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Factors Determining the
Performance of Private Equity Funds

*A litterature review and an empirical study of the effects
of industrial and geographical specialization*

av

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ABSTRACT[1]

The purpose of this report is to explore factors determining the performance of private equity (PE) funds. The first part of the report discusses performance measurement in the PE industry and reviews literature aiming at estimating the historical performance of PE as an asset class. Subsequently, literature on performance determinants in the PE industry is reviewed.

The second part of this report is an empirical study based on a mixture of private placement memoranda, due diligence material and other information about 28 PE funds. These funds are described with respect to their general characteristics and investment strategy. Furthermore, the track records of the general partners raising the funds are described and compared to relevant benchmark information from Thomson Financial's VentureXpert database.

Based on the collected data, the effects of geographical and industrial specialization are investigated using univariate analyses and multiple regression. The results indicate that, for the venture capital funds, an exclusive focus on the Nordic region has yielded better performance than a less focused Nordic strategy. What is more, indications that venture funds benefit from specializing industrially is also found. However, simultaneous geographical and industrial specialization is found to have a negative effect. No significant effects of specialization are found in the buyout part of the sample.

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1. Introduction

This chapter explains the purpose of the report and gives a short introduction to the concept of private equity. Some statistics from the Nordic private equity markets are also presented.

1.1 The purpose of this report

The purpose of this report is to explore factors determining the performance of private equity (PE) funds. The first question to be addressed is: How should the performance of PE funds be measured? And secondly, what factors determine the performance of PE funds?

To address these questions, relevant theory and literature is reviewed in chapter 2 and 3. In addition, an empirical study focusing on the effects of geographical and industrial specialization is carried out in chapter 4 and 5. The empirical study is based on fund data provided by a PE investor in the Nordic market.

1.2 What is private equity?

In general, PE may refer to all equity capital that is not listed on a public stock market. More precisely, PE investments may be distinguished from other investments by the way the capital invested is raised, namely on the private markets, as opposed to the public markets. The European Private Equity and Venture Capital Association (EVCA, 2007) defines PE as "investing in securities through a negotiated process". The term negotiated process indicates that the interaction between investors and the companies they invest in is close.

The ownership of public companies is often dispersed and a large number of passive investors own stocks in each company. PE investors, on the other hand, seek to create value by combining capital input with active ownership and often acquire a major position in the companies they invest in.

PE is often categorized under the umbrella "alternative investments" together with hedge funds, real estate, physical commodities, currencies, interest rates and natural resources (EVCA, 2007). This classification is based on the assumption that investors tend to view PE as complementary to investments made on public markets.

1.3 The organization of PE funds

PE investing is often organized in funds specializing on different types of PE investments. The funds are typically specialized with respect to the maturity of the companies they invest in (the portfolio companies). In relation to this, a framework based on EVCA (2007) is presented in figure 1. Venture capital (VC) funds concentrate in one or more of the first four stages. Buyout (BO) funds, on the other hand, focus on mature companies that typically need some sort of restructuring.

Figure 1: Classification of PE funds according to the maturity of the portfolio companies
(EVCA, 2007)

Maturity of the portfolio companies →

Venture Capital				Buyout
Seed	Start-up	Expansion	Replacement	Buyout
- Funding for research and concept development - The business has typically not been set up yet	- Financing for product development and initial marketing - The products have not yet been sold commercially - Companies not yet generating a profit	-Financing for growth and expansion (increased capacity or market/product development) - Companies breaking even or trading profitably	Purchase of shares from another investor or to reduce gearing via the refinancing of debt	-Typically an acquisition of a significant portion or majority control of businesses with established business plans -Value creation through expansions, consolidations, turnarounds, spinouts etc. - Investment styles can vary widely

A PE fund is typically organized as a limited partnership. The investors participate in the partnership as limited partners (LP), while a team of professional fund managers serve as the general partner (GP) (Fenn et al., 1997). The fund managers typically raise funds through private placements directed towards professional investors. After a fund is raised, the managers search for investment opportunities and make investments in portfolio companies.

The typical PE fund has a duration of ten years. In this period, the investors have little control over their investment. Moral hazard is prevented by making the fund managers' compensation highly dependent on the partnership's profits. Another factor preventing moral hazard is that the managers, hoping to raise new funds in the future, care about their reputation (Fenn et al., 1997). Figure 2 depicts the typical structure of a PE partnership.

Figure 2: The typical structure of a PE partnership
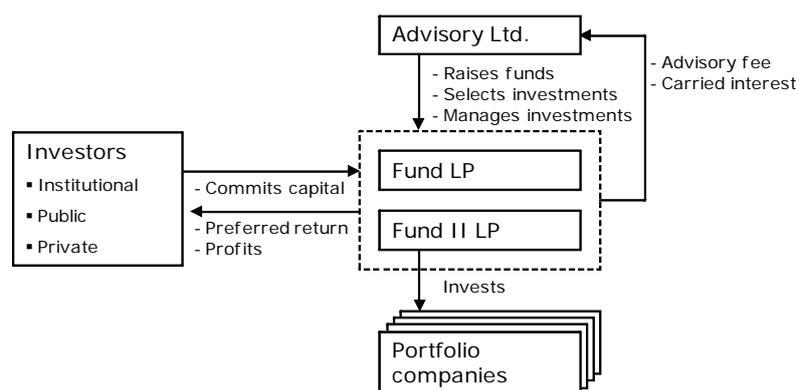
The LPs commit to invest a set amount in the fund. However, the amount is normally not paid in all at once, but consecutively as the fund invests in portfolio companies. In return for their commitment, the LPs receive preference shares. The fund manager is compensated with an advisory fee (typically 2-2.5% of committed capital) and carried interest (typically 20% of the fund's profits). However, the LPs will receive a set preferred return on their investment (typically 2-10%) before any carried interest is paid to the GP.

1.4 PE in the Nordic markets

Figure 3 shows the total capital under management in the buyout and venture capital segments of the Nordic PE markets from 2003 to 2006. The total capital available for PE investments in the Nordic region is increasing and this trend is evident both in the venture capital and the buyout segment. The Swedish PE market is by far the largest in the region. This is in particular due to the large buyout market in Sweden, but the Swedish market is also largest when it comes to venture capital.

Figure 3: Total capital under management in the Nordic PE markets from 2003 to 2006
(Vækstfonden, 2006; FVCA, 2006; NVCA, 2005, 2006; SVCA, 2003, 2004, 2005, 2006)
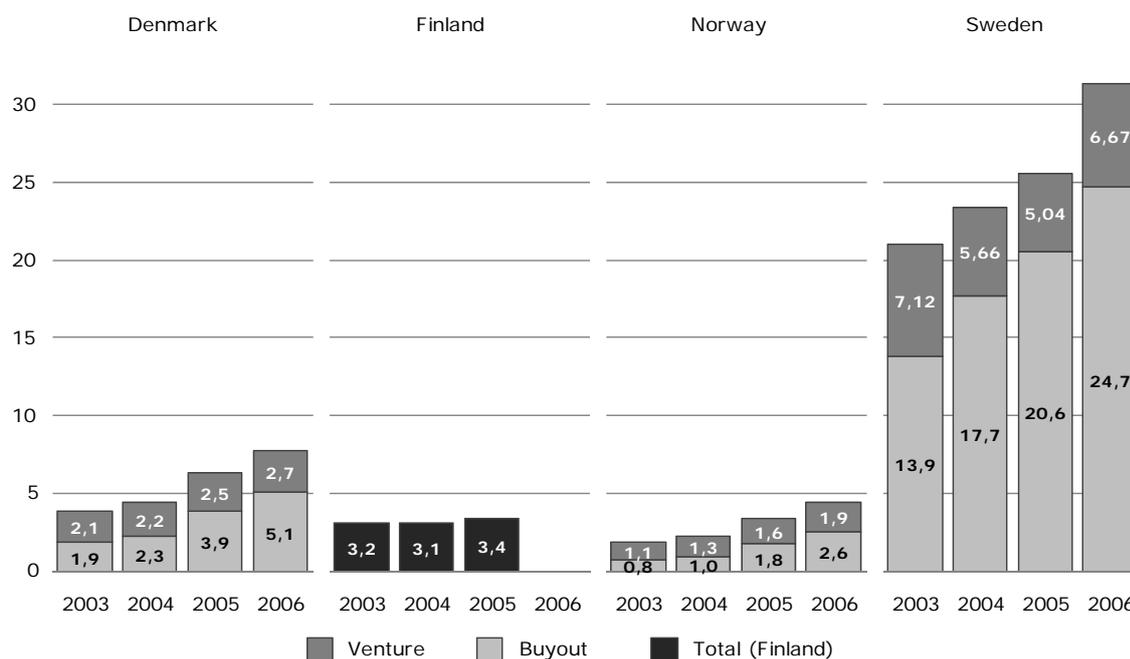
In comparison to the overall European PE market, the Nordic countries are characterized by a relatively large share of venture capital investments. Norway is the country within the region where this feature is most pronounced. Total PE investments in 2005 as a share of each country's GDP are shown in figure 4[2]. The Norwegian PE market was well below the European average, while the Danish, Swedish and Finnish markets lay above the average.

Figure 4: PE Investments in the Nordic countries as a percentage of GDP
(EVCA, 2005)
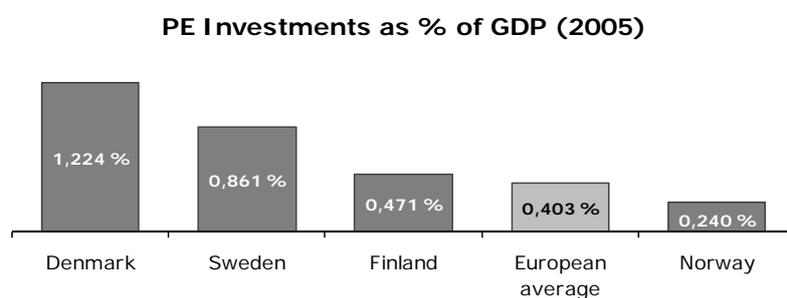
[2] The information in figure 4 is not consistent with the information in figure 3. Figure 4 is based on numbers from EVCA, while figure 3 is based on numbers from the national venture capital associations in the Nordic countries. It is unclear why the information from these sources is not consistent.

2. MEASURING THE PERFORMANCE OF PE FUNDS

This chapter discusses how the performance of PE funds is, and should be measured. I concentrate on the investor perspective. In this setting performance refers to a fund's returns taken into account the relevant cost of capital. Performance measurement is used both to compare individual funds with each other and to compare the performance of PE in general to other asset classes. However, measuring performance can be complex and a number of factors have to be considered to ensure the quality of the results.

Section 2.1 discusses performance measures used in the PE industry. Section 2.2 discusses important factors that should be considered when measuring performance. Section 2.3 reviews research aiming at estimating the historical performance of PE investments.

2.1 Performance measures

PE investments are rarely traded on secondary markets and are in general illiquid, thus no continuous market value is observable. Because of this, performance is most often evaluated on the basis of cash flow data (and, in some cases, interim valuations of non-realized investments). The cash flow data is used to calculate performance measures, typical examples include the internal rate of return (IRR), the profitability index (PI) and multiples (e.g. total value to paid-in capial – TVPI). This section will take a closer look at each of these measures.

2.1.1 The internal rate of return

IRR is probably the most popular of all performance measures in the PE industry. The IRR of an investment is defined as any rate which equates the present value of the cash outflows and inflows associated with the investment. This is the rate of return that is earned from the investment (Copeland et al., 2005). Due to the measure's popularity it is vital to be aware of some important pitfalls associated with it.

Firstly, when calculating IRR, it is implicitly assumed that cash flows can be reinvested at the IRR. However, the correct reinvestment rate is equal to the opportunity cost of capital (Copeland et al., 2005). When an investment has a positive NPV, the IRR is greater than the opportunity cost of capital and thus the implicit reinvestment rate will be too high. Secondly, in IRR calculations all cash flows are implicitly treated as having the same risk characteristics. In reality, however, the riskiness of in- and outflows is different. The inflows can probably be considered as close to riskless. The outflows, on the other hand, are obviously more risky because they depend on the performance of the fund's investments.

Another pitfall arises when more than one sign change occur in the stream of cash flows. In that case we may end up with multiple possible IRRs. The cash flow to and from a PE fund may indeed change sign several times because capital is called in gradually and investments are realized at different points of time. This means that conclusions about performance may be ambiguous. The IRR also has certain shortcomings when it comes to evaluating mutually exclusive projects because it violates the value-additivity principle (Copeland et al., 2005). This means there are problems associated with computing aggregated measures (e.g. averages) based on separately calculated IRRs.

Furthermore, investors care about total returns while IRR is a measure of per period return, i.e. investors care not only about IRR, but also duration. If IRR and duration are correlated, aggregations of IRR will be biased. Phalippou and Gottschalg (2007) estimate the correlation between IRR and duration empirically, and find it to be negative (funds with longer duration tend to perform worse and vice versa). This leads to the conclusion that estimates of average IRR will give a too optimistic impression of average performance.

2.1.2 The profitability index and the public market equivalent

Net present value (NPV) is often recommended instead of IRR to evaluate investments. The NPV is calculated by discounting all expected cash flows at the relevant opportunity cost of capital. An investor should accept all investments with a positive NPV. There are good reasons to recommend NPV as the investment criterion because it is the only criterion that consistently maximize investors' wealth (Copeland et al., 2005). The PI of an investment is a performance measure based on NPV.

In general terms, the PI is defined as the net present value of future cash flows divided by the initial investment. The measure is typically used as the investment criterion when the supply of capital is limited. In the absence of capital constraints, all projects with a PI greater than one should be accepted (Grinblatt and Titman, 2002). The PI may be thought of as the value (in excess of the cost of capital) created for each dollar invested, i.e. $1 invested is worth $1 plus the PI of the investment (Ljungqvist and Richardson, 2003).

The measure is also useful when evaluating funds' performance. The PI is then calculated slightly differently by dividing the net present value of future cash flows by the present value of all cash called to the fund instead of just the initial investment. This way, funds calling in capital through several rounds may also be evaluated.

A central question when calculating both NPV and the PI is what discount rate one should use. Ljungqvist and Richardson (2003) use the Treasury-bond rate with corresponding maturity for the outflows and the expected aggregate market return for the inflows. This is consistent with the above mentioned difference in risk that exists between cash in- and outflows. Sometimes the return on a public market index (e.g. the S&P 500) is used to discount both outflows and inflows in the calculation of the profitability index. When this is done, the measure is also referred to as the public market equivalent (PME) (see for example Kaplan and Schoar 2005). PME is a relative measure that compares an investment in a PE fund to an investment in a public index. For example, if an investment in a PE fund is compared to the S&P 500 and the resulting PME is smaller than one, this means the investor would have been better off investing in the S&P 500. If PME is larger than one, the fund returns have been higher than those of the S&P 500. Comparisons on the basis of PME are not risk adjusted. If the systematic risk of an investment is greater than the systematic risk of the benchmark index, PME will overstate the investments true risk-adjusted relative performance (Kaplan and Schoar, 2005).

2.1.3 Multiples

Different multiples (ratios) may also be used to benchmark fund performance. Examples of such multiples are total value to paid-in capital (TVPI), distributions to paid-in capital (DPI) and residual value to paid-in capital (RVPI). Total value is defined as distributed value plus estimated residual value, thus TVPI is equal to the sum of DPI and RVPI. These measures'

value in analyses of performance is reduced by the fact that they do not take into account the time value of money or risk. Nevertheless, multiples seem to be popular among practitioners and funds often use them to account for their previous performance. This is perhaps due to these measures' simplicity. Moreover, the distribution of cash flows over the life cycle and risk characteristics are often similar across funds. This means multiples, despite their weaknesses, may be used to make rough comparisons of funds.

2.2 Important factors when measuring performance

Measures of PE performance may be influenced and distorted by several different factors. The following section discusses risk adjustment, selection bias and how GPs report performance with respect to fees and valuation of non-realised investments.

2.2.1 Risk

Returns alone give an incomplete picture of the performance of an investment. An equally important part of the picture is the risk associated with the investment. Thus, to assess performance, we need an appropriate measure of risk and a way to determine the market price for that risk.

A natural starting point for analyses of the cost of capital is the capital asset pricing model (CAPM). According to portfolio theory, the total risk of any individual asset can be separated into systematic and unsystematic risk. The unsystematic risk is diversifiable, i.e. investors are able, by holding diversified portfolios, to eliminate all unsystematic risk. The systematic risk is associated with the economy as a whole and is undiversifiable. Consequently, the only risk investors will pay a premium to avoid is the systematic risk (Copeland et al., 2005).

In CAPM the required rate of return is calculated from the basic relationship given in equation (1). The required return is equal to the risk-free rate of return plus a risk premium. The risk premium is the product of the amount of systematic risk measured by beta (specified in equation (2)) and the market's risk premium. When markets are frictionless all

assets will be priced so that their expected return equals the required return, i.e. the relationship below holds (Copeland et al., 2005).

$$(1) \quad E(R_i) = R_f + \beta_{im}(E(R_m) - R_f)$$

$E(R_i) = $ Expected/required return

$R_f = $ Risk free rate

$$(2) \quad \beta_{im} = \frac{COV(R_i, R_m)}{VAR(R_m)}$$

$\beta_{im} = $ Asset beta

$E(R_m) - R_f = $ Market risk premium

In the CAPM framework, differences in the required return of different assets are explained by a single factor, the systematic risk, measured by beta. The beta of an asset is equal to the expected percentage change in the price of the asset when the price of the market portfolio changes with one percent (i.e. the assets financial elasticity). It can be seen as a measure of the asset's sensitivity to market fluctuations.

The insights from CAPM make it clear that an analysis of performance is only meaningful when risk is taken into account. Investors look at returns adjusted for risk when they make investments and require compensation for carrying systematic risk.

2.2.2 Other factors affecting the required rate of return

Factors other than those included in CAPM are also potentially important to the required rate of return. I will briefly mention some factors particularly important in the PE industry that may result in a higher required return than predicted by CAPM alone.

Investors may have less access to credible information about their investments in PE compared to investments on public markets. This information asymmetry can reduce investors' willingness to invest and make them demand specific governance measures to mitigate the asymmetry. Furthermore, PE investments are relatively illiquid (Ljungqvist and Richardson, 2003), and investors will demand compensation for this lack of liquidity (Lerner and Schoar, 2002). In addition, the minimum investment in a PE fund is typically relatively large. This may increase investors' required return because their ability to diversify is reduced.

2.2.3 Selection bias

Selection bias may also represent a major hurdle in analyzes of PE performance. Selection bias is generally defined as distortions of statistical analyses due to the methodology of how samples are collected. Selection bias may cause incorrect inferences and may result in false conclusions.

One potential source of bias affecting the widely used benchmark data from Thomson Financial's VentureXpert database is that it is based on voluntary reporting by funds and investors. Kaplan and Schoar (2005) argue that this may cause a bias because worse-performing funds probably report less frequently than other funds. This, in turn, leads to an upward bias on estimations of average performance.

2.2.4 Performance gross and net of fees

GPs in the PE industry normally enjoy substantial fees. In addition to a flat fee, they typically receive 20% of fund profits. However, GPs often report performance on a gross of fees basis to the LPs. The LPs, on the other hand, should primarily be concerned about performance net of fees because they do not directly enjoy any of the cash flows allocated to compensation of the GP. Thus, when evaluating performance reported gross of fees, LPs have to take into account the fee structure of the fund.

2.2.5 Valuation of non-realized investments

Another issue when measuring the performance of PE funds is how unrealized investments should be treated. Funds report residual values that are supposed to reflect the value of their unliquidated investments. In industry benchmarks and in some of the academic literature based on cash flow data (e.g. Kaplan and Schoar, 2005) these residual values are treated as cash inflows. Other researchers (Phalippou and Gottschalg, 2007) write-off the residual values because they perceive them to be significantly overstated especially by weak funds and in times with falling markets. Cumming and Walz (2004) have shown that there are systematic positive biases in the reporting of unrealized investments to institutional investors. To sum up, reported residual values and performance of unrealized investments should be interpreted with caution.

2.3 Historical PE performance

I will now have a look at academic papers aiming at estimating the historical performance of private equity funds. Researchers have chosen different approaches to estimating PE performance. Some have analyzed individual portfolio company performance (see Cochrane, 2000 and Quigley and Woodward, 2002) others have had fund performance as their unit of analysis. I will focus on the latter of these groups.

Kaplan and Schoar's (2005) sample is based on fund-by-fund data from the VentureXpert database. Before assessing performance, they filter out 746 largely liquidated funds. This is to ensure that their results are based mainly on actual cash flows to LPs and not intermediate valuations of residual value. When weighting the funds by size, they find an average performance approximately equal to that of the S&P 500. The venture funds in their sample outperform the index (PME equal to 1.21), while the buyout funds underperform the index (PME equal to 0.93). Kaplan and Schoar also find strong heterogeneity across funds (IRR at the 25th and 75th percentile is 4% and 20% respectively) and a great deal of time series variation (i.e. PE performance is cyclical). Kaplan and Schoar do not adjust for differences in systematic risk. By using PME to compare average returns with the S&P 500 they assume that funds on average have a beta of one. The authors also acknowledge that their results are potentially distorted by sample selection biases.

Jones and Rhodes-Kropf (2003) use the same dataset as Kaplan and Schoar. However, they use a different sample of 1245 funds. They estimate an overall value weighted IRR of 9.18%. For the buyout and venture funds separately, they estimate a value weighted IRR of 4.57% and 19.25% respectively. The difference in estimated performance compared to Kaplan and Schoar (2005) is explained by the fact that more recent funds are included. These funds have performed weakly and are in an early stage of their life cycle. When Jones and Rhodes-Kropf (2003) filter out a buyout sample that is similar to Kaplan and Schoar, the findings of Kaplan and Schoar are confirmed. Jones and Rhodes-Kropf also document a large cross-sectional standard deviation, confirming the finding that fund heterogeneity is strong.

Ljungqvist and Richardson (2003) use a different approach. Their assessment of

performance relies entirely on investments made by one single LP. Their data includes detailed information about 73 PE funds in which this LP has invested. The funds in their sample are raised between 1981 and 1993 and they show an average IRR of 19.81%. Compared to the S&P 500 they find the funds in their sample to yield an excess IRR between 5% and 8%

Because Ljungqvist and Richardson (2003) have access to detailed fund data they are better equipped to determine the systematic risk of the funds in their sample. They estimate fund level betas by assigning betas to the portfolio companies. They conclude that adjusting for systematic risk only reduces the average return on capital from 25.07% to 24%. Another interesting finding in Ljungqvist and Richardson's article is that it takes the average fund eight years to deliver a positive IRR (in this case, residual values are not included in the calculations). This is related to the so called j-curve effect. In early years, funds show small or negative returns. The investment gains usually come in later years as the companies mature and, with the help of the GP, increase in value. This causes the IRR of the typical fund to follow a j-curve shaped path over its life cycle.

Phalippou and Gottschalg (2007) use an updated version of the dataset used by Kaplan and Schoar (2005). They select funds that have reached "their normal liquidation date", i.e. funds that are older than 10 years. This leaves a sample of 852 funds. Without making adjustments to the data, their findings confirm the results from Kaplan and Schoar (2005), namely slight outperformance of PE compared to the S&P 500 (PI[3] equal to 1.01). Next, Phalippou and Gottschalg (2007) make three corrections to this standard performance estimate. They use an alternative set of weights instead of committed capital, they propose a correction to a documented sample selection bias and they write-off residual values instead of treating these as cash inflows. I will now explain their reasons for making these corrections and how the performance estimates are affected.

Funds are different with respect to the speed at which they call capital and make investments. This means the committed capital does not reflect the actual capital invested.

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[3] Phalippou and Gottschalg (2007) use the realized S&P 500 return as discount rate when calculating the PI, thus what they refer to as the PI is equivalent to the PME with the S&P 500 as the benchmark index.

Consequently, Phalippou and Gottschalg (2007) investigate the effect of using the present value of investments (value invested) instead of committed capital as weights when calculating average performance. This leads to a decrease in the PI of 0.02.

Phalippou and Gottschalg (2007) compare their main sample to an extended sample of funds where only less detailed information is available. This comparison indicates that their standard performance estimates suffer from an upward bias. The analysis is conducted by using the number of successful exits as a proxy for performance. When correcting for the documented bias, the PI decreases by an additional 0.05.

Phalippou and Gottschalg (2007) argue that in a sample of ten year old funds, residual values are most likely representing 'living dead' investments, and they find that the PI is reduces by 0.07 by writing off all residual values.

After making these corrections they estimate a PI at 0.87, a decrease of 0.14 from the original 1.01. This indicates a substantial underperformance compared to the S&P 500. However, gross of fees the funds are shown to outperform the S&P 500 with a PI of 1.12. This indicates that while GPs are adding substantial value, they tend to capture an excessive rent (Phalippou and Gottschalg, 2007).

The PI estimate of 0.87 is not risk adjusted. Because the S&P 500 is used to discount the cash flows, the average systematic risk of the PE funds is implicitly assumed to be equal to that of the S&P 500. The high leverage applied by BO funds and the high systematic risk in the typical venture backed company indicate that the assumption of a beta of one makes the performance look misleadingly high (Phalippou and Gottschalg, 2007). When using a more realistic cost of capital, Phalippou and Gottschalg find a PI of 0.75. Thus, the estimated performance is significantly lowered when adjusting for risk.

Phalippou and Gottschalg (2007) make three different hypotheses about why the performance of PE apparently has been so weak. Firstly, LPs may invest in inexperienced and poorly-performing funds to get a tacit right to invest in future more profitable funds raised by the same GP. Secondly, LPs may have mispriced PE funds. Thirdly, LPs may tolerate poor performance because they have side benefits from investing in PE (e.g. a bank

may invest in PE because it will generate fee based income from the funds it invests in)

To sum up, research has documented strong heterogeneity across funds and a great deal of time series variation in the performance of PE funds. A tendency of outperformance by VC funds and underperformance by buyout funds compared to public indices has been found in several studies. However, when adjustments are made to correct for weaknesses in these studies, the average fund seems to have underperformed public indices, at least based on cash flows to and from the LPs.

3. FACTORS DETERMINING THE PERFORMANCE OF PE FUNDS

As discussed in the preceding chapter, performance varies a lot across funds in the PE industry. The large variation in performance has led to several research efforts aiming at identifying what distinguish top performers from the rest. In this chapter, I will have a look at literature discussing factors determining the performance of PE funds.

Söderblom and Wiklund (2006) conduct a similar review of literature on performance factors in early stage VC funds. They identify four research streams based on the unit of analysis applied in the studies they examine. These are i) portfolio company, ii) venture capital firm, iii) limited partner (i.e. investor) and iv) market. I will concentrate on the second and third of these categories, i.e. research investigating relationships between performance and GP and LP characteristics. Contrary to Söderblom and Wiklund, I will not only look at studies examining the VC segment, but also include studies concerning the buyout segments of the PE industry.

Section 3.1 discusses fundamental performance relationships. Section 3.2 looks at performance determinants associated with GP characteristics. Section 3.3 discusses funding source related determinants (LP characteristics).

3.1 Fundamental performance relationships

The relationship between certain basic fund characteristics such as size and sequence number and performance has been thoroughly investigated in academic research. These relationships, which appear in a large number of studies, are the focus of this section.

3.1.1 Fund size

The relationship between fund size and performance is well documented. Kaplan & Schoar (2005) find a concave relationship between the size of a fund and its performance. They find that, up to a certain point, larger funds perform better than small ones. However, the relationship turns negative for very large fund sizes, i.e. the relationship is concave.

Interestingly, when controlling for GP fixed effects, the authors find that the relationship between size and performance switch from positive to negative. Size seems to be positively related to performance in the cross section, but negatively related to the performance of individual funds. Phalippou and Gottschalg (2007) find a positive relationship between size and performance; they do not find the relationship to be concave.

What are the underlying drivers of the relationship between size and performance? One possible explanation is that, up to a certain point, there are economies of scale associated with increased fund sizes. However, it is also likely that high quality GPs with a strong reputation can more easily raise large funds. If this is the case, large fund sizes may in part be a consequence of great performance rather than the cause of it. This interpretation seems consistent with the finding that the relationship turns negative when controlling for GP fixed effects. However, the interpretation cannot explain the concavity of the relationship.

Kaplan and Schoar (2005) suggest that a concave underlying production function in the PE industry may explain the size-performance relationship's concavity. It is argued that the number of attractive deals in the economy and the access to the needed human capital is limited. Funds trying to grow beyond a certain point perform worse because they are unable to attract the required human capital or to find enough attractive deals.

The funds of top GPs are often highly oversubscribed and the best funds seem to voluntarily limit their size. The top performers avoid growing too rapidly and moving into regions with diminishing returns to scale (Kaplan and Schoar, 2005). Consistent with the assumption that the underlying production function is concave, is the so called money chasing deals effect. This effect, which is discussed by Gompers and Lerner (2000), implies that when inflows are high the competition for deals is intensified and the valuation of these deals increases.

3.1.2 Sequence number

Kaplan and Schoar (2005) find that the performance of a fund is positively related to its number in the sequence of funds raised by a GP (i.e. the fund's sequence number). Their results also indicate that the relationship is convex, but this finding is not significant. Similar to the size effect, the sequence number effect change sign when controlling for GP fixed

effects. The positive relationship between sequence number and performance has been confirmed by Phalippou and Gottschalg (2007), but Cumming and Walz (2004) do not find a significant relationship.

A fund's sequence number may be seen as a proxy for its experience and reputation. Thus, the perhaps most obvious interpretation of the relationship between sequence number and performance is that experience and reputation are important success factors. However, the fact that the relationship is not robust to controlling for GP fixed effects contradicts this interpretation. Therefore, the results are probably primarily driven by a survivorship bias. This bias arises because top performing partnerships are more likely to be able to attract the capital necessary to raise a large number of funds. This means their chances of reaching high sequence numbers are better than for the weak partnerships. Over time, this effect results in increasing average performance of the surviving partnerships and a positive relationship between sequence number and performance.

3.1.3 Performance persistence

Another well documented finding is that the performance of PE firms is highly persistent (Kaplan and Schoar, 2005 and Phalippou and Gottschalg, 2007). This means there is a strong trend of top (and bottom) GPs to stay in their performance bracket. Kaplan and Schoar (2005) suggest underlying heterogeneity in the skill of GPs as an explanation to the documented persistence. They say the superior skill of top performing GPs may cause persistence through several different forces:

Firstly, the differences in skill may be connected to differing access to, and ability to identify, good investments. This is often referred to as "proprietary deal flow" by practitioners. Secondly, the human resources needed to provide professional input, i.e. clever fund managers, is scarce. This affects performance because much of the value creation in the PE industry is connected with the ability of the GP to provide valuable management advisory input along with capital to their portfolio companies. Thirdly, some GPs are better dealmakers than others and hence make an excess profit from their superior bargaining abilities and preferential deal terms. Moreover, some start-ups are prepared to accept lower

valuations to get access to the competence of specific GPs (Hsu, 2004).

Phalippou and Gottschalg (2007) find that when past performance is included in performance regressions, all of their other explanatory variables lose their significance. This indicates that all the other factors predicting performance is subsumed by past performance. A possible interpretation of this is that GPs that have delivered high performance in the past have done so because they have certain characteristics, and that these characteristics are still in place when raising subsequent funds. Some GPs simply have resources that improve their funds' performance consistently over time.

Contrary to what seems to be the case for PE funds, most studies show that the performance of mutual funds is not persistent. Berk and Green (2004) argue that this does not imply that differential ability across mutual fund managers is nonexistent. Put simply they claim that performance persistence is eliminated because the fund managers adjust their compensation so that they offer exactly the return necessary to attract investors. It is puzzling that the same mechanisms do not drive away performance persistence in the PE industry (Kaplan and Schoar, 2005). If skilled GPs are the scarce resource generating superior returns, economic theory predicts that the value of this resource should be appropriated by the GPs and not the funds' investors.

3.2 GP characteristics

Several studies have investigated whether various characteristics of the GP raising and managing a fund can explain cross-sectional variation in returns. This section looks at a selection of these studies.

3.2.1 The team's work history and educational background

Zarutskie (2007) tries to answer the question: "Can venture capitalist skill explain the heterogeneity and persistence of venture capital fund performance, and if so which skills matter and when?" Zarutskie (2007) has systematically registered the educational background and work history of venture capitalists raising first time funds. Subsequently,

she investigates whether this information has any predictive ability on these funds' performance. Her research has the potential to give a more detailed understanding of the importance of skill and experience. Interestingly, Zarutskie's (2007) findings indicate that venture capitalists' skills can indeed explain some of the heterogeneity and persistence in performance.

Zarutskie (2007) bases her research on first-time funds in the VentureXpert database. She argues that the skills required to achieve success is likely to vary between the venture and buyout segments of the private equity industry. Consequently, she chooses to focus on venture funds and exclude buyout funds from the sample. Her findings are therefore only directly relevant for venture funds.

Zarutskie's (2007) variables are summarized in table 1 which also indicates the documented effects on fund performance associated with each variable.

Table 1: Zarutskie's (2007) findings summarized
Effects of venture capitalists' educational background and work history on performance

	Variables (dummy)	Documented effect
Edu-cation	Has the team MBA competence?	Significantly negative
	Is the MBA taken at a prestigious university?	Negative, but insignificant
	Have any of the team members studied engineering or science?	Significantly positive
Work history	Has the team experience from another VC fund?	Significantly positive
	Has the team experience from managing a start-up?	Significantly positive
	Has the team experience from management consulting?	No significant effect
	Has the team experience from the non-venture financial industry?	No significant effect
	Has the team industrial scientist or engineering experience?	No significant effect

In general, Zarutskie (2007) finds the work history variables to have more predictive ability than the educational history variables. The skills required to achieve success as a VC fund manager seems to be mainly acquired at the workplace. She also finds that the variables have strongest predictive ability for early stage funds.

The finding that the effect of having MBA competence on the investment team is negative seems strange. Zarutskie (2007) offers few explanations to what may be causing this effect. However, she finds the negative effect to be stronger in early stage funds. One possibility is that MBA competence is not negative in itself, but that other competences are more

important. Adding new members to a team is costly and some sort of optimal team size probably exists. Having MBA candidates on the team may not be the right priority for these funds because it crowds out other more important competence.

Zarutskie (2007) not only investigates the effect of each of her variables in isolation. Possible complementarities with respect to the variables' effect on performance are also investigated. She concludes that there appears to be a complementarity between having venture investing experience and entrepreneurial management experience on the same management team.

Consistent with Kaplan and Schoar's (2005) findings of strong performance persistence, Zarutskie finds that the skills of venture capitalists not only predict the performance of first-time funds, but also follow-on funds raised by the same GP. This finding supports Kaplan and Schoar's (2005) conjecture that the persistence results may be a result of underlying heterogeneity in the GPs' skills.

LPs perform thorough investigations and reference checks of fund managers as a part of their screening and due diligence process when investing. Zarutskie's (2007) conclusions highlight the value of this work and provide academic support to the continuation of these processes. Both the experience of the single team members and the complementarity of the skills within the team seem to be important to fund performance.

3.2.2 The general partner's network

Hochberg et al. (2007) look at the network of GPs in the venture capital industry and its effect on funds' performance. The network of a GP is mapped by looking at syndicated deals in which it has participated. To put it simply, two GPs that have participated in a syndicate together is considered "connected". Whether the GP was the lead investor in a syndicate is also recorded. The resulting network data is analysed using graph theory (a mathematical discipline) and different measures of the GPs' "centrality" in their network is calculated. Hochberg et al. (2007) use these measures to model fund performance.

The findings indicate that better-networked firms deliver significantly better fund

performance and that the portfolio companies of these GPs are more likely to survive subsequent financing and eventual exit. The authors also offer some thoughts on the underlying drivers of these results.

Firstly, well-connected GPs have several advantages when it comes to deal sourcing. They are more frequently invited to co-invest in promising deals, and they are able to pool information within their network and thereby reduce uncertainty and make better investments. Furthermore, they are able to combine specialization with improved diversification through coinvesting in their network (Hochberg et al., 2007).

Secondly, a strong network may give the portfolio companies access to attractive alliance partners and improve the availability of follow-on funding. In addition, the portfolio companies of the VC firms with the strongest networks may get access to more high-quality service providers such as head hunters and investments banks (Hochberg et al., 2007). Consequently, being well-connected probably increases a GP's ability to improve its portfolio companies.

Hochberg et al. (2007) control for other known determinants of performance, i.e. fund characteristics, competition for deal flow, investment opportunities and parent firm experience. The authors argue that because they use lagged network characteristics to predict future performance, it is unlikely that their findings are caused by reverse causality. This means they do not believe outstanding performance facilitates the development of a strong network, but rather that it is the other way around.

3.2.3 Active ownership

In public markets investors are basically providing companies with a single input, namely capital. Most investors prefer to only get involved in the companies which they invest in if there is a crisis (Carlsson, 2003). A private equity investment is different because it is based on a combination of capital input and active ownership. Active ownership has been said to be the true value driver in private equity (Heel and Kehoe, 2005). This observation makes it interesting to look for dependencies between different indicators of a GP's involvement in

its portfolio companies and its performance.

That active ownership in some cases is vital to the success of a company is illustrated by a case study performed by Carlsson (2003). Carlsson has done an in depth study of the Swedish "Wallenberg sphere" and its success with exercising active ownership in two historically very successful Swedish companies, ABB and Ericsson. The active ownership involvement in these cases included, among other things, changing the CEO when necessary to adapt to changing situations, restructuring of ownership and the industry through mergers and acquisitions and changing the focus from short term gains to long term profitability (e.g. by making profitable R&D investments). Carlsson's (2003) work highlights the differences between passive and active ownership and illustrates that active involvement by a company's owners sometimes leads to outstanding performance.

Heel and Kehoe (2005) use active ownership as an explanation to why some PE firms do better than others. Their work investigates the details of 60 PE deals from 11 PE firms which they refer to as leading within the industry. The authors identify different sources of value creation in the deals they analyze and rank their relative importance. Company outperformance is the source of 63% of the measured value creation while market/sector appreciation and arbitrage contributes with 32% and 5% respectively. The authors conclude that the primary way PE firms create value is through improving the companies they invest in. Heel and Kehoe (2005) also identify five factors distinguishing the top performing firms from the rest in their sample. First, the top performers seek out expertise before making investments. Second, they employ focused and substantial incentive systems directed towards the chief executives in the portfolio companies. Third, they craft better value creation plans. Fourth, they devote more hours to their portfolio companies. Fifth, if they want to replace the management they do so early in the process.

3.2.4 Specialization

Funds are typically specialized with respect to the stage of the companies they invest in, i.e. they choose to invest in seed, early stage venture, later stage venture, buyout or a combination of these (see figure 1). Moreover, they may limit their investments to a specific geographical area and to specific industries. Funds differ with respect to the chosen degree

of specialization along each of these three dimensions. Manigart et al. (2002) have developed hypotheses about how the chosen degree of specialization influences a fund's required rate of return. They base their hypotheses on two theoretical frameworks, traditional finance theory (more specifically portfolio theory) and resource based theory.

According to portfolio theory, the risk of a portfolio is reduced by diversification. When a fund specializes it is assumed that diversification is reduced and consequently that it will require a higher return in order to be willing to specialize. This theory implies that in order to be able to compete for investments on a perfectly competitive market, all investors will have to diversify. Based on this theory, Manigart et al. (2002) put forward the hypothesis that a specialized VC firm will require a higher rate of return when investing within its area of specialization. Implicitly they say finance theory predict specialization will give funds a disadvantage.

Manigart et al. (2002) put forward the opposite hypothesis based on resource based theory, namely that a specialized fund will require a lower rate of return when investing within its area of specialization. Resource based theory views the firm as a collection of resources and competitive advantage is achieved by the accumulation of valuable, hard-to-imitate internal resources (Barney, 1991). Manigart et al. (2002) assert that specialization will increase a VC fund's understanding of its area of focus and that this understanding will enable the fund to make better investment decisions and to monitor its investments more effectively. They implicitly say that resource based theory predicts specialization will give funds an advantage.

The portfolio theory based view of the specialization/diversification trade-off in the VC industry may be inadequate because it is based on assumptions of frictionless markets and the absence of asymmetric information (Christensen, 2006). Specialization may also have advantages in the perspective of finance theory, e.g. in relation to improved monitoring abilities and the mitigation of information asymmetry. Another relevant question in relation to the portfolio theory based analysis is how important it is for the funds to diversify considering that diversification may occur equally efficient at the investor level.

The predictions based on resource based theory may also be questioned. Christensen (2006) points out that having a broad scope enables a fund to interact with many types of people. This, in turn, might have a positive effect on the fund manager's insight and experience and thus the accumulation of valuable resources. However, Christensen (2006) argues that specializing is indeed one possible approach to developing valuable resources and thus that resource based theory may explain why funds specialize.

The insights from finance theory and resource based theory seem applicable to the effects associated with all three dimensions of specialization: stage, geography and industry. However, the resources accumulated based on specialization in stages or industries are probably more competence related compared to the ones accumulated through geographical specialization. This brings Christensen (2006) to question what competences VC firms obtain by focusing on a limited industry or geographic area. He says that industry specialization may generate technical competences related to products and markets, while geographical specialization will give access to local networks and improved ability to interpret information from the local environment. Furthermore, it is claimed that spatial proximity gives a fund clear advantages in relation to active ownership.

De Clercq and Dimov (2003) find that VC firms' specialization in terms of stage and industry has strong positive effects on performance. They say uncertainty is reduced by specialization because the VC firm is able to provide more competent advice to their portfolio companies. Specialized knowledge is also found to enable the VC firms to get more directly involved in their portfolio companies. A link to the reflections discussed about active ownership in the preceding section is apparent here; specialized firms are able to more efficiently exercise active ownership. DeClercq and Dimov's (2003) findings are consistent with the resource based theory hypothesis of Manigart et al. (2002), i.e. that specialized funds have an advantage because they are able to accumulate valuable hard-to-imitate internal resources.

While most of the research on specialization has been done in relation to VC funds, the insights from the theoretical frameworks discussed are likely to be relevant in the buyout segment as well. Specialized buyout funds will probably experience the same disadvantages in relation to diversification as the VC funds. Furthermore, they will also enjoy any benefits

associated with improved monitoring and accumulation of resources associated with having a specialized strategy.

3.3 Funding source related determinants

Systematic performance patterns in the PE industry are not only found across different funds and GPs, but also across different LPs. Lerner et al. (2005) look at different classes of LPs and how PE investment performance varies across these classes. The classes are: endowments, advisors, public pension funds, corporate pension funds, insurance companies, banks and "other LPs". They find the annual returns earned by endowments to be 14% greater than the average, while the returns of banks and advisors are found to lag sharply. The difference in performance is only observed for VC investments.

Lerner et al. (2005) suggest several possible explanations to the observed performance differential between the different classes of LPs. First, they compare the performance of partnerships in which the LPs decide to reinvest to that of the partnerships they choose to exit. This way they can observe how good the reinvestment decisions of the different LPs are. Overall, endowments and public pension funds seem to be less likely to reinvest compared to other LPs. Furthermore, the funds in which they reinvest outperform the average fund. Lerner et al. (2005) say this indicates that these LP classes are the best at utilizing an informational advantage they gain by working with a GP over time.

Another suggested explanation is that some LPs have preferential access to the best funds. As discussed by for example Kaplan and Schoar (2005) the best performing funds seem to voluntarily limit their size. Consequently, it may be the case that some LP classes have systematically inferior access to the top performers. Lerner et al. (2005), find that different access to funds is likely to explain some of the performance differential, but not all of it. Lerner et al. (2005) also argue that the difference in observed performance between LP classes is possibly in part a result of differences in their objectives. A banks decision to invest in a specific partnership may for example be partly driven by the prospects of earning fee based income from the same partnership. Another example is that funds in the public sector may invest to support the businesses in their own geographic area. When LPs have

other objectives than pure profit maximization the measured performance may fail to fully capture the true benefit enjoyed by the LP.

3.4 Conclusion

Fund size and sequence number seems to be related to fund performance at least in the cross-section and the size-performance relationship has been found to be concave. Furthermore, there is a strong tendency of top (and bottom) performers to stay in their performance bracket. The fundamental effects associated with size, sequence number and performance persistence are well documented and seem to apply both to VC funds and buyout funds.

The work history and education of the individuals managing VC funds have been found to significantly affect performance, and competence acquired at the work place seems to be most important. Furthermore, evidence that a strong network positively affects VC funds' deal flow and ability to improve portfolio companies has been found. Moreover, PE funds seem to create value primarily by exercising active ownership. Different theories offer different predictions concerning the effects specialization has on a fund's performance. However, at least for VC funds, the effects of specializing with respect to stage and industries seem to be positive.

Some LPs appear superior at utilising an informational advantage they gain when investing in multiple funds raised by the same GP. Furthermore, significant differences in the performance of different classes of LPs have been found. At least when it comes to VC investing, endowments have been found to perform better than other LP classes.

4. DATA COLLECTION AND DESCRIPTION OF THE SAMPLE

The empirical study in this report is based on various material provided by a PE investor in the Nordic region. The material consists of documents received by the data provider from PE firms in the fund raising process or as a part of a due diligence process. These documents represent a mixture of private placement memoranda, due diligence material and other information about specific PE funds. I will refer to this material as the raw data.

The aim of the empirical study is to use the raw data to identify determinants of fund performance. In order to do this, I have mapped out important characteristics of the funds in the sample and looked at their track record to assess their previous performance. The underlying idea of the study is to identify factors distinguishing the top performers from the other funds.

This chapter is structured as follows. Section 4.1 describes how the data was collected. Section 4.2 describes how the track record data was prepared for analyses. Section 4.3 describes the characteristics of the funds in my sample.

4.1 Data collection

The process of systemizing the raw data consisted of two steps. First, I recorded important fund characteristics and thereafter I systemized all track record information.

4.1.1 Fund characteristics

Firstly, an examination of the raw data was carried out with the aim to identify important characteristics of the funds. The variation among the funds both with respect to the amount of available information and how the information was presented was large. Because of this, the selection of what information to record was largely governed by the availability and consistency of the information about different characteristics. Table 2 gives an overview of the information collected about each fund.

Table 2: An overview of the information collected about the funds' characteristics

Variable category	Information collected
General fund information	• The nationality of the firm managing the fund • Total committed capital • Commitments made to the fund by the provider of the raw data • Vintage year • Sequence number
Fees and other partnership terms	• Maximum commitment per investor • The fund's duration • The GP's commitment to the fund • Management fee • Preferred return • Carried interest
The fund's investment strategy	• Stage focus (early stage venture, later stage venture or buyout) • Geographical focus area • Which industries the fund focus on • Expected number of investments • Typical investment size • Typical size of target companies • Is the fund's strategy consistent with the strategy of previous funds raised by the same partnership? • Does the fund require control in the companies it invests in?
Deal flow	• Statements found in the raw data concerning the fund's sources of deal flow, e.g. reputation, network and market conditions
Value creation	• Statements found in the raw data concerning how the fund plans to create value in its portfolio companies

As shown in table 2, the information collected is divided into five categories. Relevant variables concerning general fund information and partnership terms was identified and recorded. Furthermore, information about the investment strategy was systemized. However, when it came to deal flow and value creation, the information available was less tangible. Because of this, the information recorded about these aspects is more qualitative.

After excluding funds where the information available was judged to be insufficient, the remaining sample consists of 38 funds. Of these, the investor providing the raw data has invested in 14, rejected 22 and the remaining two was listed as candidates for investment at the time the data was recorded.

4.1.2 The general partners' track records

Ideally, when trying to identify factors determining performance, it would be preferable to have information about the performance of the actual funds in the sample. However, this study is based on information typically issued by the funds before they have made any investments, and consequently information about their performance was not available.

Instead, I have collected information about the track records of the firms raising the funds. Because the funds typically report past performance to demonstrate their ability to deliver returns, track record information was available in most of the cases. In addition, performance reports from some of the funds which the data provider has invested in were obtained. Information found in these reports was also included in the dataset.

I started with the 38 funds about which I have detailed information concerning general characteristics, fees and partnership terms and investment strategy. I was able to find at least one track record observation for 28 of these. This sample of 28 funds will be referred to as the main sample. Of the ten funds I failed to find any track record information about, five were first time funds. For the remaining five funds any adequate information about previous performance could not be found even though they are not first time funds.

Whether a fund's strategy has changed over time should be checked in order to justify the use of track record information to assess the success of the fund's strategy. Of the 28 funds in the main sample, 16 explicitly say their strategy will be consistent with the one followed in earlier funds. Furthermore, information indicating a consistent strategy was found in the raw data for eight funds. In the remaining four cases no statements about the strategies' consistency were found in the raw data. However, information found about these partnerships elsewhere (e.g. their web pages and the media) indicate that their strategies have not changed materially.

No standardized way of reporting past performance exists in the PE industry and the funds in the sample report their track record in a number of different ways. To make the necessary normalizations possible, the foundation of all track record information collected was documented.

First of all, some of the funds report their track record on a fund by fund basis, while others report the aggregate performance of all (or a subset of) their previous investments. A variable named "track basis" was recorded for each track record observation to distinguish these reporting practices. This variable contains a fund name or another description of the track basis, e.g. "25 previous venture investments made by 2 different funds".

Secondly, the reported track record is often partially based on unrealized investments. The funds have different ways of treating these. Some funds report the returns on realized investments only and exclude all cash flows associated with unrealized investments in the performance calculations. Other funds include unrealized investments in the track record by using various methods to estimate their value (e.g. they value them at cost or follow guidelines given by EVCA). A variable named "track type" was recorded for each track record observation to indicate whether the reported performance is based on realized investments only, both realized and unrealized investments or a fully realized fund.

Thirdly, most of the track record information concern unrealized funds. The funds have different vintage years and the performance is measured at different points of time. The measured performance of a fund cannot be evaluated without knowing where it is in its life cycle (this is related to the j-curve effect mentioned in section 2.3). To take this aspect into account a variable named "track record end date" was recorded. This variable indicates up until which date cash flow information was included in the performance measurement. Together with vintage year, this variable makes it possible to determine what stage of the life cycle the fund was in at the time of the performance measurement.

Fourthly, some funds report performance based on cash flows between the fund and the portfolio companies, while others report performance based on cash flows between the fund and the LPs. The first type of performance is typically referred to as the gross IRR or gross multiple because management fees, carried interest, expenses and other costs are not deducted from the cash flows. The second type is typically referred to as the net IRR or net multiple (TVPI) because it measures the actual return enjoyed by the LPs net of all costs.

Table 3 lists and describes the variables used to systemize the track record information. The four last variables mentioned in the table, i.e. gross IRR, gross multiple, net IRR and TVPI represent the performance recorded. For each track record observation at least one performance measure is available, but for some observations several performance measures are reported. To clarify what a typical observation looks like, an example is given in the last column of table 3.

Table 3: The variables used to structure the track record information

Variable name	Description	Example
Main fund	The name of the fund the track record observation refers to. This variable links the track record information to the fund characteristics information	"NN" fund III
Track basis	If the observation relates to a specific fund, this variable indicates the name of that fund, if not, the basis of the track is described (e.g. all previous buyout investments made by firm "NN")	"NN" fund II
Track type	Indicates whether the performance measurement is based on either: • Realized investments only • Both realized and unrealized investments • A terminated, and thus, fully realized fund	Realized and unrealized
Track record end date	Indicates up until what date cash flow information was included in the performance measurement	25.04.2005
Vintage	If the track basis is a fund, this variable indicates this fund's vintage	2000
Size	If the track basis is a fund, this variable indicates the amount of capital committed to it (NOK million)	1842
Gross IRR	The Gross IRRs are normally calculated based on cash flows between the portfolio companies and the fund. Residual values are treated as cash inflows. Gross IRR reflects the return before deduction of expenses, management fees and carried interest	20%
Gross multiple	The estimated value of a fund's unrealized portfolio companies and cash flows from realized investments divided by the total equity invested in the portfolio companies	N/A
Net IRR	Net IRRs are calculated on actual cash-calls and distributions from/to the LPs. Residual values are treated as cash inflows. The GP's carried interest is normally subtracted from any residual values	N/A
TVPI	Total value to paid-in capital. The sum of all distributions to the LPs and their share of the residual value divided by the LPs investment	N/A
Comments	Any deviation from the above stated variable definitions is noted here	None

4.2 Preparation of the track record data

Because of the heterogeneity in the way funds report previous performance, a number of adjustments and normalizations had to be made to make further analysis possible. The aim of these adjustments and normalizations is to make the data suited to assess the relative performance of the different partnerships raising the funds in the main sample.

4.2.1 Identification of the appropriate benchmark

The majority of the track record observations consists of previous funds where the gross IRR has been reported based on both realized and unrealized investments. However, some

funds have reported their performance based on realized investments only (imagine for example a fund with ten investments reporting its performance based on the cash flows associated with its four realized investments only). It is hard to compare performance measures based on all the investments of a fund with performance measures based on realized investments only. Consequently, except for fully realized funds, all track record observations based on realized investments only were excluded from the sample.

Relevant benchmark information for each observation was gathered from the commercial data vendor Thomson VentureXpert. VentureXpert base their benchmark information on cash flow data voluntarily reported by PE firms and their investors on a quarterly basis. Benchmark information for venture and buyout funds was collected separately. Because most of the funds in the sample are European I chose to retrieve benchmark information based on funds with Europe as their primary market.

To identify the correct benchmark associated with each track record observation three inputs were used: the observation's stage focus, vintage year and the "track record end date". The vintage year is important both to eliminate variation in returns caused by market cyclicality and to take into account where the fund was in its life cycle when performance was measured. The capital weighted average IRR and the lower, medium and top quartile IRRs for each combination of these three inputs were recorded.

4.2.2 Making the track record comparable to the benchmark

VentureXpert reports IRRs based on cash flows between the funds and their investors modified to incorporate the year-end valuation of the partnership's unliquidated holdings or residual value. This is equivalent to the net IRR of the funds. However, the performance measure most frequently used by the funds in the sample is gross IRR. Thus, I needed some method to adjust the gross IRRs to make them comparable to the net IRRs used by VentureXpert.

Firstly, I spoke with a practitioner (working with the PE investor providing me with data) who indicated that the gross IRR will typically lie 4-5 percentage points above the net IRR. Furthermore, I have made my own calculations which indicate that the net IRR is

approximately equal to 0.9 times the gross IRR minus 0.03 (for positive IRRs). This result is consistent with the practitioner's statement for typical values of the gross IRR. My calculations, which are based on a typical fee structure and other appropriate assumptions, are described in detail in appendix 1. I have tested the estimated relationship on 12 track record observations where both the gross and net IRRs are reported. This was done by comparing the net IRR predicted by the estimated relationship to the actual net IRR. This comparison indicated that the adjustment succeeds at approximating the net IRRs. However, the adjustment is far from perfect. In the absence of better data, the described adjustment is probably the best available method to make the sample comparable to the VentureXpert benchmark.

By adjusting gross IRRs and using net IRRs where reported, I am able to determine an estimated or actual net IRR for 68 track record observations (these observations will be referred to as the track record sample). The difference between the net IRR of each track record observation and the relevant capital weighted average IRR (benchmark) was calculated. I will refer to this difference as the benchmark outperformance. In addition, each observation was placed in one of four performance classes based on the benchmark quartiles. An observation is placed in class one if its net IRR lies below the lower quartile, in class two if it lies between the lower and medium quartiles, in class three if it lies between the medium and top quartiles and in class four if it lies above the top quartile.

4.2.3 Measures of past performance

Based on the performance class and adjusted net IRR of all the 68 track record observations I am now able to assess the track record of the 28 partnerships which these observations are connected to. For each partnership I have calculated the average benchmark outperformance and average performance class of all track record observations associated with it. In addition, I have recorded the adjusted net IRR and performance class of the most recent track record observation associated with each fund. The end result is four different measures expressing the recorded past performance of each partnership. It should be mentioned that none of these measures adjust for possible differences with respect to risk characteristics. Thus, comparisons based on these measures may be distorted if the underlying risk characteristics are different across the funds. The measures and their descriptions are

summarized in table 4.

Table 4: The measures of the previous performance of each partnership

Performance measure	Description
Average benchmark outperformance	• The average benchmark outperformance of the track record observations associated with each partnership • The benchmark outperformance tells us how a fund has performed relative to the appropriate benchmark

Average performance class	• The average performance class of the track record observations associated with the partnership raising the fund
	• The performance classes are defined as follows:
	   1. Performance below the lower quartile
	   2. Performance between the median and the lower quartile
	   3. Performance between the median and the top quartile
	   4. Performance above the top quartile

Adjusted net IRR most recent track	The same as the average adjusted net IRR, but only based on the most recent track record information associated with each partnership
Performance class most recent track	The same as the average performance class, but only based on the most recent track record information associated with each partnership

4.3 Description of the funds in the sample

In this section, I describe the characteristics of the 28 funds in the main sample. I look at the funds' general characteristics, partnership terms and strategy with respect to geographical and industrial specialization. Information recorded regarding the funds' deal flow and their perspectives on portfolio company value creation is also discussed, and the results from the track record assessment are examined.

4.3.1 General characteristics

Table 5 presents basic descriptive statistics with respect to the general characteristics of the funds in the main sample. The sample consists of 11 buyout funds and 17 venture funds. Of the 17 venture funds, six are focusing on early stage investments (EVC). The sample is relatively small, and this may lead to difficulties with finding significant results. The problem might be even more pronounced when splitting the sample and looking at buyout and venture funds separately.

24 of the funds are of Nordic origin, two funds are based in the UK and two are based in the US. The distribution with respect to the funds' nationality is natural considering the data provider's focus on the Nordic region. The sample's geographical concentration means the results of analyses based on it are primarily applicable to the Nordic region.

Table 5: Descriptive statistics with respect to the funds' general characteristics

Focus stage	Count
Buyout (BO)	11
Non-early venture (VC)	11
Early stage venture (EVC)	6

	Count			
Nationality	BO	VC	EVC	Total
Norwegian	5	3	3	11
Finnish	1	4	1	6
Swedish	1	1	2	4
Danish	2	1	0	3
United Kingdom	2	0	0	2
United States	0	2	0	2

Commited capital	Count			
(mNOK)	BO	VC	EVC	Total
>10000	2	0	0	2
2500-10000	3	1	0	4
2500-10000	5	7	0	12
1000-2499	0	3	4	7
0-250	1	0	2	3

The data provider's	Count			
relation to the fund	BO	VC	EVC	Total
Rejected	4	7	3	14
Invested	7	3	3	13
Under evaluation	0	1	0	1

	Count			
Vintage year	BO	VC	EVC	All
2000	1	0	0	1
2001	0	1	1	2
2002	0	1	1	2
2003	0	1	0	1
2004	4	2	1	7
2005	2	2	1	5
2006	3	2	1	6
2007	1	2	1	4

	Average			
	BO	VC	EVC	All
Sequence number	3.9	5.3	4.3	4.5
Com. capital (mNOK)	7222	1470	437	3508

The heterogeneity with respect to fund size is large in the sample. The smallest fund has a committed capital of NOK130mn and the largest more than NOK30bn. The buyout funds are largest with an average committed capital of NOK7222mn. The large average size of the buyout funds is mainly driven by two very large funds with more than NOK20bn and NOK30bn in committed capital respectively. Not surprising, the venture funds are smaller than the buyout funds and the early stage venture funds are smallest.

The funds in my sample are relatively young. The funds' vintage years span from 2000 to 2007 and the majority of the funds were established after 2003. This highlights the problem of getting performance data from the actual funds in the sample and the need to look at track record information in order to assess performance. The average fund in the sample is the fourth or fifth fund raised by the firm managing it.

The investor providing the raw data has different relations to the funds in the sample. They have invested in 14 of them, 13 have been evaluated and rejected and one fund was in the process of being evaluated when the data was collected.

24 of the funds in the sample are limited partnerships and the remaining four are established as limited companies. The duration of the funds are typically set to 10 years with one or more one-year extensions possible. When it comes to the fees the fund managers charge, the funds are very homogeneous. The fund managers are, with only small variation, charging around 1.5-2.5% each year in management fee. In the investment period, the calculation of the management fee is typically based on total committed capital and thereafter on capital invested by the fund with all realized investments subtracted. A preferred return to the limited partners between 2% and 10% on their investment is also found in most of the funds. Where information about carried return to the GP is found (in 24 of the observations) this is defined as 20% with only one exception where it is defined as 15%. Most of the funds have also defined a so called catch-up arrangement[1].

To conclude, my sample is relatively small; this is expected to represent a problem especially if the sample is split up into sub-samples according to the stage focus of the funds. The sample is also heterogeneous with respect to fund size. With respect to the funds' origins the sample is dominated by Nordic funds. The funds seem to mostly be organized with terms and fees in accordance with prevailing industry standards.

4.3.2 Geographical specialization

As stated in table 2, I have recorded each fund's geographical focus area. Based on this information, I have defined a variable meant to measure the degree of geographical specialization. The definition of this variable is accounted for in table 6. The definition should be regarded as indicative and the value attributed to each fund is based on my qualitative judgement.

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[1]A catch up arrangement is used to make sure the GP receives its full carried return when the fund performs well (typically 20% after the capital drawn down is paid back). If a catch up arrangement is not in place, any preferred return paid to the LPs may result in an effective carried interest below the defined level. A typical catch-up arrangement may entitle the GP to receive 80% of all realizations until it has received 20% of distributions in excess of drawn down commitments.

Table 1: The variable measuring each fund's degree of geographical specialization

Degree of geographical specialization

Value	Indicative description
5	Scope limited within a single country (e.g. Western Norway)
4	Focus on single small country (e.g. Norway)
3	Region focus (e.g. Nordic)
2	Extended region focus (e.g. mainly Nordic focus, but also the US)
1	Global scope (e.g. Europe and the US)

The different descriptions of focus areas found in my sample and the corresponding number of funds using each description is shown in table 7. The table also indicates the value assigned to the variable measuring the degree of specialization in each case. The most specialized funds in the sample have defined a specific region within Norway as their focus area whilst the least focused funds indicate a global investment strategy. A plus sign behind a description of a focus area in table 7 means the fund is indicating that it will also consider investments outside its focus area.

Table 2: The fund's geographical focus areas
The number of funds focusing on each region and the value assigned to the variable measuring the degree of specialization in each case is given in the table.

Geographic focus area	Count				Degree of spec.
	BO	VC	EVC	All	
Region in Norway	2	0	0	2	5
Denmark and Sweden	2	0	0	2	4
Norway +	2	0	0	2	4
Finland	0	0	1	1	4
Nordic	1	3	3	7	3
Nordic +	3	5	2	10	2
Europe	1	0	0	1	2
Europe and North Americ	0	1	0	1	2
United states	0	1	0	1	2
Global	0	1	0	1	1

As made evident by table 7, the majority of the funds in my sample focus on the Nordic region. Ten funds have a pure Nordic focus and seven funds have a Nordic focus but hold the possibility of investing outside the Nordic countries open (Nordic +). In addition, five funds are focusing on a single Nordic country and two funds are focusing on a specific region within Norway. The remaining four funds are focusing on Europe or the US as a whole or have a global focus. The number of funds with each of the defined degrees of geographical specialization is shown in table 8.

Table 8: The number of funds with the different degrees of geographical specialization

Degree of geo.	Count			
specialization	BO	VC	EVC	Total
5	2	0	0	2
4	4	0	1	5
3	1	3	3	7
2	4	7	2	13
1	0	1	0	1
Average	3.36	2.18	2.83	2.79

The average degrees of geographical specialization indicate that the venture funds in my sample are less specialized with respect to geography compared to the buyout funds. The most typical strategy with respect to geographical specialization is to have an "extended region focus" (variable value = 2), which implies having defined a geographic region to focus on, but at the same time holding the opportunity of investing in other areas open.

4.3.3 Industrial specialization

For each fund, the information gathered about industrial focus area was used to determine the degree of industrial specialization. The definition of this variable is accounted for in table 9. Similarly to the variable measuring the degree of geographical specialization, the definition should be regarded as indicative and, again, the value attributed to each fund is based on my qualitative judgement.

Table 9: The variable measuring each fund's degree of industrial specialization

Degree of industrial specialization

Value	Indicative description
5	Single industry (e.g. mobile communication)
4	Single industry group (e.g. ICT or life sciences)
3	Multiple industry groups (e.g. ICT and life sciences)
2	Selective general scope (general fund with some preferences)
1	Completely general scope (the fund is completely opportunistic)

Table 10 shows the distribution of the funds with respect to their degree of industrial specialization. The most focused funds in my sample have defined a single industry as their focus, while the least focused funds indicate that they have no limitations with respect to what industries they invest in.

Table 10: The number of funds with the different degrees of industrial specialization

Degree of ind.	Count			
specialization	BO	VC	EVC	Total
5	1	2	0	3
4	0	7	3	10
3	1	2	3	6
2	5	0	0	5
1	4	0	0	4
Average	2.00	4.00	3.50	3.11

In general, the venture funds tend to be more industrially specialized than the buyout funds. 17 of the venture funds in the sample are focusing on life sciences, information and communications technology or both. Three plan to invest in technology companies in general and two limit their investment scope to mobile communications. It is clear that the venture funds in the sample plan to invest in traditional high-growth industries, this is typical for venture funds in general.

The buyout funds in general have a wider industrial investment scope. Four of them have not specified any limitations to what industries they invest in and five have a general investment strategy, but have indicated certain industries which they prefer. One fund is focusing on a limited number of industries that are strong in Western Norway. The remaining fund is

investing in petroleum related businesses only. It is noted that while the venture funds are more specialized with respect to industries, the buyout funds are more specialized with respect to geography.

The correlation of the geographical and industrial specialization variables is estimated to be negative at -0.324 (which is significantly negative at the 10% level). One possible conjecture based on this finding is that a trade-off between geographical and industrial specialization exists. If a fund has a very narrow industrial focus, it has to widen its geographical focus in order to get access to sufficient deal flow. Furthermore, as discussed in section 3.2.4, it is possible that funds benefit from specializing along at least one dimension because it allows them to accumulate some sort of valuable specialized competence.

4.3.4 Sources of deal flow

Differences between funds with respect to their access to attractive deals have been introduced as an explanation to the observed persistence in the performance of PE firms (Kaplan and Schoar, 2005). Thus, it is interesting to look at what the funds say about their deal flow.

Almost all the funds in the sample mention their access to attractive deals as an important driver of value creation. Network and reputation are the most commonly mentioned drivers of deal flow. Some funds also mention attractive market conditions within their focus area as important[5].

Regarding network, some funds mention their local presence in certain areas as important. Others, typically venture funds, refer to their history of making syndicated deals with attractive partners as important, this is consistent with the findings in Hochberg et al. (2007)

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[5] Originally, I worked with a hypothesis that funds focusing on their reputation and networks as drivers of deal flow would perform better relative to the benchmark compared to funds focusing on good market conditions and strong deal flow in general. The idea was that the benefit from a strong market would already be captured in the benchmark. Alas, I was not able to find data suited for quantitative analyses concerning the funds' sources of deal flow. The firms' emphasis on these aspects indicates that they are indeed important to value creation, but I am not able to test this quantitatively.

discussed in section 3.2.2. Several of the funds also claim to have advisory boards with experienced and well connected individuals that are expected to contribute to their deal flow.

Reputation among prospective portfolio companies is also mentioned as being important by a large number of the funds in the main sample. Some venture firms say their reputation will give them access to deals on lower valuations because entrepreneurs find it attractive to work with them. This is consistent with Hsu's (2004) findings.

4.3.5 Perspectives on portfolio company value creation

The funds seem to follow different logics when it comes to how they plan to create value in their portfolio companies. Most of the funds explicitly say they will focus on active ownership as a driver of value creation. These funds typically say they will focus on increasing sales and improving margins, a few mention optimization of capital structure. The common factor of these funds' logic is that it is based on resources that are internal to the fund (e.g. superior management abilities or access to a network that is attractive for the portfolio companies).

However, some funds seem to rely more on attractive market conditions than on internal resources. Attractive market conditions in this setting may refer to strong prospects of the industries on which the fund focuses, or that the competition for deals in their selected segment of the market is weak and consequently that deals are available at attractive valuations. The funds focusing on these factors share the common feature that their value creation logic is based on attractive conditions in their environment[6].

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[6] Originally, I had a hypothesis that the funds focusing on internal resources as a driver of value creation would perform better relative to the benchmark compared to funds focusing on attractive market conditions. My idea was that benchmark outperformance cannot be based on strong market conditions because these are common to all funds. Internal resources, on the other hand, are what differentiates the funds, and is thus more likely to result in systematic differences in performance. Similarly to what was the case with respect to sources of deal flow, I was not able to find data suited for quantitative analyses concerning the funds' perspectives on portfolio company value creation.

4.3.6 Performance

This section summarizes the findings from the performance assessment described in section 4.2.2. Figure 5 shows the distribution of the 68 track record observations with respects to outperformance of their respective benchmarks. The distribution seems to be approximately normal, albeit with a fat right tail. This means that compared to a normal distribution, funds showing very strong outperformance of the benchmark are overrepresented.

Figure 5: The track record sample's distribution with respect to benchmark outperformance
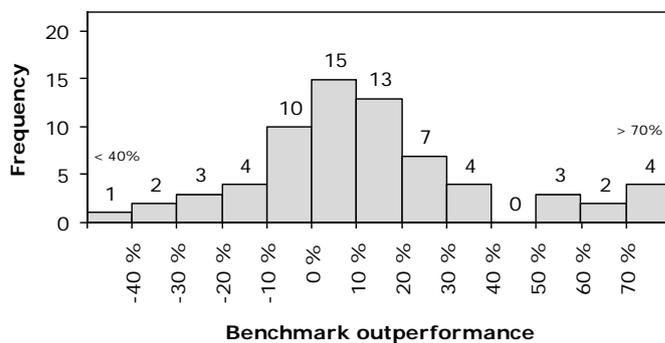
In a random sample of PE funds, the benchmark outperformance is expected to be close to zero, given that the benchmark used is appropriate. However, the average outperformance in the track record sample is 15.1% which is significantly different from zero at the 1% level[7].

The distribution of the track record observations with respect to the defined performance groups, shown in figure 6, indicate that as many as 41 (60%) of the track record observations are classified as top quartile. The funds in the track record sample seem to strongly outperform the benchmark. This may have several explanations. First of all, several possible sources of sample selection bias are present. Moreover, the method used to adjust the fund's reported performance may have weaknesses.

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[7] Two-sided hypothesis test p-value = 0.0004. 95 % confidence interval [7.0%, 23.2%]

Figure 6: The track record sample's distribution with respect to the performance classes
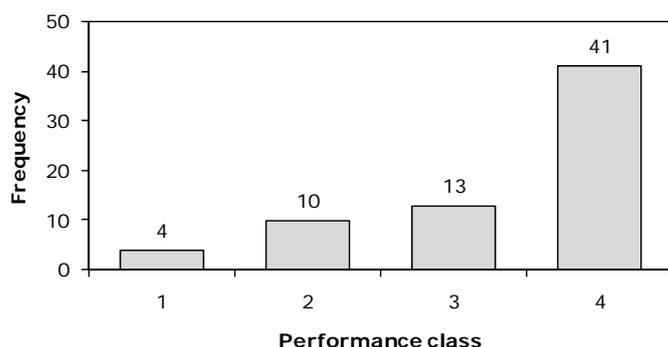
One potential source of bias is related to the fact that the raw data provider has invested in 13 of the 28 funds which I have track record information about. Among other things, the investor looks at track record information when making investment decisions and consequently the funds it chooses to invest in presumably have outperformed the benchmark on average. In table 11, the funds the data provider has invested in are compared to the funds where no investment has been made. However, no clear differences with respect to benchmark outperformance, sequence number or stage focus is found between the two groups of funds.

Table 11: A comparison of the funds the data provider has invested in and the ones it has not invested in

	Obs	Avg BM outperf	Seq. no	Size	BO	VC	EVC
Has invested	13	16.68 %	4.54	3857	7	3	3
Has not invested	15	15.78 %	4.53	3206	4	8	3
	28	16.20 %	4.54	3508	11	11	6

Furthermore, it is possible that the funds selectively choose which of their previous funds they report the performance of to LPs. If a tendency of underreporting of weak past performance exists, this will result in an upward bias on the measure of benchmark outperformance.

The average fund in my sample is a fourth fund raised by a GP. If we reasonably assume successful GPs are more likely to raise new funds than other GPs, it is not surprising that the funds on average have outperformed the benchmark. The fact that a GP is in the process of raising its fourth fund is in itself saying something about the quality of its track record. This

phenomenon is commonly referred to as a survivorship bias.

The approach used to adjust the funds' performance may also give an incorrect picture of the funds' actual track record. First of all, the detailed basis of the funds' performance measurement is not always made explicit by the funds and large differences across the sample exist. Even though I have tried to normalize the data, all inconsistencies almost certainly have not been eliminated and the recorded performance is probably to some extent misrepresenting the true track record of the firms.

Figure 7 shows the distribution of the main sample with respect to average benchmark outperformance. The buyout and VC funds are shown separately. Altogether, the funds seem to be approximately normally distributed with respect to average past performance. However, one buyout fund and one venture fund show abnormally strong past performance. This echoes the fat right tail observed in the track record sample. No significant difference between the buyout and venture funds is observed.

Figure 7: The main sample's distribution with respect to average track record benchmark outperformance
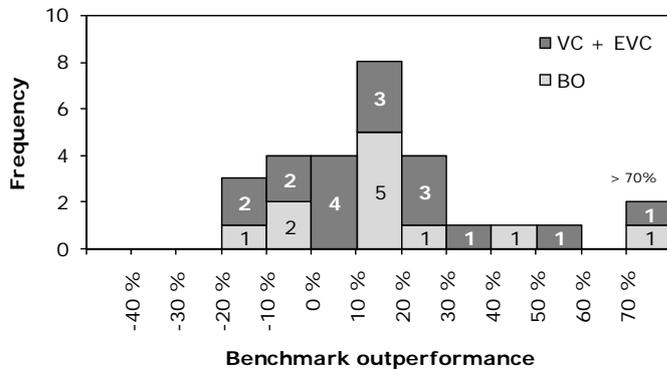
Figure 8 shows the distribution of the main sample with respect to benchmark outperformance of the most recent track record observation of each fund. This distribution gives the same impression of the fund's track record as figure 7, but the variation in this measure of past performance is greater. Considering that this measure is based on a much smaller number of track record observations (28 versus 68), this is not surprising. When the track record assessment is based on more than one fund, random variation is reduced and we are left with a more accurate measure of a GP's true ability to deliver strong returns. On the

other hand, using old track record information may represent a problem because the firm's abilities may change over time.

Figure 8: The main sample's distribution with respect to the benchmark outperformance of the most recent track record observation associated with each fund
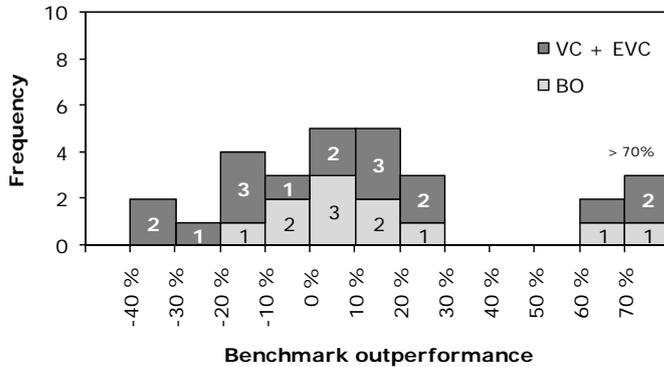
Figure 9 and 10 show the distribution of the main sample with respect to the defined performance classes. Figure 9 is based on all track record observations and figure 10 on the most recent track record observation only. Again, the impression is that the sample consists of strongly performing PE funds. Regardless of whether we look at the average track record performance class or the performance class of the most recent track record only, more than 60% of the firms are classified as top quartile. This makes the performance classes a poor measure to assess relative performance within the sample and probably less suited than the IRR measures to identifying determinants of performance.

Figure 9: The main sample's distribution with respect to the average track record performance class
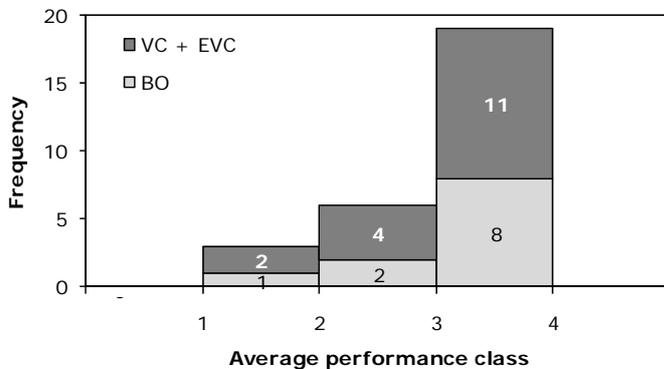
Figure 10: The distribution of the main sample with respect to the performance class of the most recent track record observation associated with each fund
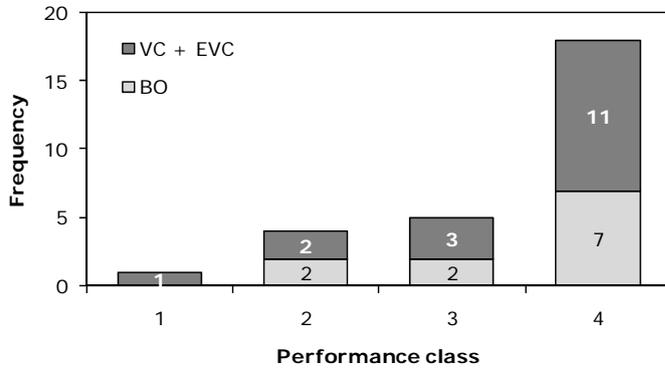
To conclude, my sample consists of funds raised by partnerships that on average have outperformed relevant benchmarks in the past. No systematic differences related to performance have been found between the buyout and venture funds. The past performance of the funds seems to be captured best by the average benchmark outperformance based on all available track record information.

5. EMPIRICAL ANALYSIS OF PERFORMANCE DETERMINANTS

Based on the data collected as described in chapter four, an explorative study of performance determinants was conducted. Based on the available data, it was decided to concentrate on the effects of geographical and industrial specialization.

Section 5.1 tests whether the relationships between size and performance and sequence number and performance documented in previous research can be found in the dataset. It will also be investigated whether performance persistence can be indicated. Section 5.2 conducts an analysis of the performance effects of industrial and geographical specialization and discusses potential drivers of the identified relationships. Section 5.3 concludes.

5.1 Test of fundamental performance relationships

In this section, I will investigate some of the most established relationships between fund characteristics and performance. In section 3.1 I referred to these relationships as fundamental performance relationships. The tests in this section are based on the funds in the track record sample where information about size and sequence number was obtainable (58 observations). Benchmark outperformance is used as the dependent variable in the tests.

5.1.1 Fund size and sequence number

As discussed in the literature review, Kaplan and Schoar (2005) and Phalippou and Gottschalg (2007), have found both fund size and sequence number to be related to performance. In order to investigate these relationships, regressions were run on the track record data collected (observations not related to single specific funds had to be excluded). Benchmark outperformance was used as the dependent variable and the logarithms of committed capital and sequence number were used as the explanatory variables. These are the same variables as used by Kaplan and Schoar (2005) in their most basic model specification. Regressions were run based on the entire sample and separately for the buyout

and venture funds. Based on previous research both the coefficient on size and sequence number is expected to be positive. The results are given in table 12.

Table 12: Regressions testing the fund size and sequence number effects
The analysis is based on the funds in the track record sample. The dependent variable is benchmark outperformance. The explanatory variables are the logarithms of committed capital and sequence number and stage focus (BO_dummy). P-values are in parentheses. Standard errors used for the tests of hypotheses are adjusted for heteroscedasticity. ***, ** and * indicate significance on the 1%, 5% and 10% levels respectively.

Regression number	1	2	3
Dependent variable	Benchmark outperf.	Benchmark outperf.	Benchmark outperf.
Observations	All (n=58)	BO (n=24)	VC (n=34)
Constant	0.46956	0.14123	0.90191
	(0.034) **	(0.461)	(0.018) **
Ln(Committed capital)	-0.06524	0.00078	-0.14766
	(0.094) *	(0.982)	(0.037) **
Ln(Seq.number)	0.01192	-0.02621	0.02868
	(0.887)	(0.733)	(0.826)
BO_dummy	0.09906		
	(0.185)		
R-sq	0.071	0.007	0.184
R-sq(adj)	0.037	0.000	0.131
F-test (p-value)	0.203	0.919	0.054 *

Contrary to what was expected, the coefficient on the logarithm of committed capital is negative in the regression based on the entire sample (regression 1) and the VC funds only (regression 3). The negative coefficient on the logarithm of sequence number in the regression based on the buyout funds is also unexpected. The sequence number coefficient has the expected positive sign in the VC part of the sample. The deviations from the expected signs on several of the coefficients in addition to low r-squares and high p-values (associated with the f-tests with a null hypothesis that all coefficients are zero) indicate that the performance effects associated with fund size and sequence number found in previous research cannot be replicated in this sample. Other specifications were also tested (e.g. the square of committed capital and sequence number was included), but these regressions did not show any better fit.

There are several probable reasons why the size and sequence number effects cannot be found in this sample. The most obvious reason is that the sample, consisting of only 58 funds, is too small. Kaplan and Schoar (2005) base their investigation of these effects on a sample of 746 funds. Furthermore, Kaplan & Schoar report an r-squared of 0.17 in their

model specification most similar to the one used here (their model also includes year fixed effects). This indicates that size and sequence number do not explain much of the variation in the dependent variable. This, in turn, makes it hard to estimate the effects based on small samples. My benchmark adjusted dependent variable is also different from the ones used in earlier research, a fact that may affect the results.

5.1.2 Performance persistence

The documented tendency of top (and bottom) performers to stay in their performance bracket was also tested. To investigate whether performance persistence can be found in my sample, I used the track record information collected. Partnerships with only one track record observation naturally had to be excluded from these tests. Using the remaining track record information, the correlation between the benchmark outperformance recorded for each fund and the benchmark outperformance of the preceding fund raised by the same partnership was calculated. If the correlation between past outperformance and the outperformance of each fund is positive, this is an indication of performance persistence. The correlation estimates and p-values associated with the hypothesis that the true correlation is zero are given in table 13.

Table 13: Testing performance persistence
The table shows the correlation between the benchmark outperformance recorded for each fund and the benchmark outperformance of the preceding fund raised by the same partnership. The p-values are associated with a hypothesis that the true correlation is zero.

	BO	VC	ALL
Observations	17	21	38
Estimated correlation	0.3809	-0.093	-0.0039
p-value	0.131	0.689	0.982

The estimated correlations are positive for the buyout funds, but negative for the VC funds and the consolidated sample. None of the correlations are significantly different from zero. The results for the buyout funds are in line with the results from previous research, i.e. benchmark outperformance seems to be persistent for these funds. The results from the buyout funds are also closest to being significant on a reasonable significance level. For the

VC funds, the negative sign on the correlation is not consistent with previous research. When it comes to the entire sample, the estimated correlation is very close to zero.

Regressions (unreported) with benchmark outperformance as the dependent variable were also tested. The logarithm of fund size and sequence number and the benchmark outperformance of the preceding fund raised by the same partnership were used as explanatory variables. Again, the results give only weak indications of performance persistence in the buyout part of the sample. In the VC part of the sample a negative sign (not significant) on the coefficient on preceding benchmark outperformance confirm that performance persistence cannot be found in this part of the sample.

It is likely that the positive correlation found for the buyout funds in the sample would become significant if the number of observations had been increased. However, performance persistence is not consistently found in this sample.

5.2 Geographical and industrial specialization

In relation to geographical and industrial specialization it was chosen to investigate the following research questions:

- Does the funds' chosen geographical focus affect their performance?
- Does the funds' chosen industrial focus affect their performance?
- Are the effects of specialization different for venture and buyout funds?

5.2.1 Geographical specialization

As an initial approach to the investigation of possible relationships between geographical specialization and performance, the average benchmark outperformance of funds with each of the five defined degrees of geographical specialization was calculated separately. If there are positive effects associated with specializing geographically the performance of the more specialized funds should be higher on average. Moreover, the average performance should increase gradually as the degree of specialization increases. General conclusions about the

effects of specialization will be more uncertain if the average outperformance behaves unsystematically as the degree of specialization increases. The results from the calculations, which are based on the funds in the main sample, are shown in table 14.

Table 14: The average benchmark outperformance calculated separately for funds with each of the five defined degrees of geographical specialization

Degree of geo. specialization	BO obs	BO Avg BM outperf	VC obs	VC Avg BM outperf	Total obs	Total Avg BM outperf
5	2	32.7 %	0		2	32.7 %
4	4	11.6 %	1	53.0 %	5	19.9 %
3	1	13.4 %	6	32.6 %	7	29.8 %
2	4	14.3 %	9	0.3 %	13	4.6 %
1	0		1	19.8 %	1	19.8 %
	11	16.6 %	17	15.9 %	28	16.2 %

None of the buyout funds in the sample fall within the least geographically specialized group. Among the buyout funds, the performance of the funds in group 4, 3 and 2 seems to be approximately equal. Of the two funds in group 5, one has strongly outperformed the benchmark, while the other has a weak track record. Based on these observations it does not seem to be any relationship between geographical specialization and performance in the buyout part of the sample. In order to investigate this observation further, group 5 and 4 and group 3 and 2 were merged. The average benchmark outperformance in these two groups is 18.6% and 14.1% respectively. A simple t-test indicates that the difference between the two groups is not significant on the 10% level (see appendix 2, report 1 for details). There seems to be no indication that specializing geographically is positively related to performance for the buyout funds.

When it comes to the VC funds, none of them are classified as belonging in the most geographically specialized group. If we disregard the single fund having a global investment strategy (degree of geographical focus equal to 1), the tendency of outperformance by the most geographically specialized funds seems quite clear.

The average benchmark outperformance of the VC funds in group 2 is particularly low. A closer look at the funds in this group rules out the possibility that this finding is driven entirely by a few very weakly performing funds. In fact, only one fund in this group has a track record with an average benchmark outperformance above the average for the VC funds

in the sample. Table 7 shows that seven of the nine funds within group 2 are funds focusing on the Nordic region while at the same time allowing investments in other regions (e.g. in other European countries or the US). The remaining two funds within this group focus on Europe and North America. Group 3, on the other hand, consists solely of funds focusing exclusively on the Nordic region. The relatively clear performance differential between these groups indicates that an exclusive focus on the Nordic countries has been more profitable than a less focused Nordic strategy also allowing investments in other parts of the world.

Similar to the approach followed for the buyout funds, the VC funds were split into two groups. Funds assigned with 4 and 3 as their degree of geographical specialization formed the first group and funds assigned with 2 and 1 formed the second group. The average benchmark outperformance of these two groups is 35.5% and 2.3% respectively. A simple t-test indicates that the difference between the two groups is significant on the 5% level (see appendix 2, report 2 for details).

I now turn to the results for the entire main sample. Echoing the findings for the buyout and VC funds separately, the performance of the most geographically specialized funds seems to be stronger than that of the least specialized. Again, the sample was split up. This time, the first group consisted of funds with a defined degree of geographical specialization equal to 5, 4 or 3 and the second group of funds with a degree of specialization equal to 2 or 1. The average benchmark outperformance of these two groups is 26.6% and 5.7% respectively. This difference is not significant on the 10% level (see appendix 2, report 3 for details).

5.2.2 Industrial specialization

The same approach as followed with respect to geographical specialization was followed with respect to industrial specialization.

The average benchmark outperformance of funds with each of the five defined degrees of industrial specialization was calculated. If there are positive effects associated with specializing industrially, the performance of the more specialized funds should be higher on average. Again, the average performance should increase gradually as the degree of specialization increases. The results from the calculations, which are based on the funds in

the main sample, are shown in table 15.

Table 15: The average benchmark outperformance calculated separately for funds with each of the five defined degrees of industrial specialization

	BO		VC		Total	
Degree of ind. Specialization	**obs**	**Avg BM outperf**	**obs**	**Avg BM outperf**	**obs**	**Avg BM outperf**
5	1	41.3 %	2	18.0 %	3	25.8 %
4			10	15.3 %	10	15.3 %
3	1	75.1 %	5	16.3 %	6	26.1 %
2	5	3.4 %			5	3.4 %
1	4	12.2 %			4	12.2 %
	11	16.6 %	17	15.9 %	28	16.2 %

For the buyout funds, no obvious pattern is observed. The fund having the most industrially specialized strategy (degree of industrial specialization = 5) focuses exclusively on petroleum, and has probably benefitted from market appreciation within this sector. The rest of the buyout funds have, to a smaller or greater extent, a general investment strategy. If group 3 and 2 are merged, the average outperformance of the new group is 15.4% which is not significantly different from the average outperformance of 12.2% found in group 1 (See appendix 2, report 4 for details).

No systematic pattern is clear when it comes to the industrial specialization of the VC funds either. Thus, no conclusions can be drawn with respect to the effects of industrial specialization based on these tests. Likewise, when looking at the entire sample of funds, no systematic effects are found. This is not surprising considering that no patterns were found for the VC and buyout funds separately.

5.2.3 Further investigation of the effects of specialization

The analyses presented in the preceding sections are univariate in nature. A possible tool for further investigation of the effects of specialization is multiple regression. By using this tool we are able to better satisfy the ceteris paribus condition (i.e. estimating the effect of specialization while holding other factors constant).

Considering the survivorship bias discussed in section 4.3.6 and the general positive relationship between sequence number and performance found in previous research, funds with high sequence numbers are more likely to have a track record above average. Consequently, fund sequence number should be included in the analysis to control for these effects. Fund size should perhaps also be included. However, fund size is probably a consequence rather than the cause of previous benchmark outperformance (which is used as the dependent variable). Consequently, fund size is probably an unsuited explanatory variable considering the nature of the dependent variable. A third possible control variable is a dummy variable indicating the stage focus of each fund. In theory, however, it should not be necessary to include this variable taking into account how the dependent variable is constructed. Different benchmarks are used for the buyout and VC funds, and this should eliminate general differences in the performance of these fund types. What is more, interesting results were found only when looking at VC funds separately.

The univariate analyses may also be disturbed by the documented negative correlation between industrial and geographical specialization in the sample. Consequently, the effects of including geographical specialization and industrial specialization simultaneously, and any interaction effects between these variables, should be investigated. Unfortunately, the small sample size (28 observations), together with strong multicollinearity amongst the explanatory variables (correlation matrix available in appendix 3), is potentially a major problem. Because of this, the results from the multiple regressions should be interpreted with caution.

Despite the mentioned methodological problems, multiple regressions were run to investigate the effects of specialization. The only control variable included in the final model specifications is sequence number. The regressions for the buyout funds (unreported) show results consistent with the univariate analyses, i.e. no significant effects associated with geographical or industrial specialization. Considering the results from the univariate analyses and the multiple regressions associated with the buyout funds, the results for the main sample seem to be mainly driven by the VC funds. As a consequence, I will in the following focus on the results from the VC part of the sample. The most interesting results are summarized in table 16.

Table 16: Regressions testing the effects of specialization
The analysis is based on the VC funds in the main sample. The dependent variable is benchmark outperformance, and the explanatory variables are sequence number, degree of geographical and industrial specialization (1-5 where 5 is most specialized). P-values are in parentheses. Standard errors used for the tests of hypotheses are adjusted for heteroscedasticity. ***, ** and * indicate significance on the 1%, 5% and 10% levels respectively.

Regression number	4	5	6	7
Dependent variable	Avg. benchmark outperf.	Avg. Benchmark outperf.	Avg. Benchmark outperf.	Avg. Benchmark outperf.
Observations	VC (n=17)	VC (n=17)	VC (n=17)	VC (n=17)
Constant	-0.5660	-0.1717	-0.5455	-4.4473
	(0.043) **	(0.640)	(0.062) *	(0.021) **
Sequence number	0.0407	0.0397	0.0406	0.0252
	(0.113)	(0.218)	(0.105)	(0.232)
Degree of geo. spec	0.2173		0.2181	1.7576
	(0.020) **		(0.035) **	(0.026) **
Degree of ind. spec		0.0353	-0.0056	1.0231
		(0.726)	(0.947)	(0.038) **
Interaction ind. geo. spec				-0.3947
				(0.041) **
R-sq	0.497	0.193	0.497	0.652
R-sq(adj)	0.463	0.139	0.445	0.602
F-test (p-value)	0.041 **	0.274	0.024 **	0.010 **

The reported regression coefficients on sequence number indicate that when sequence number increases with 1, the average benchmark outperformance increases with between 2.5% and 4% (depending on the model specification). This seems consistent with previous research. The coefficients on sequence number are generally not significantly different from zero. However, it is likely that the coefficients would turn significant if the number of observations had been increased.

In regression 4, the significantly positive coefficient on the degree of geographical specialization indicates that the results from the univariate analyses are robust to controlling for the funds' sequence numbers. Also consistent with the univariate analyses, regression 5 shows that when included alone, the degree of industrial specialization is not significant. Contrary to the other model specifications, the coefficient on the degree of industrial specialization is negative in regression 6. This highlights the problem associated with multicollinearity and is a reminder of the uncertainty regarding the reliability of these regressions.

Regression 7 shows interesting results. In this regression an interaction term is included (the product of the degree of geographical specialization and the degree of industrial

specialization). All the specialization variables in this regression are significant. The signs on the coefficients indicate that while specializing along each dimension separately has a positive effect on performance, specializing on both dimensions at the same time has harmful effects. This effect may be the reason why the coefficients are unstable in the other specifications (regression 6 in particular).

5.2.4 Possible explanations for the findings

As discussed in section 3.2.4, different theoretical frameworks seem to give different predictions about the effects specialization has on performance. In reality, the effect of specializing can probably not be explained by one of the frameworks in isolation. Consequently, positive and negative effects may cancel each other out and this may explain the lack of significant results. The fact that funds choose different degrees of specialization is in itself indicating that both positive and negative effects are associated with specialization.

The outperformance by the funds having an exclusive Nordic investment focus may be the result of strong performance of the Nordic VC market in general. In VentureXpert a benchmark report based on VC funds with a Nordic location started in 2002, 2003 and 2004 shows a capital weighted average IRR of 14%. A similar report with no location restrictions shows an average of 2.4%. This indicates outperformance by the Nordic region in this period. However, the average IRR of the funds with a Nordic location is based on fifteen funds only and this makes the estimate uncertain. It should also be kept in mind that most of the funds in group 2 are also focusing mainly (but not exclusively) on the Nordic market. Thus, a strong Nordic market can probably not explain the performance differential between funds with different degrees of geographical specialization.

In the absence of information making it possible to risk-adjust the performance measures, we cannot rule out the possibility that the apparent performance differential may be attributable to differences in risk characteristics. The entire, or at least some, of the difference might disappear if risk were taken into account. However, there seems to be no apparent reason why the systematic risk should be materially different between the groups.

Another possibility is that the investor providing the raw data may have stronger relations and superior access to pure Nordic VC funds compared to funds less focused on the Nordics. If this is the case, the investor may on average see more attractive opportunities in the Nordic region compared to other regions. However, the investor has invested in an approximately equal share of the funds having a defined degree of geographical specialization of 2 and 3. This contradicts the notion that the performance differential found between these groups is driven by a bias resulting from the data provider's investment scope.

Section 3.2.4 discusses several hypotheses concerning how specialization is related to performance. The finding of outperformance by the geographically focused VC funds gives some support to the hypothesis based on resource based theory. In short, this hypothesis says that specialized funds will outperform other funds because they are better equipped to develop valuable and hard-to-imitate resources. For the funds focusing exclusively on the Nordics, such valuable resources may, for example, be superior region specific investment competence or network within this market. These resources may enable funds to improve their screening of potential deals, their ability to exert active ownership and their monitoring abilities. The funds choosing a less focused strategy may find themselves in an inferior position to develop such resources because they are trying to back two horses.

The results from the multiple regressions indicated that the VC funds' performance is positively related to both geographical and industrial specialization separately. However, also that specializing along both dimensions simultaneously affects performance negatively. One possible driver of this result is that a fund specializing along both dimensions at the same time may not be able to attract sufficient deal flow because its focus area is too narrow. Another factor is that it might be sufficient to specialize along one dimension in order to achieve the benefits associated with specialization. This means the advantage of specializing along one dimension is reduced as the specialization along the other dimension increase. Regarding possible harmful effects associated with specialization (e.g. with respect to reductions in diversification and deal flow) it might be the other way around, i.e. the disadvantage of specializing along one dimension increases as the specialization along the other is increased.

5.3 Conclusions

For the buyout funds in the sample no systematic relationship between performance and geographical specialization was found. For the VC funds a clear tendency of outperformance by the more geographically specialized funds was observed. This tendency is primarily driven by funds having an exclusive Nordic focus outperforming funds with a less focused Nordic strategy (the ones also allowing investments in other regions). A possible reason for the outperformance by these funds is that they are in a superior position to develop resources valuable when investing in the Nordic region. Such resources may for example be related to the funds' investment competence or network within the region.

No systematic effects of industrial specialization were observed in the univariate analyses. In the multiple regressions, however, both geographical and industrial specialization was found to be positively related to performance in the VC part of the sample. Simultaneous geographical and industrial specialization, on the other hand, was found to have a negative effect on performance. One cause of this effect may be that funds specializing along both dimensions simultaneously experience problems with identifying a sufficient number of attractive deals within their narrow focus area.

REFERENCES

Barney, J. (1991) *Firm Resources and Sustained Competitive Advantage.* Journal of Management, volume 17, number 1, pp. 99-120 (1991)

Berk, J. & Green, R. (2004) *Mutual Fund Flows and Performance in Rational Markets.* Journal of Political Economy, volume 112, issue 6, pp. 1269-1295 (27)

Carlsson, R. H. (2003) *The benefits of active ownership.* Corporate Governance: The International Journal of Effective Board Performance, volume 3, issue 2, pp. 6-31 (26)

Christensen, J. L. (2007) *The Development of Geographical Specialization of Venture Capital.* European Planning Studies, volume 15, issue 6, pp. 817-833 (17)

Cochrane, J. H. (2005) *The risk and return of venture capital.* Journal of financial economics, Volume 75, Issue 1, pp. 3-52 (50)

Copeland, T. E., Weston, J. F., Shastri, K. (2000) *Financial Theory and Corporate Policy*, 4th ed. Boston, Addison Wesley

Cumming, D. J. & Walz, U. (2004): *Private Equity Returns and Disclosure Around the World.* Working paper

De Clercq, D. & Dimov, D. (2003) *A knowledge-based view of venture capital firms' portfolio investment specialization and syndication.* Frontiers of Entrepreneurship Research, 2003 III, Babson College

EVCA (2005) *EVCA yearbook 2005.* Belgium, European Venture Capital Association

EVCA (2007) *Why and How to Invest in Private Equity, An EVCA Investor Relations Committee Paper.* Belgium, European Venture Capital Association

Fenn, George W., Liang, N., Prowse, S. (1997) *The Private Equity Market: An Overveiw.* Financial Markets, Institutions & Instruments, Volume 6, Number 4, pp. 1–16 (16)

FVCA (2006) *Yearbook 2006.* The Finnish Venture Capital Association

Gompers, P. & Lerner, J. (2000) *Money chasing deals? The impact of fund inflows on private equity valuations.* Journal of Financial Economics, Volume 55, number 2, pp. 281–325 (45)

Grinblatt, M. & Titman, S. (2002) *Financial markets and corporate strategy*, 2nd ed. Boston, McGraw-Hill

Heel, J. & Kehoe, C. (2005). *Why some private equity firms do better than others.* McKinsey Quarterly, 2005 number 1

Hochberg, Y. V., Ljungqvist, A., Lu, Y. (2007) *Whom You Know Matters: Venture Capital Networks and Investment Performance.* The Journal of Finance, volume 62, number 1, pp. 251-301(51)

Hsu, D. (2004) *What do entrepreneurs pay for venture capital affiliation?* Journal of Finance, Volume 59, Issue 4, pp. 1805-1844 (40)

Jones, C. & Rhodes-Kropf, M. (2003): *The price of diversifiable risk in venture capital and private equity.* Working Paper

Kaplan, S. N. & Schoar, A. (2005): *Private equity performance: Returns, persistence, and capital flows*. Journal of Finance, Volume 60, Number 4, pp. 1791-1823 (33)

Lerner, J. & Schoar, A. (2002) *The illiquidity puzzle: Theory and evidence from private equity*, Journal of Financial Economics, Volume 72, Issue 1, pp. 3-40 (38)

Lerner, J., Schoar, A. & Wongsunwai, W. (2005) *Smart Institutions, Foolish Choices?: The Limited Partner Performance Puzzle*. Working paper

Ljungqvist, A. & Richardson, Matthew (2003) *The cash flow, return and risk characteristics of private equity*. Working Paper

Manigart, S., De Waele, K., Wright, M., Robbie, K., Desbrières, P., Sapienza, H. J., Beekman, A. (2002) *Determinants of required return in venture capital investments: A five country study*. Journal of Business Venturing, volume 17 issue 4, pp. 291-312 (22)

NVCA (2005) *Bransjeanalyse – Venturemarkedet 2005*. Norwegian Venture Capital Association

NVCA (2006) *Aktivitetsanalyse 1. halvår 2006*. Norwegian Venture Capital Association

Phalippou, L. & Zollo, M. (2006) *What Drives Private Equity Fund Performance?* Working Paper

Phalippou, L. & Gottschalg, O. (2007) *Performance of Private Equity Funds*. Working paper.

Quigley, J. M. & Woodward, S. E. (2005) *An Index for Venture Capital, 1987-2003*. Contributions to Economic Analysis & Policy 2005, Volume: 4, Issue: 1, pp. 1180-1180

SVCA (2003) *Riskkapitalbolagens aktiviteter: Fjärde kvartalet 2003*. Swedish Private Equity & Venture Capital Association

SVCA (2004) *Riskkapitalbolagens aktiviteter: Fjärde kvartalet 2004*. Swedish Private Equity & Venture Capital Association

SVCA (2005) *Riskkapitalbolagens aktiviteter: Fjärde kvartalet 2005*. Swedish Private Equity & Venture Capital Association

SVCA (2006) *Riskkapitalbolagensaktiviteter och annan finansiering i tidiga skeden: Fjärde kvartalet 2006*. Swedish Private Equity & Venture Capital Association

Söderblom, A. & Wiklund, J. (2005) *Factors determining the performance of early stage high-technology venture capital funds: A review of the academic literature*. Small Business Service (SBS), UK

Vækstfonden (2006) *Det danske markedet for venturekapital og buy-out 2006*. Vækstfonden

Zarutskie, Rebecca (2007) *Do Venture Capitalists Affect Investment Performance? Evidence from First-Time Funds*. Working paper

APPENDIX 1 – THE GROSS/NET IRR RELATIONSHIP

The relationship between gross IRR and net IRR was estimated by studying the performance and cash flow structure of a hypothetical PE fund.

Assumptions based on typical partnership terms:

The management fee is set to 2% each year and proceeds will be distributed in the following order of priority:
- To the investors, until they have received the total amount of the drawn down commitments
- A compounded internal rate of return of 8% on drawn down commitments to investors (preferred return)
- 80% to the General Partner and 20% to the Investors, until the General Partner has received 20% of distributions in excess of drawn down commitments (catch up)
- 80% to the Investor and 20% to the General Partner (carried return)

The fund's investments are uniformly distributed over the fund's first five years (20% each year)

Realizations from the fund's investments are assumed to occur according to the following distribution: 5% after year 5, 15% after each of the following four years, and 35% after year 10

If the total capital committed is 1000 and the fund's gross multiple is set to 3, the cash flows to (and from) the fund will look like this:

Time (years since inception)	Cash calls	Investments	Realizations	Portfolio Cash flow	Cash flow GP (management fee and carry incl catch up)	Cash flow LPs (pay back, hurdle and excess returns)
0	200	-180	0	-180	-20	200
1	200	-180	0	-180	-20	200
2	200	-180	0	-180	-20	200
3	200	-180	0	-180	-20	200
4	200	-180	0	-180	-20	200
5	0	0	135	135	-20	-115
6	0	0	405	405	-20	-385
7	0	0	405	405	-20	-385
8	0	0	405	405	-20	-385
9	0	0	405	405	-151	-254
10	0	0	945	945	-189	-756

As an illustration, the cash flows between the fund and the LPs and the fund and the GP is shown below. Cash payments to the LPs and the GP are shown as negative values in the diagrams.

Cash flows to the fund from the LPs
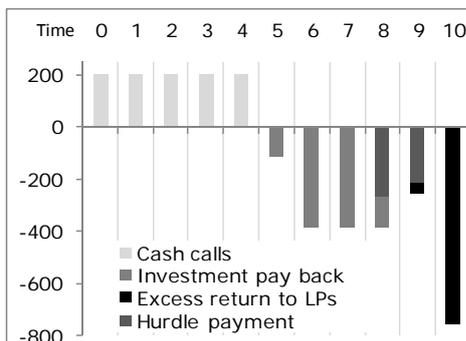
Cash flows to the GP from the fund (negative)
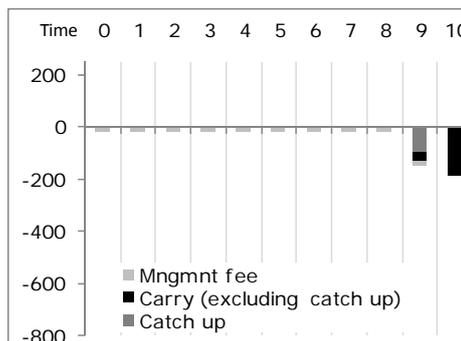
Gross multiple=3
TVPI=2.28
Gross IRR=19.45%
Net IRR=14.56%

The gross IRR and net IRR of the fund was then calculated for gross multiples between 1 and 10. (The calculation of the IRRs tended to fail when the portfolio multiple was set below 1). The table below summarizes these calculations:

Portfolio multiple	Gross IRR	Net IRR	Portfolio multiple	Gross IRR	Net IRR
1.0	0.00 %	-3.42 %	5.6	32.42 %	26.54 %
1.2	2.97 %	-0.32 %	5.8	33.20 %	27.27 %
1.4	5.55 %	2.36 %	6.0	33.96 %	27.98 %
1.6	7.85 %	4.73 %	6.2	34.69 %	28.67 %
1.8	9.92 %	6.86 %	6.4	35.41 %	29.34 %
2.0	11.81 %	8.00 %	6.6	36.11 %	30.00 %
2.2	13.56 %	9.11 %	6.8	36.79 %	30.64 %
2.4	15.18 %	10.62 %	7.0	37.45 %	31.26 %
2.6	16.69 %	12.04 %	7.2	38.10 %	31.88 %
2.8	18.11 %	13.36 %	7.4	38.74 %	32.48 %
3.0	19.45 %	14.56 %	7.6	39.36 %	33.07 %
3.2	20.72 %	15.76 %	7.8	39.97 %	33.60 %
3.4	21.93 %	16.90 %	8.0	40.57 %	34.11 %
3.6	23.08 %	17.90 %	8.2	41.15 %	34.61 %
3.8	24.18 %	18.91 %	8.4	41.73 %	35.15 %
4.0	25.24 %	19.91 %	8.6	42.29 %	35.67 %
4.2	26.25 %	20.86 %	8.8	42.84 %	36.18 %
4.4	27.23 %	21.78 %	9.0	43.39 %	36.68 %
4.6	28.17 %	22.67 %	9.2	43.92 %	37.18 %
4.8	29.07 %	23.46 %	9.4	44.44 %	37.66 %
5.0	29.95 %	24.23 %	9.6	44.96 %	38.14 %
5.2	30.80 %	25.03 %	9.8	45.46 %	38.61 %
5.4	31.63 %	25.80 %	10.0	45.96 %	39.07 %

The relationship between gross IRR and net IRR was simplified by estimating it linearly using ordinary least squares estimation. This estimation results are reported below:

```
      Source |       SS       df       MS              Number of obs =      46
-------------+------------------------------           F(  1,    44) =       .
       Model | .600446225       1 .600446225           Prob > F      =  0.0000
    Residual | .00018089       44 4.1111e-06           R-squared     =  0.9997
-------------+------------------------------           Adj R-squared =  0.9997
       Total | .600627115      45 .013347269           Root MSE      =  .00203


------------------------------------------------------------------------------
      netIRR |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     grossIRR |   .9143841   .0023926   382.17   0.000     .9095621     .919206
       _cons | -.0303466   .0007643   -39.71   0.000    -.0318868   -.0288063
------------------------------------------------------------------------------
```

This simple linear model seems to fit the data quite well. To take into account that the Net IRR will lie below the gross IRR regardless of whether the gross IRR is positive or negative, the relationship was modified as shown below:

Net IRR = Gross IRR − ABS(0.1*Gross IRR) − 0.03   (ABS indicates the absolute value)

The graph below plots the actual relationship found in the calculations and the estimated relationship. The fit seems very good.
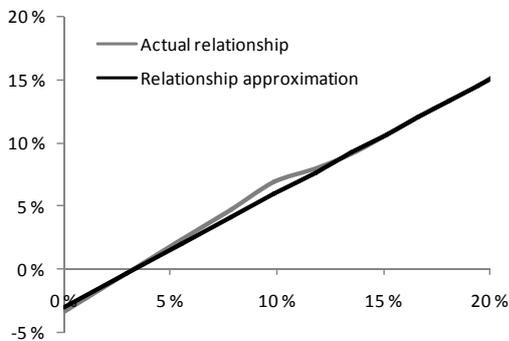
APPENDIX 2 – T-TESTS FOR THE SPECIALIZATION GROUPS

Report 1 – The performance of the most geographically specialized buyout funds (topgeobo) compared to the performance of the least geographically specialized buyout funds (botgeobo)

```
Two-sample t test with unequal variances
------------------------------------------------------------------------------
Variable |    Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
topgeobo |      6    .1863084    .1339137    .3280202   -.1579277    .5305445
botgeobo |      5      .14137    .0780569    .1745406   -.0753508    .3580908
---------+--------------------------------------------------------------------
combined |     11    .1658818    .0777731    .2579441   -.0074074     .339171
---------+--------------------------------------------------------------------
    diff |            .0449384    .1550025               -.3137467    .4036234
------------------------------------------------------------------------------
    diff = mean(topgeobo) - mean(bottomgeobo)                   t =    0.2899
Ho: diff = 0                       Satterthwaite's degrees of freedom =  7.84307

    Ha: diff < 0                  Ha: diff != 0                   Ha: diff > 0
 Pr(T < t) = 0.6103         Pr(|T| > |t|) = 0.7794          Pr(T > t) = 0.3897
```

Report 2 – The performance of the most geographically specialized venture funds (topgeovc) compared to the performance of the least geographically specialized venture funds (botgeovc)

```
Two-sample t test with unequal variances
------------------------------------------------------------------------------
Variable |    Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
topgeovc |      7    .3548378    .1191438     .315225    .0633034    .6463723
botgeovc |     10     .022667    .0449492    .1421418   -.0790151    .1243492
---------+--------------------------------------------------------------------
combined |     17    .1594433     .067311    .2775304    .0167503    .3021362
---------+--------------------------------------------------------------------
    diff |            .3321708    .1273408                .0366941    .6276475
------------------------------------------------------------------------------
    diff = mean(topgeovc) - mean(bottomgeovc)                   t =    2.6085
Ho: diff = 0                       Satterthwaite's degrees of freedom =  7.72519

    Ha: diff < 0                  Ha: diff != 0                   Ha: diff > 0
 Pr(T < t) = 0.9839         Pr(|T| > |t|) = 0.0321          Pr(T > t) = 0.0161
```

Report 3 – The performance of the most geographically specialized funds (VC&BO) (topgeall) compared to the performance of the least geographically specialized funds (VC&BO) (botgeall)

```
Two-sample t test with unequal variances
------------------------------------------------------------------------------
Variable |    Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
topgeall |     14    .1939943    .0678351    .2538156    .0474456     .340543
botgeall |     14    .1299511    .0752942    .2817251   -.0327121    .2926143
---------+--------------------------------------------------------------------
combined |     28    .1619727    .0501057    .2651344    .0591643    .2647811
---------+--------------------------------------------------------------------
    diff |            .0640432     .101345                -.144384    .2724705
------------------------------------------------------------------------------
    diff = mean(topgeoall) - mean(bottomgeoall)                 t =    0.6319
Ho: diff = 0                       Satterthwaite's degrees of freedom =  25.7221

    Ha: diff < 0                  Ha: diff != 0                   Ha: diff > 0
 Pr(T < t) = 0.7335         Pr(|T| > |t|) = 0.5330          Pr(T > t) = 0.2665
```

Report 4 – The performance of the most industrially specialized venture funds (topindvc)
compared to the performance of the least geographically specialized venture funds (botindvc)

```
Two-sample t test with unequal variances
---------------------------------------------------------------------------
Variable |    Obs       Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+-----------------------------------------------------------------
topindbo |      6   .1538334    .1326137    .3248358   -.1870609    .4947276
botindbo |      4   .1220917    .0752698    .1505397   -.1174505    .3616339
---------+-----------------------------------------------------------------
combined |     10   .1411367    .0815132    .2577674    -.043259    .3255324
---------+-----------------------------------------------------------------
    diff |            .0317417    .1524858                -.3244475    .3879309
---------------------------------------------------------------------------
    diff = mean(topindbo) - mean(bootomindbo)                    t =   0.2082
Ho: diff = 0                     Satterthwaite's degrees of freedom =  7.45155

   Ha: diff < 0                  Ha: diff != 0                   Ha: diff > 0
 Pr(T < t) = 0.5797       Pr(|T| > |t|) = 0.8407         Pr(T > t) = 0.4203
```

APPENDIX 3 – VARIABLE CORRELATIONS

Main sample:

	Avg. BM Outperf	Rec. BM Outperf	Com. capital	ln(com. capital)	Seq. number	ln(seq. num)	geo. spec	ind. spec	interact spec	Buyout dummy
Average BM	1.00									
Recent BM Outperf	0.78	1.00								
Committed capital	-0.12	-0.14	1.00							
ln(com. capital)	-0.03	-0.12	0.77	1.00						
Sequence number	0.25	0.09	0.20	0.23	1.00					
ln(seq.number)	0.24	0.09	0.24	0.34	0.94	1.00				
Degree of geo.	0.29	0.35	-0.26	-0.32	-0.35	-0.42	1.00			
Degree of ind. spec	0.17	0.24	-0.50	-0.43	0.04	0.08	-0.32	1.00		
ind. spec * geo.	0.41	0.52	-0.52	-0.58	-0.19	-0.20	0.44	0.67	1.00	
Buyout dummy	0.05	0.07	0.40	0.47	-0.18	-0.17	0.46	-0.72	-0.34	1.00

Track record sample:

	BM outperf	Com. capital	ln(com. capital)	Seq. number	ln(seq. number)	Buyout dummy
BM outperf	1.00					
Committed capital	-0.06	1.00				
ln(com. capital)	-0.23	0.72	1.00			
Sequence number	-0.11	0.42	0.43	1.00		
ln(seq. number)	-0.09	0.39	0.42	0.95	1.00	
Buyout dummy	0.00	0.41	0.50	0.17	0.15	1.00