DRY POWDER IN PRIVATE EQUITY

HOW DOES IT RELATE TO PERFORMANCE AND WHAT ARE THE IMPLICATIONS FOR INVESTORS?

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Abstract:

Although average returns are decreasing in the PE industry, fund sizes are increasing more than ever, as more and more capital is poured into the industry. The amount of uncalled capital, known as dry powder, has recently hit record-high levels. This paper aims to invest how the return of PE funds correlates with the amount of dry powder left at liquidation. The hypothesis is that there may be a tendency among managers of the fast-growing PE funds to invest close to all committed capital either by pursuing extra projects or by spending it on trying to save failing ones - even though it may have been optimal to do neither one of them. Using an OLS-regression test, we test how the IRR to limited partners correlates with dry powder left at liquidation. We also test how different strategies for deploying dry powder could affect the return. Our results show that the final IRR to limited partners correlates positively with the amount of dry powder left at funds' liquidation. Furthermore, we find no correlation between the IRR and the number of investments pursued. Results are significant on a 0.1% level when controlling for size, industry, strategy, and year. The results show that funds with more dry powder left at liquidation have had a stronger performance than those with less and that the number of investments does not affect return to investors. This indicates that funds who have deployed all committed capital may have done so either by paying too much in acquisitions or by trying to save failing investments, resulting in a lower IRR.

Key words:

Private Equity, Dry Powder, IRR, Fundraising, Cost of equity

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1. Introduction

1.1. An overlook of the private equity industry

The return to limited partners investing in private equity funds has been decreasing compared to benchmarks over the last 20 years (Appelbaum and Batt 2016). Despite this, rapidly increasing amounts of capital are being committed to private equity funds, with former peak years being the years before the financial crisis between 2003 and 2007. These years are known as "the golden age of private equity." Loose credit markets and enhanced risk-taking drove the vast increase in fundraising during these years (Rizzi 2009), leading up to the PE industry later suffering from a significant downturn during the financial crisis in 2008 when the PE bubble burst. The industry became smaller, and firms with substantial portfolio legacy problems had trouble raising new funds and had to be liquidated (Rizzi 2009).

Today it seems as if the PE industry has forgotten about the hard downturn, considering the present global economic environment, which is, to some extent, comparable to the one leading up to the crisis. Today the credit markets are favorable, and there is enhanced risk-taking by investors, and fundraising has once again reached record levels. Furthermore, the amount of uninvested capital in PE funds, known as dry powder, reached an all-time high in 2017 and seems to be concentrated in the largest funds (Bain Global Private Equity Report, 2018). While the average fund size has been increasing, average returns to private equity have steadily decreased.

Prior research on the size-performance relationship of Private Equity is extensive but inconclusive. Several studies have shown a negative or concave correlation between size and return, while others have indicated the relationship is insignificant or that a positive relationship between the two exists. In conclusion, there is an obvious need for additional research on the field.

Our research aims to dig deeper into the increasing average sizes of funds, the decreasing returns, and the increased amounts of dry powder in the PE industry. The goal is to examine how dry powder and the net return to investors are correlated, and whether the strategy of pursuing more investments to deploy capital is correlated with return to investors.

1.2. Research Focus and Delimitations

We suggest that the increasing amounts of capital in conjunction with greater competition has driven fund managers to either invest more capital than predicted, invest in more companies, or a combination of the two in order to deploy more of the

committed capital. The rationale behind this theory is that the increasing fund sizes and stiffer competition are making it hard to find suitable investments, and at the same time, maintain a manageable number of investments. Therefore, we should see that successful funds have left money uninvested, having decided not to invest all the available capital. The less successful funds should then tend to either invest more in their planned acquisitions or turn to additional investments. This could partly explain the decreasing returns to investors.

Consequently, this study aims to examine the relationship between the uninvested capital's share of the total capitalization and the funds' return to investors, and thereby answer the following research questions:

- Is there a correlation between a fund's performance and its share of committed capital that remains uninvested?
- Is there a correlation between private equity funds' performance and the investment choices made by managers regarding the number of investments pursued?

To narrow the scope of our study, we make delimitations as below:

- We limit our data to a sample of US funds between 1990-2007.
- We focus our research on venture capital and buyout funds.
- We limit the "investment choices" to the more specific variable "number of acquisitions pursued." We argue it is one of the most relevant parameters since it captures decisions that fund managers need to make when faced with increased amounts of committed capital. Should they engage in more investments and risk that they are suboptimal in order to deploy all capital (optimize capital utilization), or should they leave some capital uninvested and use their resources as efficiently as possible (optimize resource utilization).

1.3. Definitions

Buyout fund (BO): A type of private equity fund strategy that uses investors' capital and leverage to acquire other companies, often with the intention of improving their operations and later selling them.

Committed capital: The amount of capital invested in the fund by the limited partners and general partners.

Deployment rate: The share of committed capital that is invested by managers, expressed as a percentage of the total commitments.

Dry powder: The committed capital or cash equivalents in a fund that has not been invested.

General Partner (GP): The firm managing the private equity fund. It usually also has the highest share of money invested in the fund. Makes all the decisions for the fund, including the number of investments pursued.

Gross Internal Rate of Return (Gross IRR) to LPs: The return on investment before fees to GPs are deducted.

Limited Partner (LP): Investors who commit capital to a private equity fund. Together they have committed a majority of the total committed capital, they are however passive when it comes to decision-making. Common examples of LPs are pension funds and insurance companies.

Merger and acquisition (M&A): The consolidation of companies. Mergers are usually the consolidation of two companies into one, while an acquisition implies one company taking over another.

Net Internal Rate of Return (Net IRR) to LPs: The return limited partners get from the PE fund when fees to GPs are deducted. These fees are usually a management fee of 2% of total committed capital and a performance fee of 20% of the fund's profits.

PE fund: Unlisted fund that is usually active for a period of 10-12 years.

Return spread: The difference between gross IRR and net IRR. Often used as a way to measure costs in private equity investing.

Venture capital fund (VC): A private equity fund that mainly targets and invests in start-ups with high growth potential and high risk.

2. Background

2.1. Features of the PE industry

The private equity industry consists of funds investing in equity securities and private companies. When speaking about the business model of private equity, the term is used to describe the operation of taking a company into ownership for reconstructions, in order to later sell it with a profit. There are many different kinds of PE funds, but the investment is typically accomplished by a BO fund, a VC firm, or a real estate fund. Of these, the most common are BO and VC funds. Each fund belongs to a specific firm, which can have multiple funds operating simultaneously.

The PE funds are established by investors who have invested their money. These are known as limited partners (LPs) and general partners (GPs). General partners normally have several years of experience from other PE firms and the banking or consulting industries before starting a fund. This is of importance since GPs are responsible for the overall management and administration of the firm, which means their knowledge helps them understand the process of value creation and operations improvement in companies. In addition, they usually have an extensive network that can aid them in raising funds and finding attractive targets. GPs typically commit 1-5 percent of the fund's entire equity. The rest of the equity is committed by LPs, who are not involved with the fund management. GPs are usually compensated for their work by a fixed management fee of 2%, of the fund's total capital committed, along with a performance fee that is around 20% of profits, known as carried interest.

The limited partners usually consist of institutional investors, including corporate and public pension funds, endowments, and insurance companies, as well as wealthy individuals (Kaplan and Strömberg, 2009).

The investments are typically made with an investment horizon of five to ten years but can be extended for up to three additional years. A PE firm typically has up to five years to invest the fund's capital into companies, and then an additional five to eight years to return the capital to its investors (Kaplan and Strömberg, 2009).

The industry is to a great extent cyclical, with returns and the ability to fundraise being deeply dependent on market conditions. In times when interest rates are unusually low relative to fundamentals, firms tend to increase borrowing, and when equity markets are overvalued firms tend to raise more equity (Gompers, Kaplan and Mukharlyamov, 2016). With the low-interest rates in today's market, investors are thus relying increasingly on equity, hoping for better returns. As a result, the average PE fund size is increasing, implying increased competition for investments. Also, global dry powder has reached record levels.

2.2. The Cyclicality of PE and its impact on cash flows

According to Robinson and Sensoy (2011), fluctuations in public and private equity markets move together. For example, the VC boom and bust in the late 1990s and early 2000s was accompanied by the rise of the high-tech internet era, and the buyout boom of the mid-2000s corresponded with high public equity valuations and low-cost debt financing. The implications of this co-cyclicality for PE cash flows and fundraising has been investigated by many. For instance, Kaplan and Strömberg (2009), find evidence for counter-cyclicality in fundraising and performance. According to them, the IRR of buyout funds raised in boom eras is worse than the IRR of funds raised in bust periods. Robinson and Sensoy (2011) found the same result, that high private equity fundraising could forecast low private equity cash flows and low market returns. Hence, they suggest a positive correlation between private equity net cash flows and public equity valuations.

The implication from this is that dry powder may be a significant asset for PE funds, especially in bust periods, where it can be used to make profitable investments.

2.3. Costs of the PE asset class

Braun and Stoff (2016) argue that there are three main drivers of the cost of PE investing, affecting the return spread between LPs and GPs. These costs are partly interacting, being: fund terms, fund gross performance, and GP investment behavior. The most obvious of these being fund terms since that is the main determinant for GP compensation in terms of fees. Normally, these are about 2% per year in management fees and 20% in carried interest in excessive fund profits beyond a preferred return to LPs (Braun and Stoff, 2016). Fund terms interact with the second driver of PE investment costs - gross fund performance. This, as fund terms determine the level of minimum gross return before GPs receive carried interest. To illustrate, consider a fund where the minimum return is reached. For this fund, elevated gross returns will imply higher performance-based compensation for GPs and consequently higher costs for LPs.

The third driver is GP investment behavior, generally expressed as a fund's deployment rate, which is the committed capital invested by managers, expressed as a percentage of the total committed capital. The relevance of GP investment behavior becomes evident when considering funds with different deployment rates, and how they affect the fees LPs pay to GPs in relation to the amount of capital the GPs actually invest, known as the *effective management fee.*

Braun and Stoff (2016), illustrate the cost of GP investment behavior with a simple example:

"Assume a USD 100 million fund with a 2% management fee for a five-year investment period, which consequently receives USD 10 million in fees for this period. If the GP is able to also invest USD 100 million (equivalent to a gross deployment rate of 100%), the return spread of USD 10 million fees amounts to 0.1xMM (USD 10 million/USD 50 million). Effectively, a deployment rate of only half the committed capital implies a doubling of the effective management fee percentage to 5% for the capital employed."

Concluded, in absolute numbers the management fee to general partners is the same in both cases. However, for the limited partners, the cost in comparison to how much capital they get invested varies a lot.

2.3.1. The History of Dry Powder - Is it an Overlooked Driver of Cost?

Dry powder has become an increasingly important issue, particularly since 2006 due to the extensive fundraising that occurred in the PE industry the years prior to the financial crisis. These raised funds then faced low M&A activity the following years in the recovering market. As a result, dry powder increased excessively on a global scale from USD 796 billion in 2006 to USD 1,318 trillion in June 2015 (Braun, Stoff 2014). The increased amounts of dry powder signal a reduction of good investment opportunities increased uncertainty and LPs that are eager to invest money. Consequently, the PE industry experiences higher competition for investment opportunities, resulting in a significant price increase for new investment opportunities.

The enhanced level of competition in the industry has resulted in GPs wanting to keep cash reserves in order to be able to act fast in the event of a sudden investment opportunity appearing. Consequently, an increased search time for GP:s for potential targets has been shown (Ljungqvist and Richardson, 2003; Inderst and Mueller, 2003), which increases the amounts of dry powder even further. For LPs, the increased time from fundraising to investment naturally results in lower gross returns, as they have committed capital that is uninvested, and that they cannot invest in other opportunities.

Braun and Stoff (2016) argue that dry powder is a vastly overlooked driver of cost in the PE asset class, as they find that costs when controlling for gross fund returns (lower performance-based fees) have actually increased between the years of 1983 and 2007. This, in contrast with what should be expected, which is lower costs as the PE industry has reached increased market maturity.

Finally, research within dry powder is limited, since there are several difficulties in obtaining data. One reason is that the amount of dry powder is to a large extent self-reported, which implies a certain level of ambiguity in the numbers provided.

2.4. Differences between Buyout and Venture Funds

The main differences between the two forms of investing within Private Equity are the stage in which it is chosen to invest. While buyout funds invest mainly in mature companies that are already established, venture capital funds invest in early-stage companies that are usually associated with higher risk. Additionally, buyout funds usually acquire a majority stake in their investments, with the goal of being in total control of the firm after the buyout. Venture capital firms instead tend to invest in a smaller part of the equity, aiding firms with financing while being provided with a significant upside if the acquired firm proves successful. Due to the high risk in venture capital, they tend to prefer to spread their risk over many different projects. Naturally, BO funds thus tend to pursue larger companies, and VC funds smaller. According to Metrick and Yasuda (2010), the BO business model is also a more scalable one than the VC, which results in that also the sizes of the funds themselves tend to differ.

Bertoni, Ferrer, and Marti (2013) also concluded that VC funds on average perform better, as they tend to invest in smaller and riskier firms with higher growth rates. Although there are significant differences between the two industries, Phalippou and Zollo (2005) find a significant overlap between the two. In their research, they show BO funds invest up to 18% in VC, and correspondingly that VC funds invest 11% in BO.

2.5. Differences Across Industry Specializations

In the early stages of PE, funds typically invested in a large variety of sectors, not specializing in any specific industry. As the PE market matured, however, more and more funds have realized the advantages with industry specialization and chosen to act accordingly. Research has further shown that PE funds specializing tend to outperform generalists (Zweig, Auerbach and Tabares, 2014; Gompers, Kovner and Lerner, 2009). The different industry focuses, excluding generalists, tend to be quite similar in many ways, although some funds are unique. Bitsch, Buchner, and Kaserer (2010) find that funds specializing in infrastructure on average are larger, as their investments tend to require a lot of capital. Their deals usually also require longer time horizons, as the life of their assets on average is longer than for other specializations.

2.6. The Size-Performance Relationship in PE

2.6.1. Disadvantages with large funds

Many studies have investigated the size-performance relationship in the PE industry, and a concave relationship has repeatedly been observed. However, the theories as to why such a relationship exists are many, and research has not been conclusive. What is known, however, is that with increased capitalization, funds tend to engage in at least

one out of two strategies. They either pursue a higher number of investments or invest in larger companies.

In the case of investing in more companies, the GPs available resources for each investment will usually decrease. If PE firms add value by undertaking investments that require attention and resources by the GP, then smaller PE firms could potentially have an advantage (Lopez-de-Silanes et al., 2013). It has also been shown that as PE funds grow, their number of skilled GPs do not grow proportionally (Cumming, Siegel and Wright, 2007), further supporting the argument. Although one could assume that larger funds would have several advantages due to the more extensive knowledge pool, research indicates larger companies imply stricter hierarchy than smaller companies do, and more often disadvantages are emerging from communication difficulties (Lopez-de-Silanes et al. (2013)

The other strategy available for PE funds is to invest in larger companies. Supporting the argument, Robinson and Sensoy (2015) found that the size of a BO fund and the size of its portfolio companies are highly correlated. Following Humphrey-Jenner (2012), this a preferable strategy, since large BO-funds are better equipped to transform larger companies, while small funds should pursue small. Furthermore, funds tend to pursue companies in which they can centralize processes and improve administration (Bertoni et al., 2013). Large funds have demonstrated difficulties observing all divisions at once (Taymaz, 2005) and managing radical innovation (Leifer O'Connor and Rice (2001).

To conclude, both strategies to deploy capital entail disadvantages. The most significant being that more investments lead to fewer resources per professional as human capital does not increase proportionally, ineffective communication due to hierarchy and having a hard time to manage radical innovation.

2.6.2. Advantages with large funds

Although research indicates that large funds may earn lower returns than small ones, large funds do have plenty of advantages. First of all, they have superior connections with essential institutions such as investment banks, which may aid them in signing better deal terms (Hochberg, Ljungqvist and Lu, 2007; Hellman, Lindsey, and Puri, 2008; Hege, Palomino and Schwienbacher, 2009; Demiroglu and James, 2010). Second, they have a better chance of diversifying internationally (Cumming and Dai, 2010b). Since every country offers its favorable investment environments (Hege, Palomino, and Schwienbacher, 2009; Cumming and Walz, 2010), there is an excellent advantage in large PE-funds being able to select their investment environment to a greater extent.

2.7. Agency Conflicts in PE

With the increased competition in the PE industry, it has been more and more challenging to generate outstanding fund returns. Naturally, LPs, who invest money into

the PE funds, have been increasingly critical towards the GPs, who are responsible for finding and investing the LPs money in the best possible deals. The criticism has been noticed by academic literature, that has started to investigate the compensation structure between GPs and LPs (Litvak 2009), and the distribution between fixed and variable compensation (Metrick and Yasuda 2010), as well as the connection between the costliness of fund terms and net performance (Robinson and Sensoy 2013).

Since GPs usually receive a management fee of 2% on all committed capital from LPs, there is a clear incentive to raise as much capital as possible. Also, GPs have evident incentives to maintain low deployment rates since they thereby can extract more management fees for less work (Braun and Scott, 2016). In conclusion, in theory, it could be to be beneficial for GPs to keep high amounts of dry powder in the fund. Since levels of dry powder have increased rapidly in the last couple of years, this is an area of high interest. Extreme cases, known as “zombie funds”, have also been observed, providing practical implications for the theory. These being funds with almost no investments, simply extracting annual management fees from their funds (Braun and Stoff 2016).

2.8. Literature overview

Name of Article	Author/Date	Data	Most relevant findings
Are Lower Private Equity Returns the New Normal?	Appelbaum and Batt 2016	Buyout funds from 2006 - 2016	While median private equity buyout funds once beat the S&P 500, they have not done so since 2006.
Giants at the Gate: Investment Returns and Diseconomies of Scale in Private Equity	Lopez-de-Silanes, Phalippou & Gottschalg 2013	334 PE funds	PE firms' operations and actions do not seem mechanical or easily scalable. 1 in 10 investments does not return any money, while 1 in 4 has an IRR over 50%.
Private equity, leveraged buyouts, and governance	Cumming, Siegel and Wright 2007	U.K. management buyouts: 1982–2005	As PE funds grow, their number of skilled GPs does not grow proportionally.
Private Equity Performance: Returns, Persistence, and Capital Flows	Kaplan & Schoar 2005	1980- 2001, quasi-liquidated funds larger than USD 5m, VC and LBOs	The average fund returns are approximately equal to the S&P 500. Performance drivers are a previous good performance and a smaller size. The relationship is concave. At the industry level, market entry and fund performance are procyclical, but established funds are less sensitive to cycles than new entrants.
The Cost of Private Equity Investing and the Impact of Dry Powder	Braun and Stoff 2016	586 buyout funds, realized funds, from North America, Europe, and Asia	Return spreads have increased over time, while fund terms on average have been stable, implying GP investment behavior is a third, vastly overlooked driver of PE investment costs. Dry powder is an overlooked driver of cost in PE investing.
The Investment Behavior of PE Fund Managers	Ljungqvist and Richardson 2003	3,800 portfolio companies by hundreds of private equity funds. 1981-2001	Existing funds earn higher returns when investment opportunities improve and when demand for capital increases. Supply increases result in tougher competition for deal flow, and PE fund managers respond by cutting their investment spending.
What Drives Private Equity Fund Performance?	Phalippou & Zollo 2005	US and European Venture Funds between 1980-2003	Larger funds perform better. Fund performance co-varies positively with both business cycles and stock-market cycles.
What Drives PE? Analyses of Success Factors for Private Equity	Aigner, Albrecht, Beyschlag, Friederich, Kalepky & Zagst 2008	104 European funds between 1971-2007, of which 70% were liquidated	Years of experience is an important factor for top performing private equity GPs. Successful GPs pursue riskier investments. GDP growth, low-interest rates, small fund sizes are performance drivers in PE.

3. Hypothesis

Following previous research and reviewed literature on private equity performance related to size, which is not conclusive, we have formulated two hypotheses regarding the effect dry powder could have on performance:

H1: More dry powder left at liquidation is correlated with a higher net return

In line with this hypothesis, we present the idea that firms with less dry powder may have chosen to pursue a higher number of investments. To illustrate this, consider a firm that has pursued a certain number of investments they consider optimal or perfect. Do they choose to take on another investment, not as suitable as the other ones, just because they have money left to spend? To be able to confirm or reject this theory, we also test the correlation between the IRR and the number of investments pursued by a fund. If true, we should see a significant negative correlation between the IRR and the number of investments pursued. In case no such correlation is found, we suggest it may be the case that funds with less dry powder have not spent their extra capitalization on another investment, but either spent their dry powder trying to save failing investments, or they could have paid too much in acquisitions to start with. Both scenarios would also result in a lower IRR for the investments pursued, and hence a positive correlation between dry powder and IRR.

Also, based on previous research by Ljungqvist and Richardson, (2003), and Inderst and Mueller (2003), we suggest that PE firms pursuing a strategy to keep some dry powder enables them to act fast in the event of a sudden investment opportunity appearing. These firms would accordingly have a higher IRR at liquidation since they have been able to pursue optimal investment opportunities when they arise, instead of investing everything from the start as may be the case for those with no dry powder. This will, however, be hard to test and is outside of our scope for this paper.

Additionally, a positive correlation between dry powder and IRR could indicate that the rapidly increasing fund sizes between 1990-2005 have resulted in funds that are too big to be efficiently handled. As human capital, in general, does not increase proportionally to fund size (Cumming, Siegel and Wright, 2007), our suggestion is that funds that are pursuing less or smaller investments than other funds (leaving more dry powder) have had a more appropriate size of their investment team for their pursued investments, than funds investing their entire capitalization. They, therefore, have a higher IRR on their pursued investments.

H2: There is a negative or nonexistent relationship between funds' dry powder left at liquidation and net return to investors

The rationale in case the regression results in a negative relationship is based on the agency conflicts in PE. The argument is that GPs may intentionally keep low deployment rates since they earn a 2% management fee on total committed capital. Therefore, there is an incentive to commit as much capital as possible, while not deploying all since they in that way collect higher fees for their invested effort in the fond (higher effective management fee). This incentive would result in funds with high amounts of dry powder (low deployment rates) performing worse than those with low amounts since their GPs do not act to maximize return, but rather to maximize their effective management fees.

Additionally, this hypothesis is supported by Braun and Stoff (2016), suggesting that dry powder is genuinely a fourth driver of cost in the PE industry. As the IRR in our data includes fees (both the management fee and the carried interest or performance fee), the IRR to investors would thus be lower for funds with high amounts of dry powder, as LPs have paid higher management fees in comparison to the investments made with their money.

In case no significant relationship is found, meaning the amount of dry powder at liquidation has no relationship with the return to investors, it would imply that the only cost for limited partners regarding dry powder is the need to retain enough liquidity to cover their commitments. This outcome would, similarly to H1, question the notion that dry powder is a major driver of cost for investors.

4. Data

The majority of the data used in the regression was collected from Bloomberg's Private Equity database. It was later manually combined with fund strategies extracted from the Thomson Reuter's database. The original dataset included 1580 funds. However, funds that were missing values were excluded, leaving us with a sample of 413 funds. We see no indications that the funds with missing values are systematic.

The dataset includes the following variables: Fund Name, Fund Manager, Industry, Vintage, Target Size, Committed Capital, Invested Capital, Dry Powder, and Net IRR. All variables are reported by the fund manager, except the net IRR, which is reported by LPs and calculated using their cash flows.

There are several issues when it comes to obtaining useful data on private equity in general. According to Harris, Jenkinson, and Stucke (2010), performance data only cover a small fraction of funds started, as funds who did not survive are not included in the performance measures. Moreover, there could be a particular bias to be expected when using self-reported data, as funds with poor performance may have sustained from reporting at all. However, we argue this performance bias is mitigated as the LPs report the net IRR, and not the GPs or fund managers, as is the case for the other variables. The incentives for misreporting IRRs are significantly smaller for LPs than GPs, as they have a smaller gain of reporting incorrectly. Also, all IRRs in Bloomberg are matched against the reports of other LPs of the same PE fund. In this manner, largely misreported performances are likely to be small.

However, survivor bias, which tends to plague standard private equity databases (Harris, Jenkinson, and Stucke, 2010) maintains an issue in this study as well. Continuing, we are therefore aware of that our results regarding IRR and dry powder are only for funds who have survived, implying that funds that have not found any investments at all (with extreme amounts of dry powder) are not included in our dataset.

4.1. Descriptive Statistics

Table 1 – Means for variables

Variable	Obs	Mean	Std.Dev.	Min	Max
Dry Powder	413	.041	.106	0	.911
Number of inv.	413	8.952	8.962	0	71
Net IRR	413	.10	.232	-.736	1.246
Size (USD)	413	5.41e+08	8.30e+08	5 000 000	8.00e+09

Table 2 – Means by size

Size	Net IRR	Dry Powder	Number of inv.
First quartile	.066	.022	5.055
Second quartile	.128	.041	7.879
Third quartile	.093	.047	9.696
Fourth quartile	.116	.054	13.369

Table 3 - Means by strategy

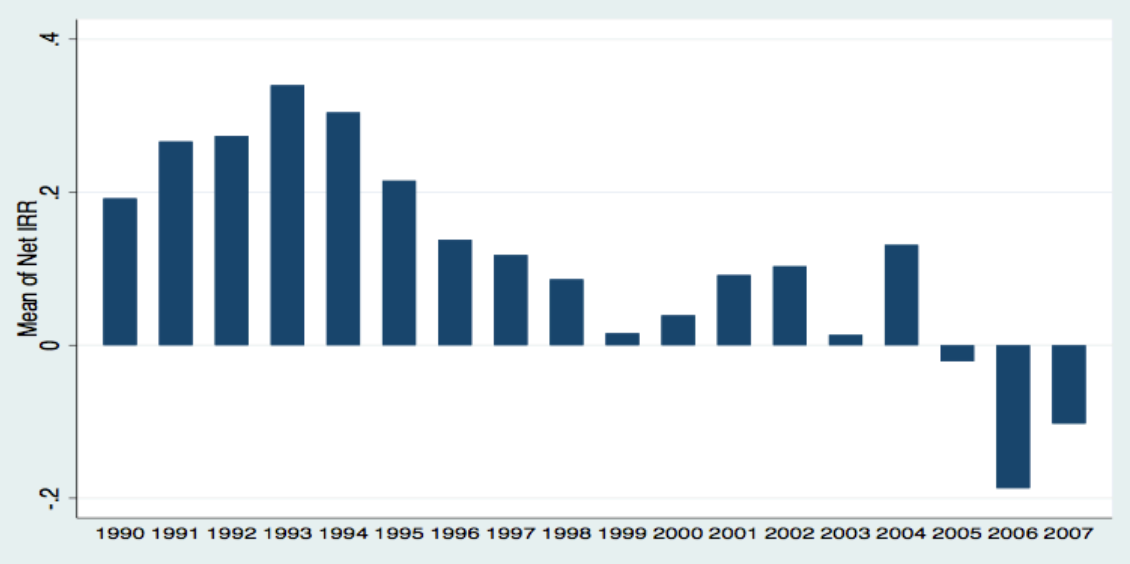
Strategy	Net IRR	Dry Powder	Number of inv.
Buyout	.087	.047	9.391
Venture Capital	.111	.03	8.974
Other	.103	.047	8.299

As we can see in table 1, there is a significant variation in the amounts of dry powder funds have reported; the smallest percentage reported being 0 and the largest 91.1. Many funds reported having zero dry powder, while only one had 91.1%. Consequently, the mean is at 4.1%. Furthermore, funds on average pursued about nine investments, with an average IRR around 10%, which in general can be considered standard numbers for the private equity industry. The sizes of funds ranged from USD 5 million to USD 8 billion.

Table two and three display that dry powder seems to be clustered in the largest funds and in funds pursuing either a buyout strategy or other strategies such as mezzanine or real estate.

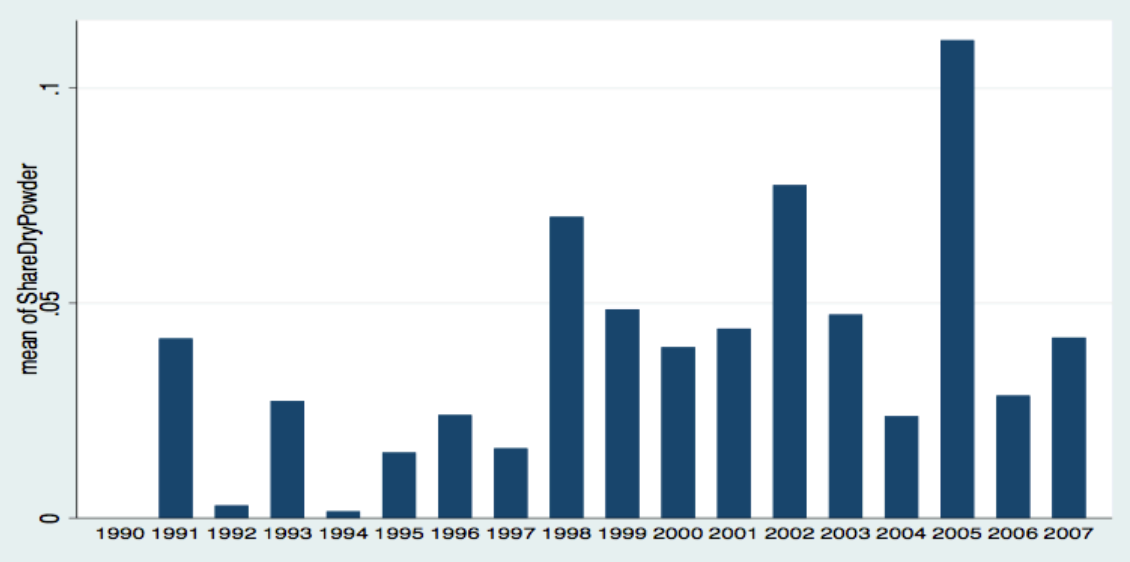
4.2. IRR, dry powder and fund size over the years

Figure 1 – Net IRR over Vintage



Note: net IRR to limited partners decreased between 1990-2007.

Figure 2 – Share of Dry Powder over Vintage

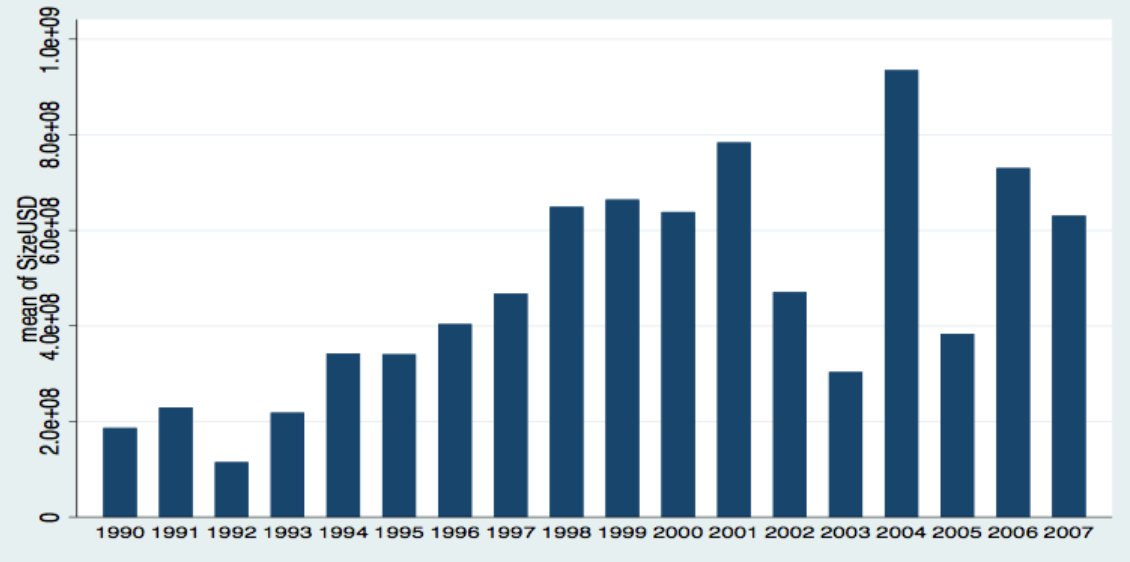


Note: Dry powder in relation to total commitments increased between 1990-2007.

As can be seen, dry powder was not much of an issue in the 1990s. Almost all funds deployed all committed capital, leaving none left at liquidation. These years, the IRR

was also significantly higher. This is likely to be due to the boom of the internet and tech industry, mostly affecting venture capital firms positively. Also, the level of competition in the PE industry was lower. As the PE market matured, the internet boom was over, and competition increased, the average IRR also decreased.

Figure 3 – Mean fund size over Vintage



Note: Average fund size increased between 1990-2007

In our data, we also see that the average fund size increased between 1990-2007. This increase is a result of the larger and larger amounts of capital poured into PE.

In conclusion, our data shows decreasing returns, increasing amounts of dry powder and a growing average fund size. Although these results are for the years of 1990-2007, a similar pattern is shown in today's market (2019), where we have hit record levels in fund size and dry powder, and returns to PE are decreasing.

5. Method

5.1. Variable selection

Variables/Dependents	Comment
Net IRR	Dependent variable; net Internal Rate of Return to investors
Dry Powder	Independent variable; Dry powder at liquidation as a share of total commitments
Number of investments	Independent variable; number of investments
Vintage	Dummy; year of liquidation
Venture capital	Dummy; funds employing a venture capital strategy
Buyout	Dummy; funds employing a buyout strategy
Industry	Dummy; what industry specialization the fund has
Smallest 25%	Dummy; the smallest quartile in our sample
Largest 25%	Dummy; the largest quartile in our sample
DPxBuyout	Interaction variable; sensitivity to increases in dry powder for buyout funds

5.2. OLS-regression and control variables

We use an OLS-regression to test our hypotheses, which is a type of linear least squares method used to estimate uncertain parameters in a linear regression model. In order for the regression to have optimal explanatory power and provide the maximum likelihood estimator, the error term has to be normally distributed. This was tested, and a histogram of the error variables can be found in the appendix (figure 7).

If we exclude all control variables, the primary regression to test our hypothesis is as below. It is in this test we will see whether there is any correlation between the dry powder and return, and the number of investments pursued and return.

$$\boldsymbol{Net\ IRR\ =\ \beta_0 + \beta_1 Share of Dry Powder\ +\ \beta_3 Number of investments\ + \epsilon}$$

We have then chosen to add control variables in order to see how the fractions of explained variance change as we add them. These control variables being industry, strategy, vintage, and size. The variables are chosen as we know return differs across industries, strategies, years and size. Therefore, we wanted to hold these effects still.

Also, we add an interaction variable to the table, since we expect the different investment strategies to differ in how sensitive they are to dry powder. Adding the interaction variable allows us to see whether, for example, buyout funds tend to be more sensitive than venture capital or other funds to increases or decreases of dry powder.

6. Results

6.1. Net IRR and its relation to dry powder and the number of deals pursued

Table 4 – OLS-Regression with interaction variable

Dependent var: Net IRR	Basis Model 1	Vintage Model 2	Strategy Model 3	Size Model 4	Industry Model 5	Interaction Model 6
Dry Powder	0.349***	0.450***	0.462***	0.440***	0.489***	0.982***
	(0.11)	(0.10)	(0.10)	(0.10)	(0.13)	(0.20)
Nr. of investments	0.005***	0.005***	0.005***	0.004***	0.004**	0.004**
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Vintage		-0.025***	-0.025***	-0.026***	-0.026***	-0.026***
		(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Buyout			-0.021	-0.024	-0.027	0.006
			(0.03)	(0.03)	(0.03)	(0.03)
Venture Capital			0.018	0.013	0.012	0.038
			(0.03)	(0.03)	(0.03)	(0.03)
Smallest 25%				-0.050	-0.050	-0.050
				(0.03)	(0.03)	(0.03)
Largest 25%				0.002	-0.002	-0.003
				(0.03)	(0.03)	(0.03)
DPxBuyout						-0.704**
						(0.22)
Controlling for Industry	No	No	No	No	Yes	Yes
R-Sqr	0.060	0.187	0.193	0.201	0.212	0.234
N	413	413	413	413	413	413

* p<0.05, ** p<0.01, *** p<0.001

The OLS-regression tests the amount of correlation between variables, the perfect correlation being 1, and the perfect negative correlation being -1. The R-squared value, known as the coefficient of determination, explains how much variance in the data is explained by the model. In our test, the IRR works as the dependent variable, being explained by dry powder and the number of investments pursued.

Our results show a significant, positive correlation between funds' dry powder and their internal rate of return, which remains and becomes increasingly significant as control variables are added. When controlling for vintage, the correlation of 0.450 has an R-square of close to 19%. A correlation of 0.450 can be considered moderate. However, it is significant and thus has high explanatory value.

The results also show that the number of investments undertaken by each fund has close to zero correlation with their returns, with a significance of $\rho = 0.001$. These results also remain significant as control variables are added. The test also shows a significant indication that there is a negative correlation between fund vintage and return, but with a coefficient close to zero. The evolution of net IRR over the vintages in our data is illustrated in the descriptive statistics.

6.2. Robustness of the models

The main interest of this study is to test the relationship between dry powder and return to investors. The test shows a positive correlation across all models, with significance of $\rho = 0.001$. We add control variables across five additional models to test the robustness of the initial result. It is reasonable to expect that dry powder will differ across different investment strategies, industries and vintages. As illustrated in industry reports, dry powder is also clustered in larger funds (Bain Global Private Equity Report, 2018). We, therefore, add these variables, to avoid any underlying correlation with dry powder affecting the correlation. The result remains significant, and the results show structural validity. When adding the interaction variable DPxBuyout, the non-significant coefficient for buyout strategy changes its sign from positive to negative. The interaction variable is significantly negative, confirming that a fund's strategy is relevant when predicting its performance return to dry powder. This change of coefficient is expected. All other variables keep the same sign as control variables are added, and the coefficient of determination R^2 increases from 0.060 to 0.234, with the most substantial increase to the model adding vintage. This signals that the models' explanatory efficiency increases with every added variable. In conclusion, the results are robust.

7. Analysis

The result of the first regression presented in table four supports our first hypothesis that there is a positive correlation between uninvested committed capital and net return to investors. The results are significant on a 0.1% level across all models with control variables. We also find that there is substantial proof for a non-existent relationship between the number of investments pursued and net IRR.

7.1. Dry powder and fund return

The presence of dry powder has in previously reviewed literature been discussed as a driver of cost in private equity investing (Braun and Stoff, 2016), due to management fees being calculated on total committed capital rather than total invested capital. Our findings imply that, despite investors paying higher management fees due to dry powder, funds with higher amounts of dry powder tend to perform better. These results imply that higher performance returns can to some extent mitigate dry powder's effect on management fees.

A possible reason for this result is that funds with higher deployment rates have spent more money on investments that do not yield as high return. As these funds do not tend to pursue extra investments (no correlation between the number of investments and return), this implies that these funds either have spent more capital on existing investments to make them profitable or to prohibit losses, or that they have been more aggressive in their bidding for their investments to start with, paying higher prices and thereby earning a lower return.

In conclusion, our findings on the relationship between dry powder and return suggest that dry powder is more often used as capital reserve for demanding investments than as a backup to be able act on sudden opportunities.

7.2. Buyout and Venture Capital Dry Powder

In model 6, we add the interaction variable DPxBuyout. It relates the two variables Share of Dry Powder with Buyout Strategy. We thereby test how dry powder's impact on return differs between the different strategies present in our dataset. The coefficient for buyout turns from negative to positive when moving from model 5 to model 6, while the interaction variable for buyout is negative. In addition, we see the coefficient for dry powder rises from 0.489 to 0.982 when the interaction variable for buyout funds is added.

This implies that the observed average positive effect of dry powder on return to investors is partly mitigated if a fund is using a buyout strategy, compared to venture capital and other strategies. It thereby seems as if buyout funds do not have to add more

capital into existing investments to make them profitable to the same extent as, for example, venture capital funds. This finding makes intuitive sense, as a venture capital strategy usually implies a higher risk and hence a higher variation in performance, attributable to their strategy of investing in smaller and more uncertain companies, in which capital needs are less predictable.

We consciously choose not to frame our sentences as "buyout funds do not have as much to gain" from maintaining levels of dry powder, as dry powder per say does not yield a higher return. It is the conclusions one can draw as an investor, from funds that have different amounts of dry powder left at liquidation that are of importance. Rather than dismissing high levels of dry powder, investors should look at the performed investments and what they have yielded, as the fixed management fee paid on total committed capital is likely to be mitigated by high returns. However, one must be aware of the fact that with high returns the carried interest also rises, which may imply a higher return spread and, as Braun and Stoff (2016) argue, an indirect cost of dry powder. Nonetheless, we underscore that the implications of dry powder are particularly important in today's economic environment, as dry powder levels in the private equity industry have reached global record levels.

7.3. Number of investments

In H1 we hypothesize that there is a negative relationship between the number of investments a fund pursues and its return to investors. The regression significantly finds a coefficient of 0.005, implying that any correlation between the number of investments pursuit and return to investors is close to zero. As shown in Table 2, the mean number of investments varies with fund size. As size is added as a controlling independent variable, the coefficient for the number of investments remains significant at 0.004. The data, therefore, implies that the number of investments made by a fund is irrelevant to its performance. I

This finding does not support our reasoning in H1, where we argue that funds with a high number of investments may have pursued extra investments in addition to those considered optimal, and that they should therefore perform worse. Instead, our findings suggest funds with low amounts of dry powder may have had high deployment rates since they have been forced to inject more capital to their existing investments to make them profitable or to prohibit losses, alternatively that they have been more aggressive in their bidding for their investments to start with.

7.4. The cyclicality of PE return

The coefficient of determination, R^2, increases from 0.060 to 0.187 when vintage year is added as a variable, meaning the vintage variable enhances the explanatory value to our model significantly across all models. The coefficient for vintage is negative across models 2-5, implying decreasing returns over the years. This can also be viewed graphically under descriptive data. The decreasing IRR over the years is an effect of the economic cycles that affect our data, primarily the internet boom in the early 1990s where venture capital firms showed exceptional performance. As vintage is controlled for in model 2 between dry powder and IRR, the coefficient for dry powder changes from 0.349 to 0.450, further emphasizing the importance of controlling for year of liquidation. It is noteworthy that, as dry powder levels increase over the years, IRR levels decrease. Despite this, the two are undoubtedly positively correlated.

8. Implications and conclusions

The results imply that dry powder might not be the great cause of concern it has been discussed as. Since there is a positive correlation between dry powder and net return, investors should not be discouraged to invest with managers demonstrating a habit of keeping low deployment rates. We argue that funds that exceed their intended deployment rate (deploy almost all commitments) do so because their investments require additional funding either to become profitable or to avoid losses. They, therefore, have lower IRRs as they have underestimated the money needed for specific projects.

There is, nonetheless, most likely no single explanation for the results we see in our test; in contrast, they are probably a result of several factors, as is also suggested in H1. It is noteworthy that no correlation between the number of investments pursued and IRR could be noticed. This signals that other factors play in, such as:

1) Funds which tend to spend all their commitments may act on a pressure to invest their capital. There is, for example, a time pressure, since LPs gross return becomes lower when their commitments are not invested. There could also be pressure to outside (potential future) investors, to show them the ability to find suitable investments.

2) As can be seen in our dataset, the average fund size has grown. As previous research indicates, the size of the GP investment team tends not to grow proportionally with the size of the fund. This implies that funds that have not deployed all their capital may have teams that are more fit for their investments. They can, therefore, apply more resources to each investment, and as a consequence, they enjoy a higher return.

Lastly, dry powder in the 1990s was not as much of a problem as it was the years before the financial crisis, and especially today (2019), having reached global record levels. However, there is a big gap in research on dry powder, and there seems to be a misconception that a high level of uninvested capital at liquidation signals that the fund's managing partner has not done its job in investing all capital. Our results provide an introduction to what it could mean that funds have maintained some dry powder at liquidation, and indicate that it may not be all negative.

Although our results show no indication of an optimal level of dry powder, however, there is most likely a point where dry powder at liquidation does no longer correlate with higher returns. However, due to the period of our data being 1990-2005, and the survivor bias, no such conclusions could be drawn. We, therefore, welcome future research on this area.

9. Suggestions for further research

The increase of dry powder in private equity has been mapped out and discussed, but there is little theory on the implications this will for the private equity industry and its investors. We suggest that future research further examines the relationship between dry powder and fund performance. It would also be valuable to examine if there is an optimal level of dry powder, and how the industry standard relates to it.

We also suggest a more thorough examination of the costs associated with dry powder, for example regarding the different measures for management fees and gross return, as our results offer a contrary viewpoint to that discussed in previous literature. As our interaction variables imply that dry powder's effect on return is related to the fund strategy, a more in-depth analysis of this relationship would be valuable.

As we find no significant results on the correlation between net return and fund size, our results do not add explanatory value to the size-performance relationship. It would thus be interesting with a study specifically looking at if the fact that large funds have higher amounts of dry powder in general could be considered an advantage or disadvantage for large funds' return to investors.

10. References

Published papers

"Private Equity Premium Puzzle Revisited†", 2014, *The American Economic Review,* vol. 104, no. 10, pp. 3297-3334.

Aigner, P., Albrecht, S., Beyschlag, G., Friederich, T., Kalepky, M. & Zagst, R. 2008, "What Drives PE? Analyses of Success Factors for Private Equity Funds", *Journal of Private Equity,* vol. 11, no. 4, pp. 63-85.

Bertoni, F., Ferrer, M. & Martí, J. 2013, "The different roles played by venture capital and private equity investors on the investment activity of their portfolio firms", *Small Business Economics,* vol. 40, no. 3, pp. 607-633.

Braun, R. & Stoff, I. 2016, "The Cost of Private Equity Investing and the Impact of Dry Powder", *The Journal of Private Equity,* vol. 19, no. 2, pp. 22-33.

Cumming, D. & Dai, N. 2010, "Local bias in venture capital investments", *Journal of Empirical Finance,* vol. 17, no. 3, pp. 362-380.

Cumming, D., Siegel, D.S. & Wright, M. 2007, "Private equity, leveraged buyouts and governance", *Journal of Corporate Finance,* vol. 13, no. 4, pp. 439-460.

Cumming, D. & Walz, U. 2010, "Private equity returns and disclosure around the world", *Journal of International Business Studies,* vol. 41, no. 4, pp. 727-754.

Demiroglu, C. & James, C.M. 2010, "The role of private equity group reputation in LBO financing", *Journal of Financial Economics,* vol. 96, no. 2, pp. 306-330.

Gompers, P., Kaplan, S.N. & Mukharlyamov, V. 2016, "What do private equity firms say they do?", *Journal of Financial Economics,* vol. 121, no. 3, pp. 449-476.

Gompers, P., Kovner, A. & Lerner, J. 2009, "Specialization and Success: Evidence from Venture Capital", *Journal of Economics & Management Strategy,* vol. 18, no. 3, pp. 817-844.

Harris, R.S., Jenkinson, T. & Kaplan, S.N. 2014, "Private Equity Performance: What Do We Know?", *Journal of Finance,* vol. 69, no. 5, pp. 1851-1882.

Hege, U., Palomino, F. & Schwienbacher, A. 2009, "Venture Capital Performance: The Disparity Between Europe and the United States", *Finance,* vol. 30, no. 1, pp. 7-50.

Hellmann, T., Lindsey, L. & Puri, M. 2008, "Building Relationships Early: Banks in Venture Capital", *The Review of Financial Studies,* vol. 21, no. 2, pp. 513-513.

Hochberg, Y.V., Ljungqvist, A. & Lu, Y. 2007, "Whom You Know Matters: Venture Capital Networks and Investment Performance", *Journal of Finance,* vol. 62, no. 1, pp. 251-301.

Humphery-Jenner, M. 2012, "Private Equity Fund Size, Investment Size, and Value Creation", *Review of Finance,* vol. 16, no. 3, pp. 799-835.

Inderst, R. & Müller, H.M. 2003, "Internal versus External Financing: An Optimal Contracting Approach", *Journal of Finance (Wiley-Blackwell),* vol. 58, no. 3, pp. 1033-1062.

Kaplan, S.N. & Schoar, A. 2005, "Private Equity Performance: Returns, Persistence, and Capital Flows", *Journal of Finance,* vol. 60, no. 4, pp. 1791-1823.

Kaplan, S.N. & Strömberg, P. 2009, "Leveraged Buyouts and Private Equity", *Journal of Economic Perspectives,* vol. 23, no. 1, pp. 121-146.

Leifer, R., Gina, C.O., Rice, M. & Gina, C.O. 2001, "Implementing Radical Innovation in Mature Firms: The Role of Hubs", *The Academy of Management Executive (1993-2005),* vol. 15, no. 3, pp. 102-113.
Litvak, K. 2009, "Venture Capital Limited Partnership Agreements: Understanding Compensation Arrangements", *The University of Chicago Law Review,* vol. 76, no. 1, pp. 161-218.
Lopez-de-Silanes, F., Phalippou, L. & Gottschalg, O. 2015, "Giants at the Gate: Investment Returns and Diseconomies of Scale in Private Equity", *Journal of Financial and Quantitative Analysis,* vol. 50, no. 3, pp. 377-411.
Metrick, A. & Yasuda, A. 2010, "The Economics of Private Equity Funds", *The Review of Financial Studies,* vol. 23, no. 6, pp. 2303-2303.
Phalippou, L. & Zollo, M. 2005, *What Drives Private Equity Fund Performance?*.
Rizzi, J.V. 2009, "Back to the Future Again: Private Equity After the Crisis", *Journal of Applied Finance,* vol. 19, no. 1/2, pp. 165-177.
Robinson, D.T. & Sensoy, B.A. 2016, "Cyclicality, performance measurement, and cash flow liquidity in private equity", *Journal of Financial Economics,* vol. 122, no. 3, pp. 521-543.
Taymaz, E. 2005, "Are Small Firms Really Less Productive?", *Small Business Economics,* vol. 25, no. 5, pp. 429-445.

Working papers

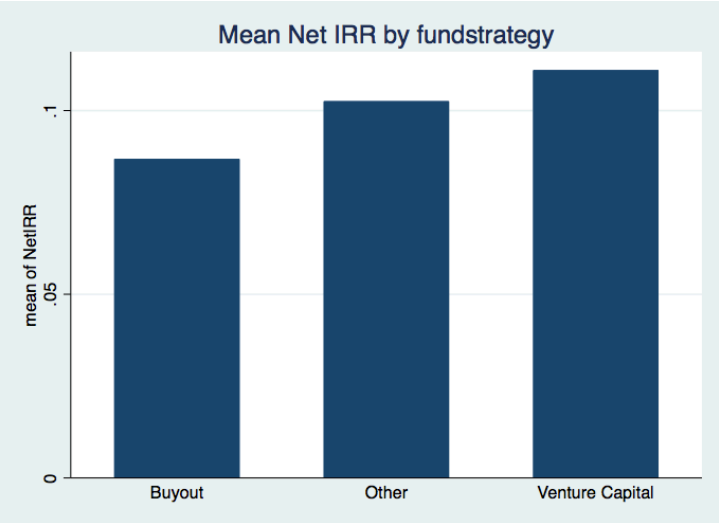
Appelbaum, A., Batt, R., 2016. Are Lower Private Equity Returns the New Normal? Working Paper, Center for Economic and Policy Research
Ljungqvist, A., Richardson, M.P., 2003. The Cash Flow, Return and Risk Characteristics of Private Equity, NYU, Finance Working Paper No. 03-001.
Harris, H., Jenkinson, T., Stucke, R., 2010. A White Paper on Private Equity Data and Research. UAI Foundation Consortium
Zweig, J., Auerbach, A., Tabares, J., 2014. Declaring a Major: Sector-Focused Private Investment Funds. Cambridge Associates.

Industry reports

Bain & Company, 2018. Global Private Equity Report

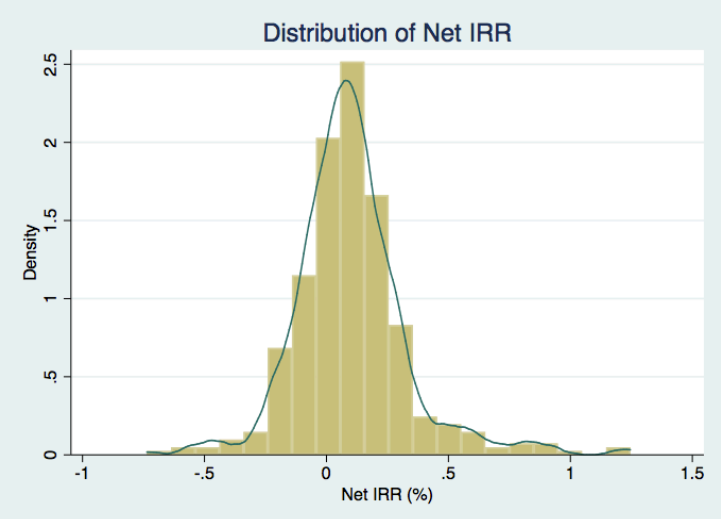
11. Appendix

Figure 4 – Mean Net IRR for strategies



Note: The Net IRR differs between the strategies.

Figure 5 – Distributions of Net IRR



Note: Illustration of the distribution of net IRR with a mean of 10%

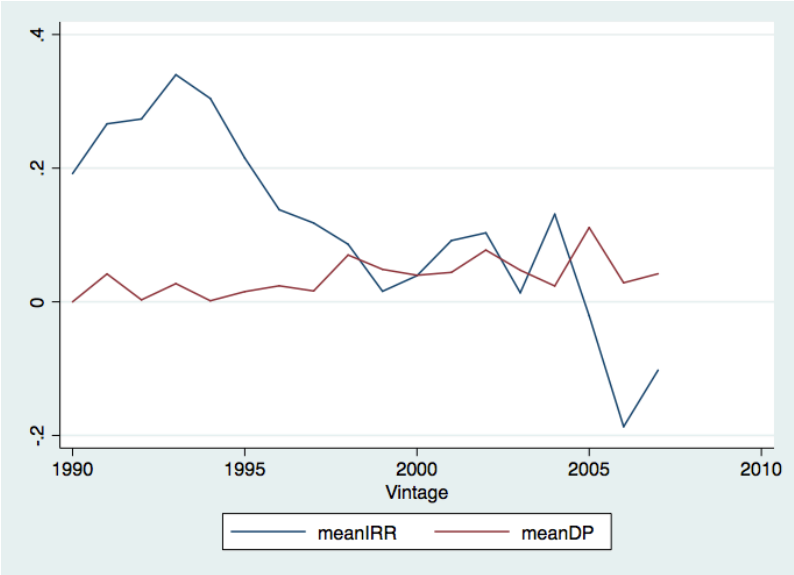
Table 5 - Correlation table for all variables

Pairwise correlations

Variables	Dry Powder	Net IRR	Vintage	DPxBuy-out	Size USD	Nr. of Inv	Buyout	Venture
Dry Powder	1.000							
Net IRR	0.147	1.000						
Vintage	0.129	-0.339	1.000					
DPxBuyout	0.708	0.010	0.094	1.000				
Size USD	0.058	0.040	0.138	0.009	1.000			
Nr. of Inv	-0.062	0.187	-0.031	-0.084	0.460	1.000		
Buyout	0.045	-0.043	-0.016	0.284	0.005	0.037	1.000	
Venture	-0.079	0.037	0.026	-0.167	0.007	0.002	-0.588	1.000

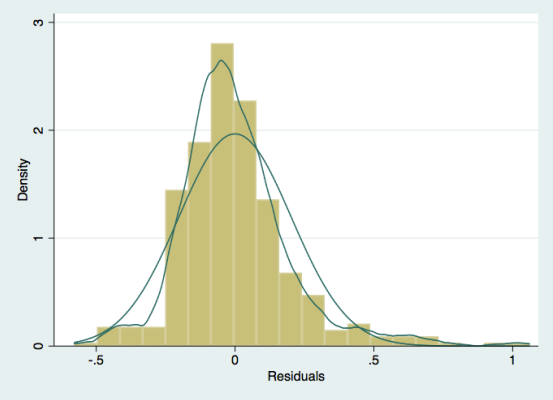
Note: Includes all variables except industry

Figure 6 – Line graph of Net IRR & Dry Powder over Vintage



Note: Illustration of the decrease in Net IRR and increase of dry powder as a share of total commitments at liquidation.

Figure 7 – Residual histogram



Note: It was confirmed our residuals are normally distributed. In other words, it was confirmed our data meets the requirements for using the OLS regression. A Breusch-Pagan / Cook-Weisberg test for heteroscedasticity significantly shows homoskedacity.