5	Riverlake	2
Baird Capital Partners	4	GS Capital Partners	6	Rizvi	2
Baker Communications	1	Halifax	3	RLH Investors	3
Bank Portfolio	1	Halpern & Denny	1	RLJ Equity Partners	1
BankCap Partners	2	Halyard Capital	2	RoundTable	1
Bastion Capital	1	Hamilton Robinson	2	Saratoga Partners	1
Beacon Group	1	Hampshire Equity Partners	2	SB	1
Beecken Petty O'Keefe	2	Hancock Park Capital	2	Seaport Capital Partners	3
Behrman Capital	3	Harbert	1	Searchlight	1
Berkshire	5	Harbinger	1	Seidler Equity Partners	4
Bertram	2	Harbour Group	4	Sentinel	1
BG Media Investors	1	HarbourVest	3	Service Equity Partners	1
Birch Hill	2	Harren Investors	2	SG Growth Partners	1
Bison Capital	1	Harvest Partners	2	Shamrock Capital	2
Blackstone	7	HCI Equity Partners	2	Short Vincent Partners	2
Blue Point	4	Healthcare Equity Partners	1	Silver Lake Partners	5
BLUM Strategic Partners	2	Hellman & Friedman	5	SK Capital Partners	2
Boston Ventures	6	Heritage	3	SKM Equity	1
Brantley Venture Partners	1	Hicks, Muse, Tate & Furst	3	Snow Phipps	2
Brazos	1	HIG Capital Partners	6	Sorenson Capital	2
Brentwood Associates	4	High Road Capital Partners	3	Southvest	2
Brera Capital Partners	1	Highcrest Partners	1	Southwest Opportunity Partners	1
Brockway Moran & Partners	3	HKW Capital Partners	3	Spectrum	1
Bruckmann Rosser Sherrill	2	HMTF	1	Spire Capital Partners	2
Brynwood Partners	1	Horizon Capital Partners	2	Sterling	8
Bunker Hill Capital	1	Huntsman Gay	1	Stonehenge	2
Calera Capital	1	ICV Partners	2	Stonington Capital	1
California Community	1	Imperial Capital	4	Summer Street Capital	2
Caltius Equity Partners	1	Incline	1	SunTx Capital Partners	2
Calvert Street	3	Industrial Growth Partners	4	Swander Pace Capital	2
Capital Partners	3	ING	2	Symphony Technology Group	1
CapStreet	1	Insight Equity	2	T3 Partners	2
Carlyle	6	Intervale Capital	2	TA	4
Carousel Capital Partners	1	Inverness Partners	2	Tailwind	1
Castle Harlan Partners	6	Investcorp	1	TCW	3
Catterton Partners	4	Irving Place	2	Tennessee Valley Ventures	1
CCMP	1	JC Flowers	1	Texas Growth	4

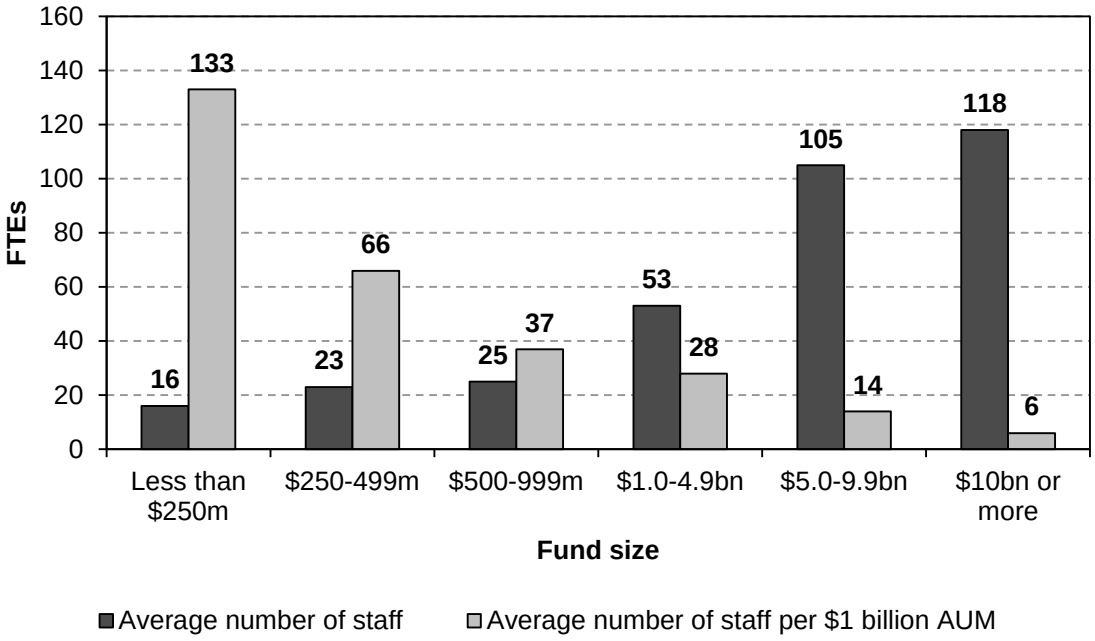
CEA Capital Partners	1	JF Lehman	1	The Resolute Fund	2
Centerview	1	JLL Partners	4	Thoma Bravo	3
Centre Investors	3	Joseph Littlejohn & Levy	2	Thoma Cressey	3
Century Park Capital Partners	2	Juggernaut	1	Thomas H Lee	5
CGW Southeast Partners	2	JW Childs	2	Thompson Street	2
Charlesbank	3	Kainos Capital Partners	1	Three Cities	1
Chart Capital Partners	4	Kelso Investment Associates	4	Ticonderoga	1
Charterhouse	2	Kidd Kamm	1	Torquest Partners	1
Chartwell	1	Kirtland	3	TowerBrook Investors	2
Chicago Growth Partners	2	KKR	6	TPG Partners	5
Chisholm	1	Kohlberg Investors	7	Trailhead	1
CHS	1	KRG Capital	4	Transportation Resource	2
CID Capital	1	KSL Capital Partners	2	Triad Ventures	1
CITIC	1	Lake Capital Partners	3	Trident	3
CIVC Partners	1	LaSalle Capital Group	1	Trilantic	3
Clarion Investors	1	Lee Equity Partners	1	Triumph	2
Clarity Partners	2	Leeds Equity Partners	2	Trivest	1
Clayton Dubilier & Rice	7	Lehman Brothers	2	Trumpet	1
Clearview Capital	2	Levine Leichtman	7	TSG	3
Code Hennessy & Simmons	4	Levmark Capital	1	Tuckerman Capital	3
Commerce Street	1	Liberty Partners	7	US Equity Partners	2
Consonance	1	Lightyear	3	Valor	2
Corinthian	1	Lincolnshire Equity	3	Vance Street	1
Cortec Group	5	Linden Capital Partners	2	Vector	3
Cotton Creek	1	Lindsay Goldberg	3	Veritas Capital	4
Court Square Capital Partners	3	Linsalata	4	Vestar Capital Partners	6
Credit Suisse First Boston	1	Littlejohn	4	Vestor Partners	1
Cressey & Co	1	LLR Equity Partners	3	Vista Foundation	5
Crestview Partners	2	LNK Partners	2	VMG Equity Partners	1
Cypress Merchant Banking	2	Lombard Nogales	1	VS&A Communications	3
DFW Capital	2	Lone Star	3	VSS Communication Partners	1
Diamond Castle Partners	1	Lovell Minnick	3	Wafra	1
DLJ Merchant Banking Partners	3	Madison Dearborn	6	Wand	1
Dogwood	1	Mainsail Partners	1	Wasserstein Partners	1
Dominus Capital	1	Marwit	1	Water Street	2
DW	1	Mason Wells	3	Waud Capital Partners	1
Edgewater	1	McCown De Leeuw & Co	2	Wellspring	4
Elevation Partners	1	MCM Capital	2	Welsh Carson Anderson Stowe	7
Encore	1	MidOcean Partners	1	WestView	1
Endeavour Capital	4	Milestone Partners	3	Whippoorwill Vega Partners	1
Energy	1	Mill Road Capital	2	Whitney	5
Enhanced Equity	1	MMV	1	Wicks Capital Partners	3
Eos Capital Partners	2	Monitor Clipper	2	William Blair	1
Equitable	2	Monument	1	Willis Stein & Partners	3
Eureka	3	Morgan Stanley	3	Wind Point Partners	8
Evercore	2	MSouth	2	Windjammer	1
Evergreen	2	MTS Health Investors	3	Windward	1
Excellere Partners	2	Narragansett Capital Partners	1	Wingate Partners	5
Falconhead	2	Nautic Partners	1	Winona	1
Falfurrias	2	New England	3	WPG	1
FdG Capital Partners	2	New Mountain Partners	4	Wynnchurch	3
Fenway Partners	3	North American	1	Yellow Wood Partners	1
Flexpoint	2	North Castle Partners	2	Yucaipa American Alliance	2
Forstmann Little	6	North Haven	1	ZMC	1
Fortress Investment	4	Noson Lawen	1		

Note: The table reports the names of the 362 PE firms in the Preqin database with active buyout funds in North America between 1985 and 2013, with the number of funds per firm. The total number of funds is 857 and the average number of funds per GP is 2.4.

Appendix B: Additional material

Table B.1

Average number of staff by fund size



Source: Preqin, Ltd.

Note: The table shows the number of full time equivalent employees (FTEs) and the number of FTEs per $1 billion in assets under management (AUM). While larger funds also have higher levels of staff, they have proportionately less so that they have less staff per dollar invested.