Aalto University
School of Business

HOW DOES NORDIC PRIVATE EQUITY PERFORMANCE COMPARE TO NORTH AMERICA?

Master's Thesis
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Abstract

As the private equity industry and especially the venture capital industry has developed in the Nordic region it is important to evaluate how it has performed. This thesis evaluates how funds in the Nordic region have performed financially compared to their North American counterparts.

The performance of the private equity funds analyzed included vintages starting in 1999 until 2016. Since there was an uneven balance of funds, a matching procedure was performed on fund size and industry. Coarsened exact matching with to one-to-one method was the most suitable with a significant improvement in the covariate balances. Matching was followed by multiple linear regression analysis estimated with the robust regression method. Multiple regression models were performed with two of the most used financial performance measures as dependent variables: internal rate of return and the net multiple. The analysis provided statistical evidence that Nordic funds are not only on par with the United States but are performing better. It was also found that venture capital fund performance in the Nordics is on par with the United States. There are signs that the investment environment has matured in the Nordics. The results have implications for foreign private equity funds and limited partners to consider investing in Nordic companies and private equity funds as they can provide good returns.

To understand the reasons for this fully the topic was approached through an exploratory question of which fund and region-specific variables are affecting private equity fund performance. In the Nordics, an increase in the unemployment rate affects fund performance negatively while in the United States the effect was the opposite. In the Nordics, this can be due to the labor market rigidities and high level of social security. It was only found that in the United States an increase in research and development spending has a positive effect on the financial performance justifying an increase in spending.

Keywords: Private equity, venture capital, fund performance, investment environment, entrepreneurship

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Tiivistelmä (Abstract in Finnish)

Viime vuosina pohjoismainen pääomasijoituskenttä on kehittynyt nopeasti. Tästä syystä on tärkeää pystyä arvioimaan sen tuottavuutta ja tekijöitä, jotka siihen vaikuttavat. Tämän tutkielman keskeisimpänä tutkimuskysymyksenä on, kuinka pohjoismaiset rahastot vertautuvat tuotossa pohjoisamerikkalaisten rahastojen kanssa.

Tutkielmassa analysoidaan vuosien 1999 ja 2016 välillä perustettujen pääomasijoitusrahastojen taloudellista tuottoa. Havaintoaineistolle tehtiin sovitus pohjoisamerikkalaisten ja pohjoismaisten rahastojen välisestä epätasaisesta otoskoosta johtuen rahaston koon ja toimialan mukaan. Merkittävin parannus kovariaattien tasapainossa saatiin hyödyntämällä sovituksessa CEM-menetelmää. Sovituksen jälkeen tehtiin usean muuttujan regressioanalyysi harjaregressio menetelmällä. Selitettävinä muuttujina usean muuttujan regressioanalyysissa olivat kaksi yleisimmin käytettyä tuoton mittaria: sisäinen korkokanta sekä nettotuottokerroin. Analyysista saatiin tilastollista tukea sille, että pohjoismaisten rahastojen tuotto ei ole ainoastaan pohjoisamerikkalaisten tasolla, vaan jopa ylittää sen. Tutkimuksesta selvisi niin ikään, että pohjoismaisten venture capital -rahastojen suoriutuminen on pohjoisamerikkalaisten tasolla. Tulokset puhuvat pohjoismaisen sijoituskentän kypsymisen puolesta sekä kannustavat kansainvälisiä sijoittajia katsomaan pohjoismaisia kasvuyrityksiä sekä rahastoja potentiaalisina ja tuottavina sijoituskohteina.

Kokonaiskuvan ymmärtämiseksi tutkittiin lisäksi, mitkä rahasto- sekä aluetason muuttujat vaikuttavat rahastojen tuottoon. Pohjoismaissa työttömyysprosentin kasvu vaikutti rahastojen tuottoon negatiivisesti, kun taas Pohjois-Amerikassa vaikutus oli päinvastainen. Tämä voi selittyä pohjoismaisten työmarkkinoiden joustamattomuudella sekä korkean sosiaaliturvan tasolla. Yhdysvalloissa tutkimus- ja kehitysinvestointien kasvu vaikutti positiivisesti rahastojen tuottoon ja perustelee investointien lisäämistä.

Avainsanat Pääomasijoittaminen, pääomasijoitusrahastojen tuotto, sijoitusympäristö, yrittäjyys

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1 Introduction

Innovation is extremely important for an economy; it increases a country's competitiveness relative to its peers and is the engine for economic growth. (Galindo & Mendéz, 2014) Startups are at the center of innovation and shape the markets with new ideas, transformative products, and services. (Spender, 2014) Yet startups struggle with the funding gap while banks are not very keen to finance firms that do not have consistent revenue streams. The difference is that since banks might be reluctant to finance early-stage ventures, venture capital (VC) plays a large role in filling this funding gap for young companies. (Iliev & Lowry, 2020) Private equity (PE) available for young companies consists of VC and buyout (BO) investments. BO funds can be working with companies on the growth stage to very large companies while VC funds focus on firms still in their early stages. VC funds are usually focusing on a sector and add value to portfolio companies by advising them (Samila & Sorensen, 2011). Whereas buyout funds specialize in helping companies grow and expand to new markets as well as optimize their operations and expenses (Achleitner et al., 2011).

In addition, PE managers add value by sitting their members as board of directors and in addition provide the startup with strategic, financial, and marketing advice. Fund managers are searching for good investments with the potential for high profitability and scalable business models with the eventual goal of exiting the company. Exit can happen in five different ways: through initial public offerings (IPOs), acquisitions, secondary sales, buybacks, and write-offs. (Cumming & Johan, 2008) VC funds have strong incentives for developing a company, due to its short ownership, which is usually less than the fund's duration of five to ten years. Developing the startup is usually done with a profitable exit in mind and keeping other competing funds from obtaining control of the company (Norbäck & Persson, 2009). Since VCs are looking for profitable investments, they need to have thorough due diligence to mitigate the information asymmetries and moral hazards arising from their investments. In contrast for BO funds, due diligence is easier since they are more established and have usually been operating for a longer time.

Information asymmetries arise when there is a difference in information between two parties. Considering outside investments, the startup knows more about its own situation than the investor. Startups can exploit this asymmetry by signaling to investors about their quality. Exploiting is possible by acquiring patents and companies with more patents acquire more VC funding (Kortum & Lerner, 2000). Another possible problem with these investments is moral hazard and in this case agency problems. Agency problems mean when a party is acting in conflict with the interests of another party. For a fund manager, this would mean the Chief Executive Officer (CEO) acting against the will of the fund and board of directors. This type of agency problem can be avoided by implementing a professional CEO to manage the firm. Replacing the owner CEO is a common way of ensuring continuous improvement and competitiveness once the company has grown too large for the owner CEO to manage. This is important in the growth stage of the startup and is a way funds get more control over a company. (Wasserman, 2003)

Apart from providing funding and fuel for innovations, VC is important for the economy. Samila and Sorensen (2011) found that increasing the supply of VC in specific regions results in a rise in entrepreneurial activity in the same region. Furthermore, previous studies have shown that VC is particularly important for innovative firms (Hellman & Puri, 2002). Additionally, a healthy VC market has positive externalities for the economy: funding innovative firms and stimulating economic growth. Once the VC market has been formed it is easier to keep it running and developing. At this point, the industry has developed structures and experience that will help emerging funds and companies. Equally, spillover arises with innovation and research which have also provided beneficial externalities for the economy. (Lerner & Tåg, 2013)

There have been differences in performance between Europe and North America in the past. The United States has outperformed Europe in VC funds but there was no difference in BO fund performance (Harris et al., 2015). The goal of this thesis was to study if the Nordic region's PE performance is on par with the United States.

Research question: Is Nordic PE performance on par with that of the United States?

Nordic countries in this thesis are defined as Finland, Sweden, Norway, Iceland, and Denmark. Nordic countries have a vibrant startup culture and are now home to many early-stage firms. Nordics are nowadays on top of the list when measured as VC funding as GDP per capita. (OECD, 2021) The topic of this study is very current with the VC market being extremely hot and breaking records year by year. In 2021 Sweden, Finland and Norway raised a record-high value of VC. (FVCA, 2022; SVCA, 2022; NVCA, 2022) In the past, it used to be Israel and United States with the most investments in dollars relative to GDP but today Nordics are on the top. BO investment amounts have been increasing steadily too. (FVCA, 2022; SVCA, 2022; NVCA, 2022). As the investment amounts have gone higher it is important to understand how they perform financially and what has contributed to their performance. In this thesis, I will study the different factors contributing to the financial performance of PE funds in North Europe and North America separately. The assumption is that there are fund-specific and region-specific factors contributing to the fund's financial performance. Having an active firm creation can be thought to lead to having an established startup investment sector. Earlier studies by Harris et al (2015), showed lacking VC performance in Europe compared to their North American counterparts. In their study, Europe was analyzed as a whole and was not divided geographically leaving a gap available to study the differences within Europe. Now the assumption in this study is that Nordic countries are performing similarly in both asset classes compared to the United States. To evaluate these assumptions, I have built a study comparing the performance of PE funds in these two different geographical areas.

This thesis consists of a theoretical and an empirical part. The literature review represents the theoretical part which consists of three parts. The first part studies the development of the PE market in both the United States and the Nordics. The second part studies which fund-specific factors have influenced PE performance in earlier studies. The third part studies the region-specific factors and how they have contributed to the performance of PE funds. There is also a comparison of the key differences in PE operating

environments between these two regions. The goal of the literature review is to understand the factors contributing to PE fund performance.

The empirical section of this thesis consists of four parts. In the first part of the empirical section coarsened exact matching (CEM) with a one-to-one method is used to balance the size of the samples. This is followed by the analysis of performance in absolute terms. This is done by analyzing both asset classes VC and BO by their vintages separately for the United States and the Nordic countries. After the matching, multiple linear regression is used for estimating the effect of fund-specific factors on PE fund performance. The third section of the empirical part consists of a separate analysis for VC funds with the matched sample. The fourth section consists of exploratory analysis in the form of multiple linear regression for the sub-samples of the United States and the Nordics separately with added region-specific variables. The aim of the fourth section is to understand how the investment environment affects the financial performance of PE funds. Financial performance is measured with an internal rate of return (IRR) and net multiple separately since these complement each other and provide a more holistic view of the financial performance than either of these measures would on their own.

2 Literature review

PE has been around for over 70 years and the first organized and professionally managed investments in PE can be dated to 1946 in the United States followed by explosive growth in the 1980s (Fenn et al., 2016). Today, PE can be categorized into two main categories VC and BO. The most common form is a commingled fund, meaning that investments of different investors usually from public and private pension funds, insurance companies, and endowments are pooled together to form a fund. The second option is a separately managed fund in which there is one fund manager for each investor. The third option is a fund of funds (FoF) which are funds that invest pooled investments into many different VC funds or alternatively to various BO funds. These can also have government funding for example Teollisuussijoitus (Tesi) in Finland but there is also a niche of private FoF in the market. Investors can also make direct investments in PE meaning that they do it without a fund manager. Co-investments are a subclass of direct

investments, and they mean investments made together with the fund manager to target companies. There are also variants to VC depending on the investor and if it is a company rather than a fund manager it is corporate VC (Fenn et al, 1996). The funds evaluated in this thesis are categorized as either VC or BO without any additional sub-division. Lately, investment environments have been developing fast in the Nordics. (Spliid, 2013)

VC offers funding for companies in exchange for usually a minority equity stake in the startup. VC funding differs from bank funding by offering the firms their expertise and guidance. There have been studies that show that VC-backed firms survive better than ones without it (Samila & Sorensen, 2011). Since BO funds invest in a later stage and take control of the company by buying most of the shares, their focus is different. At this stage, companies are more established and fund managers focus on honing and expanding the operations of these more developed firms. Even though the PE market has existed for a shorter time in the Nordics than in the United States and can be considered less developed. Yet, the first hypothesis of this thesis is:

H1: The financial performance of PE in the Nordic region is on par with that in the United States

The reasons behind this assumption are the vibrant startup ecosystem in the Nordics and Nordic startups breaking investment records year by year. Much of this development is due to the international investors making investments in the Nordics. The reason for this can be the success stories of Nordic startups, oversaturated PE markets in their own country, good financial performance, and reasonable valuations. This leads to the second hypothesis of this thesis:

H2: The financial performance of VC in the Nordic region is on par with that in the United States

Another reason why Nordic PE would be on par with the United States is the development of investment environments and today Nordic pension funds are considering alternative investments as a viable option. This is expected to have positive implications for both VC and BO funds.

2.1 Fund-specific factors affecting fund performance

In this section, fund-specific factors that have contributed to the financial performance of PE funds is analyzed. VC firms usually form a portfolio of investments and have an exit usually 5-10 years after the initiation of the fund, while for BOs the time frame is usually 10- 12 years. In these funds, they gather investments from high net-worth individuals, institutional investors, and their own capital. (Fenn et al., 1996) In contrast to the public stock market, these funds are not available to the public. Investments in early-stage startups are risky and usually, most of the firms do not provide any returns while best-performing companies provide the majority of the returns.

The first fund-specific factor is networks and within PE these are important, as they include service providers, industry connections, and other investors in the form of a syndicate. Syndicate means multiple investors pooling together for co-investment in a startup. Syndicates can be useful in providing a nurturing environment for the company with even more resources and expertise. (Hochberg et al., 2007). Especially for the early-stage firms in which VCs usually invest, networks are crucial. Cummings and Dai (2010) analyzed a set of the U.S VCs in their paper and found that there was a strong home bias in VC investments and 50% of investments were made within 233 miles of VC's offices. Characteristics of home bias were recognized, and more established VC firms were able to mitigate the information asymmetry arising with distance. It was also found that more networked VCs reduce the home bias. However, VCs that had a technological focus had a stronger home bias as was the case when VCs were acting as a lead investor of a syndicate. There are also other implications for home bias and Cummings and Dai found that excessive local VC competition drive deal prices up and reduces the investments. Local firms are also more likely to exit via IPOs since companies closer to home benefit from close monitoring from the VC and the short distance reduces the information asymmetry. (Cumming & Dai, 2010)

The second fund-specific factor is the size of the fund. Usually, VC funds are smaller than BO funds and there are differences in size even within these two categories. Fund size can range from ten million dollars in early-stage VC funds to 20 billion in so-called PE mega funds (MRDS,2022). In addition, earlier studies by Kaplan and Schoar (2005) found a relation between the success of earlier funds and fund size. More importantly, they found that performance increases with fund size with diminishing returns to scale.

The third fund-specific factor contributing to funding performance is fund manager experience. Funds vary in size, fees, returns, industry, and experience, and investors want to choose the best performing general partners. Limited partners investigate the past performance of a general partner in their previous funds and believe that it is the result of the fund manager's expertise. BO funds build on their prior experience by being able to increase the size of their funds faster than VC funds can. This affects the revenue per partner and per professional, in BO funds these both increase but in VC funds only revenue per partner increases. And since VC managers invest at an earlier stage, they can only add value to small firms, in contrast, BO managers can add value to large established companies. (Metrick & Yasuda, 2010) It was found that interim performance is critical to a fund when fundraising for a new fund. Fundraising is usually done in the third to the sixth year of the existing fund's lifetime and they run active in parallel for a few years. Fundraising is more difficult for General Partners (GP) with less reputation and for them, interim performance is immensely important. It was also found by Barber and Yasuda (2014) that the performance of funds is peaking just before the fundraising of a new fund, this effect was stronger in BO funds than in VC funds. In addition, fund managers are great at timing their fundraising for a follow-on fund right after a good exit and in BO funds there was a decrease in performance after the fundraising period. (Barber & Yasuda, 2014)

The last fund-specific factor affecting the performance of PE funds is the asset class. In the past, VC funds have had a larger variance than BO funds. It also seems that VC performance is more affected by business cycles. Moreover, during a recession, VC performance decreases more compared to BO. A good example of this is the economic crisis of the early 2000s also known as the dot-com bubble. During the bubble, VC funds were providing excellent

returns, multiple times over the stock market, and after the burst, it was performing worse than the public stock market. BO funds however were outperforming the public stock market during and after the bubble. (Harris et al., 2015) The reasons for this are that growth stocks are depending on future growth and uncertainty of the future reduces their expectations. The crash of value in the stock market affects the valuation of the unlisted companies as well. This happens when applying for funding or during listing since their valuations are being benchmarked to already listed companies. On the other hand, BOs are investing in more mature and stable companies and those can benefit from being funded in difficult times compared to their peers (Bernstein et al., 2019).

2.2 Region-specific factors affecting fund performance

In addition to fund-specific factors, there are region-specific factors contributing to the performance of PE. As we are studying the differences in two separate geographical areas identifying the factors differing is important to get a full picture of factors affecting the PE fund performance. United States PE market is more developed than in the Nordics, institutions play a big role in this development, therefore its effect should be studied to find deviations (Spliid, 2013).

Five region-specific factors are to be evaluated: taxation, financial markets development, labor market regulations, research & development (R&D) spending, and total early-stage entrepreneurial activity (TEA). These five will be focused on since they are the most important differences in investment environments between Nordics and United States. These factors provide the biggest differences between the investment environment of Europe and North America. There has been extensive research on investment environments in both locations as seen compiled below (Table 2).

The first clear difference between North America and the Nordics is taxation. It is interesting to evaluate taxation to examine one of the major differences in investment environments. Taxation, especially on capital gains tax has implications on entrepreneurship and VC investments. As entrepreneurship is usually a trade-off with being employed the level of capital gains tax

influences the expected income from being self-employed. Taxation decreases entrepreneurial entry while high wage tax could increase the supply of innovators. (Lerner & Tåg, 2013) For startups and PEs, capital gains tax is important since fund managers usually expect to exit through IPO or trade sale. At this stage, capital gains will be accrued. Keuschnigg and Nilsen (2004) argued in their paper that since capital gains tax decreases the incentives to provide managerial support and entrepreneurial effort it can be a major obstacle to generating a high-quality VC industry (Keuschnigg & Nielsen, 2004). Since VCs provide resources including networks, industry experience, and guidance while also stimulating entrepreneurial activity it is important to have these incentivized. For the differences in capital gains tax, it is beneficial to compare the United States and Finland. Today, in Finland capital gains tax is 30% up to 30,000€ and 34% following over that. Denmark has the highest capital gains tax rate in Europe while the tax level is on the same level in Sweden and Norway as Finland. In contrast, Iceland's rate is lower and close to the U.S levels. In the United States, it is dependent on your personal income and varies from 0% to 20%. In cases of earning more than $200,000 per year, there is an additional 3,8% tax on capital gains. (IRS, 2021). There are also many structural differences between Nordics and United States on taxation, therefore Sweden is used as an example for comparison. PE industry development in Sweden has been affected by three factors. Firstly, Swedish tax policy in the past has been more favorable to large investments financed by debt rather than equity investments in small firms. Secondly, entrepreneurs in Sweden have been taxed more than their counterparts in the United States. Thirdly, as mentioned earlier it has been more difficult for VC funds to acquire financing from pension funds. In addition to the taxation of capital gains and stock options, the Nordic countries and the United States have differences in the corporate tax rate. However, in this tax category, the Nordic countries have had lower tax rates than the United States. For the years analyzed in this thesis (1999-2016), the U.S corporate tax rate has been 35% while for the Nordic countries it has been around 20%. The trend of corporate tax rates has been decreasing in both regions.

In addition to personal income and capital gains taxation, it is necessary to study stock options taxation more in-depth. For example, in Nordic countries, if an individual is a shareholder in a firm they work for, this income is taxed

as labor income. Stock options are also similarly treated in Sweden as labor income rather than capital gains resulting in a higher tax rate. (Lerner & Tåg, 2013). The stock options model for compensating VCs and employees is more used and developed in the United States than it is in the Nordics. While stock options have an effective tax rate of 15% in the United States, in the Nordics they are significantly higher ranging from 50,8% in Norway to 55,3% in Denmark. Countries with lower tax rates have higher VC activity with respect to their GDP. Taxing stock options lower means more workforce flow into these sectors together with more investments. Investments increase since there are more incentives to compensate for the uncertainty of work within the young risky companies. (Henrekson & Sanandaji, 2018) It is commonly thought that the United States provides a better investment environment to startups and VCs tax-wise.

The second fund-specific factor is financial market development since affects the VC market's attractiveness and profitability. A highly developed stock market is important for VCs since it provides good exit opportunities to VCs through IPOs. (Lerner & Tåg, 2013) In addition, one of the biggest investors in VC funds are pension funds and fewer restrictions on their investment activities can boost the VC sector. VC firms have a large role in developing early-stage companies in the beginning. After the company has matured and gained traction, it is easier to raise outside funding from other VCs, BOs, and banks. IPOs are a good exit route for VCs since it presents a possibility for the owner entrepreneur to gain control of his or her company and signal to investors that VC is capable of nurturing quality investments which might help acquire funding in the next financing round of their funds. Well-developed financial markets increase the effect of an active VC market on innovation and growth. This is occurring since investment periods are shorter which opens resources of VCs for early-stage companies. Liberalization of investment policies and restriction of pension funds provides cash into VC markets. (Lerner & Tåg, 2013) Financial markets play a large role in VC exit opportunities and profitability and require well-developed financial markets. Other exit possibilities include M&A (Mergers and Acquisitions) which can be even more profitable but similarly to IPOs these are also supported by developed financial markets. Financial market development in the past can be described as the U.S having less regulated markets while the Nordics had a more bank-focused system with the stock market being deregulated as late

as the 1980s in Sweden. Historically, the United States had more IPOs than the Nordic countries and a higher valuation of companies. However, after the deregulation of the stock market in the 1980s in the Nordic countries, IPOs grew rapidly, and Sweden experienced the largest boom surpassing the U.S when measured as numbers relative to GDP. This was followed by the tech crash and a stagnant period in both regions decreasing IPOs to a roughly similar level. Similar to the stock market the deregulation of Nordic pension funds happened later. In the United States, pension funds were deregulated in 1978 while in Sweden this happened as late as 1996. (Lerner & Tåg, 2013) Another important measurement in the financial sector activity is M&A market size. The size of the M&A market is bigger in the U.S than in other Nordic countries (Spliid, 2013). Since stock and M&A markets are important for PE exits and pension funds are major investors in PE funds, the lacking behind has slowed down the development of the Nordic PE market. Today, the Nordics has a vibrant startup environment and is one of the top countries when measured as VC investments as a percentage of GDP. Yet, international investors have had a major contribution to this increase and today they count a large share of total VC investments in the Nordics (FVCA, 2022; SVCA, 2022; NVCA, 2022).

The third region-specific factors within institutions that is highly relevant to VC market are labor market regulations. These regulations affect the VC market by affecting the supply of startups in need of financing. Labor market regulations increase the cost of growing a firm and raise barriers to entrepreneurship and growth. There are three ways barriers are raised: employment protection laws make it difficult to lay off workers and this how decreases hiring, minimum wage laws raise the cost of hiring workers, insurance systems require employers to pay social security taxes and social security to employees. This is especially harmful when employment volatility is high, and these sectors described by high risk and information asymmetries are the ones in which VCs normally succeed.

A major difference between the United States and the Nordics are labor union membership rates. In Sweden labor unions are strong and the majority of workers are members of unions as opposed to the United States where unions are traditionally weaker, and membership is low. Additionally, In Sweden, collective agreements are in a big role in creating more compressed wages

which are also used for non-union members. These regulations might decrease entrepreneurship and raises the hiring costs for early-stage businesses. (Lerner & Tåg, 2013) In especially BO funds improving operational results has a central role and inflexible agreements in supply and labor contracts it is difficult to affect the cost structure. Inflexible labor agreements and strong unions make the PE market less investment-friendly than the United States. (Spliid, 2013) Labor market regulation is one of the key differences contributing to why the PE industry lagging in the Nordics.

The fourth region-specific factor that stems from the institutions of a country and contributes to the development of the PE sector is public R&D spending. Universities are a good source of innovation and an important piece of the entrepreneurial ecosystem. In earlier studies by Da Rin et al (2006), it was found that there was a positive correlation between public R&D spending and VC activities. Additionally, Gompers and Lerner (1998) studied U.S academic R&D spending on a state level and found a connection between R&D spending and VC investments measured as the number of transactions and capital invested. Public R&D spending can lead to university spin-offs and these types of companies in the technological sector acquire more VC investments than other technological startups (Ortin-Angel & Vendell-Herrero, 2010). R&D spending is thus an important geographical factor to consider in the analysis.

2.3 Supply of entrepreneurship

When estimating the variables constituting the success of PE it is important to understand that it does not grow in a vacuum and the supply of entrepreneurship is vital as well. When there are more investment targets in an area the assumption is that there will also be VC firms. Since VC firms usually invest close to their location, which supports the argument that there needs to be an existing supply of entrepreneurial activity. The vibrant startup industry provides more investment targets for VC and later to the PE market. Earlier studies by Cumming and Knill (2012) indicate that the relationship between entrepreneurial activity and VC supply can support each other in both directions. To measure this performance data is enriched with TEA retrieved from the Global Entrepreneurship Monitor survey to include in the regression model.

2.4 Macroeconomic conditions

The most important factors affecting PE fund performance are gross domestic product (GDP) and stock market performance. Macroeconomic conditions affect the investments available and can be considered as a sub-class of region-specific variables. The stock market is pro-cyclical meaning that it performs better when there is economic growth and generally does worse when there is not. It tends to follow the business cycles of an economy. Even though PE is said to provide differentiation to a portfolio, it seems that PE fund performance is related to the public stock market. PE performance has a positive correlation with the public stock market and contributed to the performance of PE investments in a study conducted by Phalippou and Zollo (2005). When the stock market does better there are better exit opportunities for PE funds through IPOs (Phalippou & Zollo, 2005). The performance of the stock market and GDP were found as being the most significant factors affecting M&A activity, another major channel used for PE exits.

Tightly related to the supply of entrepreneurship and the macroeconomic condition of a country is the unemployment rate. As entrepreneurship is a trade-off with being employed it can be assumed that as the unemployment rate increases so does the entrepreneurial activity. With a higher unemployment rate the more reasons to pursue a living through entrepreneurial activities. It was found that the unemployment rate has a negative effect on venture capital investments and the assumption was that even though there is an increase in self-employment negative effect on venture capital supply dominates this effect (Félix et al., 2012). The assumption in this study is that geographical factors and labor market rigidity will have an effect whether the effect is positive or negative. It is interesting to compare this effect since there are big differences in geographical factors and labor market rigidity between the United States and Nordics, a homogenous group with only minor differences. The assumption is that this effect will be negative in the Nordics and positive in the United States.

The above factors contributing to the PE fund performance and their sources are summarized (Tables 1 and 2). What is known from previous research is how these factors have contributed to the performance of PE funds but there

has not been a model this extensive considering the three different groups of factors affecting the performance. Nordic countries have not been before under such investigation on regional factors and have only been included in the European sample. This leads to the exploratory question of this thesis:

Which fund-specific and region-specific factors affect the financial performance of PE in each region?

Table 1. Fund-specific factors contributing to the financial performance of PE funds from previous research and their sources.

Variables affecting the performance of PE funds

Fund-specific factors	Source
Networks	(Hochberg, 2007; Cumming & Dai, 2010)
Fund size	(Kaplan & Schoar, 2005)
Fund manager experience	(Barber & Yasuda, 2017; Metrick & Yasuda, 2010)
Asset class	(Harris et al., 2015; Bernstein et al., 2019)

Table 2. Region-specific factors contributing to the financial performance of PE funds from previous research and their sources.

Variables affecting the performance of PE funds

Region-specific factors	Source
Taxation	(Lerner & Tåg, 2013; Henrekson & Sanandaji, 2018; IRS, 2021)
Financial market development	(Lerner & Tåg, 2013; Spliid, 2013)
Labor market regulations	(Lerner & Tåg, 2013; Spliid, 2013)
R&D spending	(Lerner & Tåg, 2013; Da Rin et al, 2006; Gompers & Lerner, 1998)
Total early stage entrepreneurial activity (TEA)	(Cumming & Knill, 2012)
Public stock market	(Phalippou & Zollo, 2005)
Gross domestic product	(Gompers & Lerner, 1998)
Unemployment rate	(Félix et al., 2012)

3 Methodology

To measure the performance of PE funds in the Nordics and the United States I performed a quantitative study as this will allow evaluation of different factors affecting the performance in these two regions. To accurately analyze the financial performance of PE funds with the dataset available, quantitative methods are seen as most suitable. Another reason why the quantitative study is warranted is the dataset available from the source since there is enough information for analysis, but it can also be enriched with data from other sources. This evaluation would not be possible with a qualitative design. Lastly, for the purpose of comparing the results with earlier studies, using a quantitative approach is justified.

3.1 Data sources

Data is gathered from multiple sources and the data on the fund's financial performance and fund-specific factors from the Preqin database. Preqin is a commercial database that is used for academia, education of alternative investment and private enterprises. Data is enriched with region-specific factors from the Global Entrepreneurship Monitor (GEM), Organization for Economic Co-operation and Development (OECD), the International Monetary Fund (IMF), and World Bank databases as described in the table below. Data on the public stock market performance, namely the MSCI world index is retrieved from the MSCI database. Data on region-specific factors are from reputable sources well equipped for academic research.

Table 3: Sources used for the data collection.

Sources of data

Data	Source
Financial PE performance data	Preqin database
Fund characteristics	Preqin database
TEA (Total early-stage entrepreneurial activity)	GEM Global Entrepreneurship Monitor survey
MSCI world index	MSCI database
GDP growth	OECD database
Unemployment data	OECD database
Collective bargaining agreements	OECD database
Financial development	IMF database
R&D as % of GDP	World Bank database
Corporate tax rate	OECD database

3.2 Sampling

Financial performance data from Preqin can be said to be high quality and is collected from public pension funds, insurance companies, and other public actors who are required to report this data by law. Additionally, there is also data received directly from fund managers. Another fact that gives Preqin database validity is that they mention the source of information. Preqin was also used in previous studies VC and BO fund performance studies, and it can be said that Preqin dataset seems reliable. Preqin was chosen since it has data on both the United States funds as well as the Nordic funds. It has the possibility to filter data to create the correct kind of sample needed. Since the Nordics are much smaller than the United States and the PE sector less developed there exist fewer PE funds. Preqin does not measure IRR if a fund is younger than three years old. Since some funds had data on net multiple and some on IRR only these two performance measures were divided into two panels A and B with varying sample sizes. Net multiple consists of the remaining value to be paid-in (RVPI) and distribution to paid-in (DPI) that's why they are included in the same panel. As funds mature and LPs (Limited Partners) are receiving their investments back RVPI decreases as there is less unrealized value to the fund. DPI on the other hand increases with time as this is the ratio of LP distribution to contributions. These together mark the performance of the fund measures as a net multiple.

3.3 Data collection

When exporting the data, it was limited to the Nordic funds and North American funds excluding Massachusetts and California. This limitation was done in order to construct a more accurate model, and these include the technology hub of the San Francisco Bay area and the med-tech hub of Boston in Massachusetts. With these startup hubs included in the model comparison would not be After this limitation data were exported for further evaluation. Since the data from the Preqin database was not complete, all rows with unavailable data were omitted. This reduced the sample for both panels A and B. Funds with a vintage older than 1999 were not many and there were also missing years, making it a good cut-off point. On the other end funds with a vintage of 2017 or sooner were excluded from the sample due to them not being largely realized completely. This gives the data more accurate as there would be a bias for new funds.

The omitted data consisted of two possibilities n/a meaning it was not reported and n/m meaning it was not measured. The reason for limiting the internal rate of return stems from the Preqin methodology, the first three years since the fund's inception cannot provide an accurate measurement for it. In addition, there was one error from the database which included an Indian fund that was removed manually.

Data available in the Preqin included a lot of information ranging from the size of the fund to contact information. Only the most relevant and complete data were included: internal rate of return, net multiple, DPI, RVPI, asset class, vintage, size of the fund, industry and country of the fund manager. Dummy variables were created to perform matching on the data and make analyses. After the manipulation data was imported to R for the analysis.

3.4 Multiple linear regression

A summary of dependent, independent and control variables used in the regression models are presented below. A robust regression model is applied for this data set. The reason the robust linear regression model was chosen is the assumption that there might not exist homoskedasticity as in constant error of variance terms. While plotting these regression models it can be said there was a linear relationship between the dependent and independent variables, yet outliers were found. Making the robust regression method more suitable for this dataset. The chosen method is more lenient with the linearity assumptions and can be used as a substitute for the commonly used ordinary least squares (OLS) model. The OLS model gives equal weighting to all observations and assumes homoskedasticity. The robust regression model on the other hand assumes heteroskedasticity and uses M-estimators which minimize the sum of a function that is working as residuals. This function is presented below (Eq 1). Mathematical details of the selected Huber's method functions for M-estimators are shown in the appendix (Eq A1,A2 and A3). In the robust regression models normality is assumed. The variance is finite and thus in line with the assumptions for a general linear model.

Eq 1: M-estimator function

$$\beta_M = arg\,min_\beta \sum_{i=1}^{n} p\big(\epsilon_i(\beta)\big) \qquad (1)$$

Dependent variables:

IRR: First of the two most used return measures for PE performance. Percentage measure of the returns is calculated using cash flow data and discounted relative to the time value of money. IRR is expressed as net of fees.

MULTIPLE: Second of the two most used return measures for PE performance. It is shown as multiple of invested capital and it describes how manyfold the profits of the fund have been. Net Multiple is the sum of DPI and RVPI. It is expressed as net of fees.

Independent variables:

VINTAGE: Year of the inception for the specific fund. PE funds have had historically varying performance and while VC funds have performed significantly worse during economic crises while BO funds have had more stable performance. For this reason, the year of the inception is taken into the model as a variable.

SIZE: Size of the fund expressed in millions of U.S dollars. Fund managers with more experience measured with earlier funds raise bigger funds. The variance of the size is large, which is the reason why the size of the fund is used as a variable in the matching process. A logarithmic transformation is done for fund size when used in the sub-sample models for the Nordic region and the United States.

EXPERIENCE: Number of fund series a GP has previously raised. Funds in the same asset class are only counted. More experienced fund managers tend to perform better and raise larger funds.

REGION: Dummy variable 1 = Nordic and 0 = North American fund. Previously, there have been differences in PE performance varying by location. This variable was chosen in order to distinguish if there is a difference in performance between these two regions. The dummy variable will answer the research question if Nordic performance is on par with the United States.

CLASS: Dummy variable in which 1 = VC fund and 0 = BO fund. There has previously been contradicting evidence on whether VC or BO performs better. VC funds tend to have a larger variance in performance than BO funds and are affected more by business cycles.

TEA: Total early-stage entrepreneurial activity in the inception year of the fund. TEA variable was chosen in order to measure the entrepreneurial activity in a country since it is an important variable to measure for the creation of new firms.

AGREEMENT: Percentage of the workforce whose contract is under a collective bargaining agreement. Rigidity in labor agreements can make it difficult to fire and hire employees. It is assumed that this rigidity has an effect on PE performance.

GDPCAP: GDP per capita in the year of the fund's inception. PE tends to perform better when there is a better economic situation.

RD: Percentage of R&D spending relative to the GDP of the country. R&D spending is important for the creation of new firms and technology transfer.

FI: In order to measure the financial development of a country the financial institutions depth index is used. The financial institution depth index describes the assets relative to GDP available in the institutions. It consists of private sector credit to GDP, pension fund assets to GDP, mutual fund assets to GDP, and insurance premiums to GDP. The financial institution depth index value is used in the year of the inception of the fund. Financial development is an important variable for PE performance since it describes how developed the financial institutions are in a country.

Control variable:

MSCI: JP Morgan's MSCI world index 5-year average return starting from the fund's year of inception. PE performance is correlated with the public stock market performance. MSCI was chosen instead of S&P 500 since it takes into account stock performance worldwide including Nordic countries.

Variable used in the matching process:

INDUSTRY: Industry that the fund primarily targets. There are 8 possibilities: Business services, Consumer discretionary, Diversifies, Energy & Utilities, Financial & Insurance Services, Healthcare, Industrials, and Information Technology. It is possible that funds are focusing on multiple industries. Certain industries have performed better in the past which is why industry variable is used in the matching process. The industry is not used in the multiple linear regression model but is used for matching.

Multiple linear regression models used for the full sample:

$$\text{IRR} = \alpha + \beta_{\{Vintage\}} + \beta_{\{Exp\}} + \beta_{\{Region\}} + \beta_{\{Class\}} + \beta_{\{MSCI\}} \quad (2)$$

$$\text{MULTIPLE} = \alpha + \beta_{\{Vintage\}} + \beta_{\{Exp\}} + \beta_{\{Region\}} + \beta_{\{Class\}} + \beta_{\{MSCI\}} \quad (3)$$

Multiple linear regression models used for the sub-sample:

$$\text{IRR} = \alpha + \beta_{\log(size)} + \beta_{(EXP)} + \beta_{(CLASS)} + \beta_{(TAX)} + \beta_{(FI)} + \beta_{(AGR)} + \beta_{(RD)} + \beta_{(TEA)} + \beta_{(MSCI)} + \beta_{(GDP)} + \beta_{(UNEMP)} \quad (4)$$

$$\text{MULTIPLE} = \alpha + \beta_{\log(size)} + \beta_{(EXP)} + \beta_{(CLASS)} + \beta_{(TAX)} + \beta_{(FI)} + \beta_{(AGR)} + \beta_{(RD)} + \beta_{(TEA)} + \beta_{(MSCI)} + \beta_{(GDP)} + \beta_{(UNEMP)} \quad (5)$$

3.5 Matching

As there is an uneven sample of Nordic and U.S funds matching these based on specific criteria will reduce the bias. Panel A totals 1975 funds of which 158 are in the Nordics while the rest are from the United States. Panel B totals 2132 funds of which 186 are in the Nordics and the rest are from the United States. As the United States is a much larger country than any of the Nordic countries and the PE industry has been existing for a longer time fund sizes are significantly different. For the reasons of uneven balance and varying fund sizes matching is necessary for a better comparison. Matching was done by CEM in R software using the MatchIt package. Matching criteria in the CEM matching were the main target industry of the fund and fund size.

The matching method was selected since fund sizes can vary largely between these two continents, with Nordics being a smaller market thus having smaller fund sizes. This was done for both samples of BO and VC funds separately. The matching method used was CEM, dividing the funds into different sub-categories by balance and then matching with a one-to-one method. The result of the matching was analyzed, and it resulted in a better fit with lower mean differences in all industries. Other matching methods were also tested including nearest neighbor matching, subclass matching, and full matching. CEM was deemed as the best fit for this study.

As we can see (Tables 4 and 5) absolute mean differences in both cases were reduced, providing a better fit for the model. The absolute standardized mean difference for the size of the fund was reduced in panel A from 0,326 to 0,02 and in panel B from 0,372 to 0,03. Industry matching reduced the differences to 0 for both samples, meaning that all funds were matched according to their industry. It can be interpreted that matching provided a better balance for both samples. These improved covariance balances are presented below (Tables 4 and 5).

Table 4: Matching balance for Panel A sample

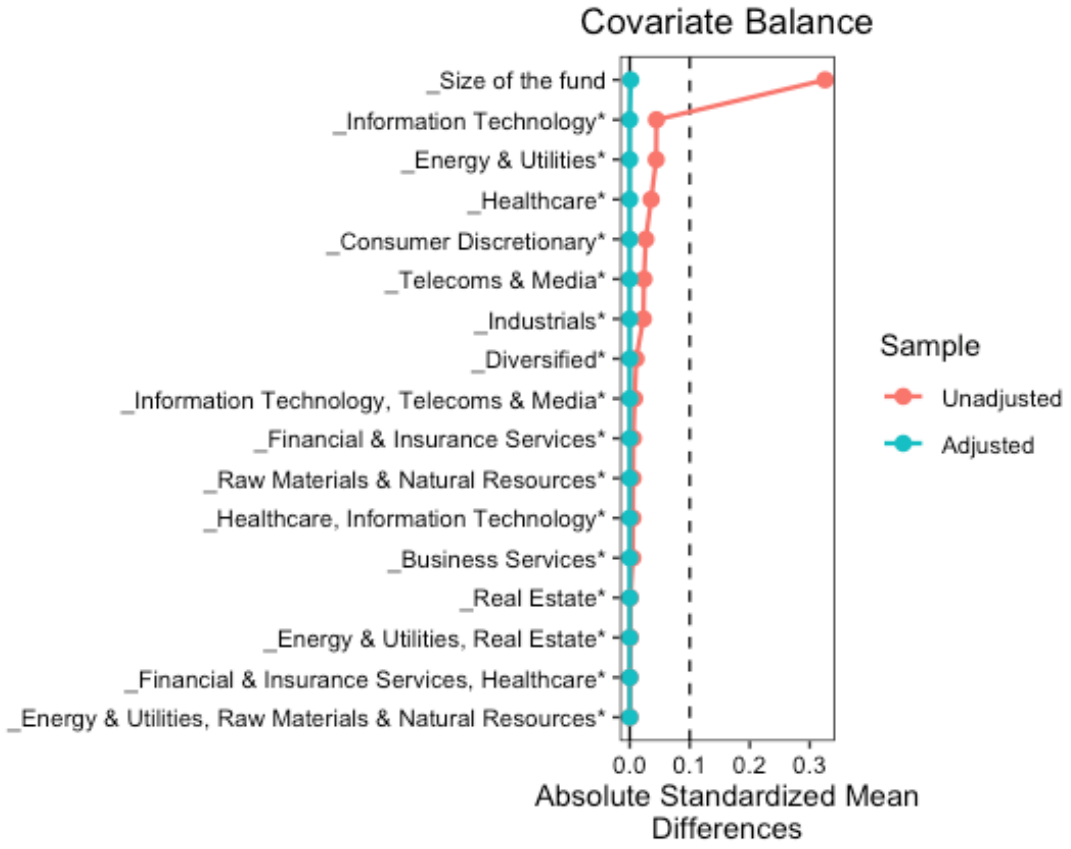
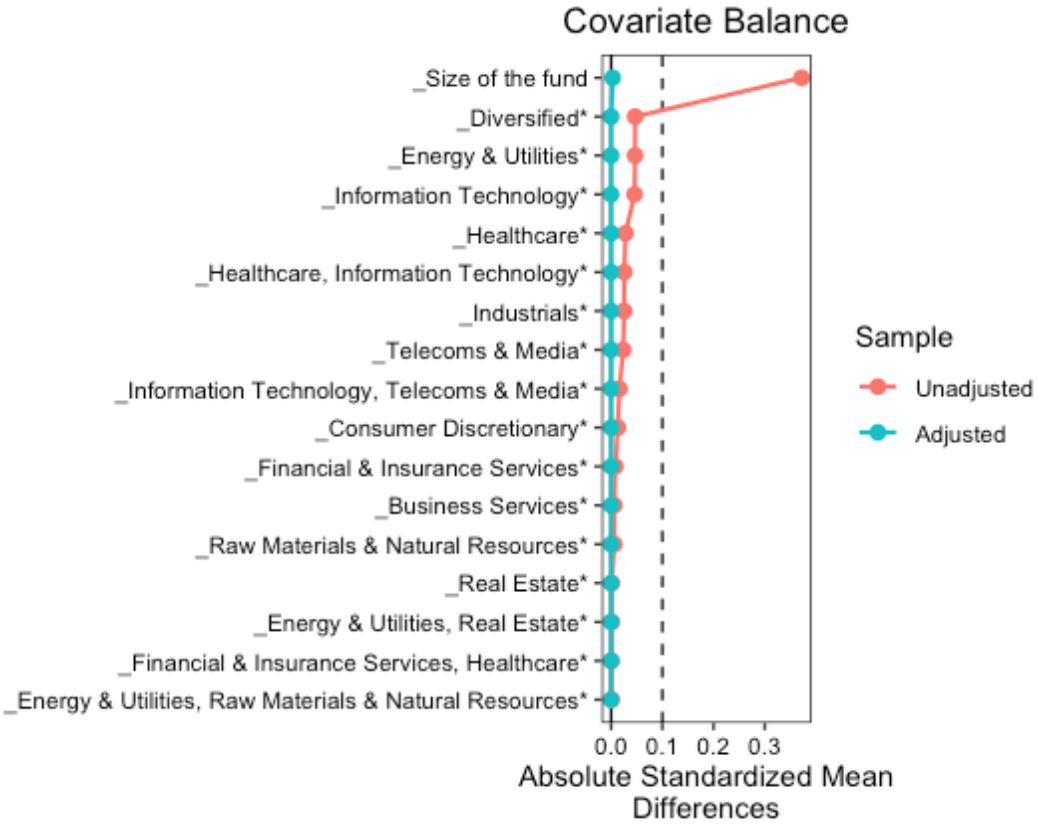


Table 5: Matching balance for Panel B sample



Performance measures

DPI: Income and capital realized from the investments. Expressed as a percentage of limited partner's investments. Value is expressed net of GP fees.

$$DPI(\%) = \frac{Total\ LP\ distribution}{Total\ LP\ contribution} x\ 100 \quad (6)$$

RVPI: Valuation of the assets unrealized in a fund. Expressed as percentage of limited partner's investments. Value is expressed net of GP fees.

$$RVPI\ (\%) = \frac{Unrealized\ value\ of\ Fund}{Total\ LP\ contribution} x\ 100 \quad (7)$$

MULTIPLE: Return measure expressed as a multiple of invested capital. Describes how manyfold the profits of the fund have been. Net Multiple is the sum of DPI and RVPI.

$$\text{Net Multiple} = \frac{(DPI(\%) + RVPI(\%))}{100} \tag{8}$$

IRR: Percentage measure of the returns calculated using cash flow data and discounted relative to the time value of money. IRR is expressed as net of fees.

$$NPV = \sum_{t=1}^{T} \frac{C_t}{(1 + IRR)^t} - C_0 = 0 \tag{9}$$

4 Results

4.1 Analysis of performance

Analysis of performance is done in groups and for both asset classes separately. I have limited the range of vintages to three groups of PE funds consisting of 5-6 years each. Two out of the three groups include a major economic crisis that affects the performance of PE funds.

For Nordic VC funds the performance has varied throughout the years. Measured with IRR the performance has been weak during the period 1999-2004 and 2005- 2010. The first period 1999-2004 includes the dot-com bubble and the following crisis and in the second period 2005-2010 the financial crisis. In the last period 2011-2016 the performance has increased to 24,81 measured as the average IRR for that period. In addition, net multiple has increased throughout the years. Between the years 2005-2010 average net multiple was slightly higher than for 2011-2016. However, when looking at the median net multiples it can be noticed that 2011-2016 was the best year, same as measured with IRR. The difference between average and median net

multiple for the years 2005-2010 can be explained by a few very high net multiples raising the average.

Table 6: Nordic VC fund performance by groups of vintages

Nordic VC fund performance										
Panel A				Panel B						
	n =35	IRR		n= 51	MULTIPLE		RVPI		DPI	
Vintages	Funds	Average	Median	Funds	Average	Median	Average	Median	Average	Median
1999-2004	15	5,83	9,50	23	1,11	0,87	25,77	42,00	85,39	100,00
2005-2010	11	2,85	0,34	17	1,86	1,02	45,15	82,00	140,68	96,54
2011-2016	9	24,81	30,00	11	1,83	1,79	111,91	69,00	71,33	89,00
Average	11,67	11,16	13,28	17,00	1,60	1,23	60,94	64,33	99,14	95,18
All funds		9,77			1,52		50,81		100,79	

Analyzing the Nordic BO funds with the same measure as VC funds there are differences. For Nordic BO funds, the performance has been much more consistent than for VC funds. Opposite to VCs BO performance has been slightly declining throughout the years while VC performance had been increasing. Performance measured as IRR was the worst during the financial crisis years. It seems that BO funds are not as affected by the crisis as VC funds are, this can be due to the fact they invest in more mature and larger companies.

Table 7: Nordic BO fund performance by groups of vintages

Nordic BO fund performance										
Panel A				Panel B						
	n=123	IRR		n=135	MULTIPLE		RVPI		DPI	
Vintages	Funds	Average	Median	Funds	Average	Median	Average	Median	Average	Median
1999-2004	33	26,15	18,61	32	2,27	1,85	8,27	184,08	218,79	97,78
2005-2010	49	12,81	11,00	57	1,91	1,64	39,19	134,95	151,95	94,44
2011-2016	41	17,24	18,00	46	1,84	1,76	105,75	47,50	78,28	90,16
Average	41,00	18,73	15,87	45,00	2,01	1,75	51,07	122,18	149,67	94,12
All funds		17,87			1,97		54,54		142,69	

VC funds in the United States follow a similar varying performance as their Nordic counterparts. U.S funds had very low performance measured with IRR during the first period of ears even lower than their Nordic counterparts. The best performance measured with IRR was an average of 17,08 with funds with vintages between the years 2011 and 2016. It can be said that the returns of U.S funds had less variation throughout the years than the Nordic VC funds. Average net multiples were close to the level of the Nordics. Net multiple averages and medians were closer to each which can be explained by the significantly higher sample size.

Table 8: U.S VC fund performance by groups of vintages

U.S VC fund performance										
Panel A				Panel B						
	n=432	IRR		n=506	MULTIPLE		RVPI		DPI	
Vintages	Funds	Average	Median	Funds	Average	Median	Average	Median	Average	Median
1999-2004	185	0,49	1,20	215	1,25	1,04	22,41	79,33	102,92	100,0
2005-2010	138	7,51	6,66	158	1,75	1,38	54,89	90,67	120,22	100,0
2011-2016	109	17,08	15,90	133	1,86	1,54	150,09	17,00	36,27	96,58
Average	144,00	8,36	7,92	168,67	1,62	1,32	75,79	62,33	86,47	98,86
All funds		6,92			1,57		66,11		90,80	

As VC funds seemed to have similar performance throughout the years it seems to be the same case with BO funds. BO funds seem to provide consistent returns even though the recent years have been the best in respect to IRR and the earliest years best in respect to net multiple. Funds with the earlier vintages were behind of their Nordic counterparts measure with IRR 13,82 compared to 26,15 of Nordic funds during the same time period. As IRR takes into account the time value of money funds with later vintages are probably returning funds back faster to LP's.

Table 9: U.S BO fund performance by groups of vintages

U.S BO fund performance										
Panel A				Panel B						
	n=1385	IRR		n=1440	MULTIPLE		RVPI		DPI	
Vintages	Funds	Average	Median	Funds	Average	Median	Average	Median	Average	Median
1999-2004	347	13,82	11,90	355	1,79	1,69	11,53	160,39	167,68	98,38
2005-2010	528	11,40	10,72	560	1,70	1,63	32,13	134,95	138,16	96,99
2011-2016	510	17,04	15,71	525	1,64	1,53	101,57	47,50	62,87	90,71
Average	461,67	14,09	12,77	480,00	1,71	1,62	48,41	114,28	122,90	95,36
All funds		14,09			1,70		52,37		117,99	

4.2 Descriptive statistics

Below are two tables of descriptive statistics for both groups internal rate of return sample in panel A and net multiple sample in panel B. There are 1975 funds in panel A and 2132 funds in panel B. As we can see from minimum and maximum values of internal rate of return and net multiple, there exists a very large difference in performance ranging from -100 to 123,200 and 0 to 13,960 respectively. The mean internal rate of return is 12,678 and the standard deviation is 15,070. The standard deviation can be considered high as it is higher than the mean and negative values are included in the confidence interval of one standard deviation from the mean. For the net multiple the mean is 1,684 with a more moderate standard deviation of 1,032. However, these are not comparable as they are very different performance measures, and the internal rate of return can take negative values. There was also a large spread in fund sizes ranging from 1,0 million to 20 265 million dollars with a standard deviation of 1 741,042. Since the period examined consisted of two very different economic areas and included two economic crises unemployment rate has a high spread ranging from 6,026 to 31,321 with a standard deviation of 7,922.

Table 10: Descriptive statistics of variables used in the regression model for panel A.

Statistic	N	Mean	St. Dev.	Min	Max
IRR	1,975	12.678	15.070	−100.000	123.200
VINTAGE	1,975	2,007.621	5.205	1,999	2,016
CLASS	1,975	0.236	0.425	0	1
SIZE	1,975	730.004	1,741.042	1.000	20,365.000
EXPERIENCE	1,975	3.342	2.473	1	13
REGION	1,975	0.080	0.271	0	1
TAX	1,975	34.348	2.317	20.000	35.000
FI	1,975	0.830	0.068	0.377	0.993
AGREEMENT	1,975	18.928	18.809	12.000	94.000
RD	1,975	2.651	0.243	1.455	3.874
TEA	1,975	10.873	2.018	3.100	13.800
GDPCAP	1,975	46,472.880	7,560.300	26,657.830	66,956.290
MSCI	1,975	0.074	0.050	0.0001	0.178
UNEMPLOYMENT	1,975	15.691	7.867	6.026	31.321

Table 11: Descriptive statistics of variables used in the regression model for panel B.

Statistic	N	Mean	St. Dev.	Min	Max
MULTIPLE	2,132	1.684	1.032	0.000	13.960
VINTAGE	2,132	2,007.586	5.185	1,999	2,016
CLASS	2,132	0.261	0.439	0	1
SIZE	2,132	709.850	1,702.171	1.000	20,365.000
EXPERIENCE	2,132	3.282	2.442	1	13
REGION	2,132	0.087	0.282	0	1
TAX	2,132	34.281	2.440	18.000	35.000
FI	2,132	0.830	0.068	0.377	0.993
AGREEMENT	2,132	19.480	19.710	12.000	94.000
RD	2,132	2.656	0.250	1.455	3.874
TEA	2,132	10.822	2.074	3.100	13.800
GDPCAP	2,132	46,339.920	7,570.911	26,657.830	66,956.290
MSCI	2,132	0.074	0.050	0.0001	0.178
UNEMPLOYMENT	2,132	15.760	7.922	6.026	31.321

4.3 Correlation analysis

Correlation for the full sample was analyzed separately for panel A and Panel B. The reason for the separate analysis is the different sample sizes. Panel A is used for model 1 and Panel B for model 2. Correlation analysis is conducted twice first for the main analysis and again for the exploratory analysis with different variables.

Correlation coefficients were low in the full sample matrices and correlation with the dependent variable was low and all variables excluding the fund manager experience were statistically significant ($p < 0.001$). The only variables with a correlation over 0,5 were fund inception year and the public stock market index 0,52 in both panels. These were both statistically significant ($p < 0.001$) The second highest correlation was between the fund manager's experience and the size of the fund 0,273 in panel A and 0,276 in panel B, with both of these statistically significant ($p < 0.001$). Other variables had correlations lower than this.

For the sub-sample used for the exploratory analysis, correlation coefficients are shown in the appendix (Tables A2 and A3). Correlation coefficients analysis consists of more variables and therefore more variation exists. No strong correlation existed with the dependent variables in this sample and the largest statistically significant correlation was -0.20 ($p > 0.001$). The largest correlation coefficient of the sub-sample was -0,70 in panel A and -0,71 in panel B between total early-stage entrepreneurial activity and the percentage of the workforce under collective bargaining agreements, which was statistically significant ($p < 0.001$). Another statistically significant ($p < 0.001$) correlation over 0,5 was a negative one -0,52 in panel A and -0.51 in panel B between the financial institution development index and the percentage of the workforce under collective bargaining agreements. Other variables had low correlations with the majority being statistically significant ($p < 0.001$).

Table 12: Correlation coefficients and their statistical significance.

Pearson correlation matrix full sample Panel A

	IRR	VINTAGE	CLASS	EXPERIENCE	REGION
IRR					
VINTAGE	0.23***				
CLASS	-0.20***	-0.16***			
EXPERIENCE	0.01	0.23***	-0.13***		
REGION	0.07**	-0.02	-0.01	-0.01	
MSCI	0.17***	0.52***	-0.08***	0.11***	0.00

*** p < 0,001, ** p < 0,01, * p < 0,05.

Table 13: Correlation coefficient and their statistical significance.

Pearson correlation matrix full sample Panel B

	MULTIPLE	VINTAGE	CLASS	EXPERIENCE	REGION
MULTIPLE					
VINTAGE	0.05*				
CLASS	-0.07**	-0.16***			
EXPERIENCE	-0.01	0.23***	-0.15***		
REGION	0.05*	-0.02	0.01	-0.01	
MSCI	0.01	0.52***	-0.09***	0.12***	0.00

*** p < 0,001, ** p < 0,01, * p < 0,05.

Variance inflation factors

As the correlation between variables do not take into account everything, it is necessary to study the variance inflation factors (VIF) for the variables included in the models. Generally, variance inflation factor values are considered troublesome if VIF > 5 or VIF >10. Menard defined acceptable values for VIF > 5 as a cause for concern and VIF > 10 as representing a serious issue with multicollinearity. (Menard, 2002)

Variance inflation factors for the full sample (models 1 and 2) are shown in Table 14. In both models, all variables exhibit values lower than 1,5, suggesting that there is no multicollinearity issue with the variables.

Table 14: Variance inflation factors

Variance inflation factors full sample

	Model 1	Model 2
VINTAGE	1.29	1.45
log(SIZE)	1.22	1.29
EXPERIENCE	1.20	1.15
REGION	1.01	1.01
CLASS	1.19	1.20
MSCI	1.24	1.38

4.4 Full matched sample analysis

To measure if there is a difference in performance between the Nordic region and North America, there will be multiple linear regression applied for both panels. Model 1 has internal rate of return as the dependent variable and model 2 has net multiple as the dependent variable. Both linear models include a significant sample of funds with 316 in panel A and 376 in panel B. Robust linear regression is used for both models.

The year of the inception of the fund had a significant positive effect on the performance ($p < 0.05$) for model 1. Fund managers with earlier funds had a significant negative effect on performance ($p > 0.05$) for model 1 only. The main independent variable to measure was the geographical location of the duns it can be said that it has a positive effect on performance at the ($p < 0.05$) level for both models. According to the full sample model, Nordic PE performance is not only on par with the United States one but performs better. For both models, the asset class being VC had a negative effect on performance that was statistically significant ($p < 0.01$). It can be said that in this sample VC funds are performing worse than BO funds. Stock market performance has a positive effect on the financial performance of PE funds measured with IRR ($p < 0.01$).

Table 15: Robust linear regression analysis for the full sample.

	Dependent variable:	
	IRR Model 1	MULTIPLE Model 2
VINTAGE	0.310**	0.001
	(0.137)	(0.008)
EXPERIENCE	−0.548**	0.004
	(0.277)	(0.017)
REGION	3.153**	0.146**
	(1.241)	(0.073)
CLASS	−5.586***	−0.479***
	(1.462)	(0.081)
MSCI	39.143***	0.761
	(13.878)	(0.815)
Constant	−610.257**	−0.829
	(275.000)	(16.440)
Observations	316	372
Residual Std. Error	9.223 (df = 310)	0.642 (df = 366)
Note:		*p<0.1; **p<0.05; ***p<0.01

Robustness checks full sample

To test the validity of the results and to estimate if the most suitable regression model was used, robustness checks are performed. These are performed for the full sample using OLS (Table A1). The robust regression model seems to work better for both models with lower residual standard error. OLS 1 is the model with an internal rate of return as a dependent variable and OLS 2 is the model with net multiple as a dependent variable. Along with Models 1 and 2 independent variables of geographical location were statistically significant in the OLS 1 ($p < 0.1$) and OLS 2 ($p < 0.05$), meaning that the results can be viewed as robust. For the asset class, the VC dummy had a statistically significant negative effect in OLS 1 ($p < 0.01$) and OLS 2 ($p < 0.05$) again in line with the main models.

4.5 Full matched sample VC performance

To test the H2, a separate analysis for the VC funds is performed. For this analysis, the same robust regression method is applied, and robustness is tested with OLS (available on request). The effect of the independent variable geographical location of the fund was not statistically significant at any level. Results from this analysis tell us that the region of the fund does not affect the performance. Thus, it can be said Nordic VC fund performance is on par with the United States for both financial performance measures (Table 16).

Table 16: Regression models for the VC full sample

	Dependent variable:	
	IRR VC Model 1	MULTIPLE VC Model 2
REGION	1.653	−0.106
	(4.292)	(0.155)
Constant	7.318***	1.274***
	(2.821)	(0.103)
Observations	81	115
Residual Std. Error	13.384 (df = 79)	0.780 (df = 113)
Note:		*p<0.1; **p<0.05; ***p<0.01

4.6 Nordic sub-sample

In order to study which region-specific factors have an effect on the performance of PE funds within a region, the Nordic region and the United States are inspected separately without matching. A robust linear model will be applied for both regions and panels. Due to variables workforce under collective bargaining agreements and research & development spending passing the VIF > 4 threshold when in the same model, they are studied in separate models.

Analyzing the Nordic sub-sample separately it can be said likewise in the full sample VC funds perform worse than BO funds in the Nordic region ($p < 0.01$). Again, the performance of the public stock market is positively related to the financial performance of the Nordic PE funds measured with the internal rate of return ($p < 0.01$) and net multiple ($p < 0.05$). For other variables, the results are not statistically significant ($p < 0.01$), possibly due to the limited sample size available.

Table 17: Robust linear regression analysis for the Nordic sub-sample.

	Dependent variable:			
	IRR		MULTIPLE	
	Model 3	Model 4	Model 5	Model 6
log(SIZE)	−1.463*	−1.463*	−0.062	−0.061
	(0.844)	(0.849)	(0.049)	(0.050)
EXPERIENCE	−0.303	−0.292	0.008	0.007
	(0.483)	(0.487)	(0.027)	(0.027)
CLASS	−8.309***	−8.467***	−0.650***	−0.649***
	(2.548)	(2.565)	(0.137)	(0.137)
FI	−6.502	−0.885	−0.546	−0.568
	(7.125)	(7.484)	(0.401)	(0.381)
RD	3.817*		0.010	
	(2.050)		(0.112)	
TEA	0.987	0.464	−0.006	−0.003
	(0.783)	(0.760)	(0.039)	(0.039)
MSCI	83.234***	92.941***	2.641**	2.675**
	(22.102)	(21.938)	(1.263)	(1.229)
GDPCAP	0.00004	−0.0001	0.00001	0.00001
	(0.0001)	(0.0001)	(0.00001)	(0.00001)
UNEMPLOYMENT	−0.196	−0.148	−0.025**	−0.025**
	(0.222)	(0.222)	(0.013)	(0.013)
AGREEMENT		0.032		0.003
		(0.247)		(0.009)
Constant	8.896	18.126	2.605***	2.348**
	(11.666)	(23.616)	(0.650)	(1.044)
Observations	157	157	187	187
Residual Std. Error	10.404 (df = 147)	10.281 (df = 147)	0.703 (df = 177)	0.706 (df = 177)
Note:				*p<0.1; **p<0.05; ***p<0.01

4.7 North American sub-sample

For the North American sub-sample, sample sizes are significantly larger than for the Nordic ones. Independent variable corporate tax rate could not be implemented in the models as it has remained constant throughout the years (1999-2016) in the United States. Likewise, in the two previous analyses for the full sample and the Nordic sub-sample asset class for VC has a negative effect on the financial performance of both financial measures internal rate of return and the net multiple ($p < 0.01$). For financial market development, there are contradictory results between the internal rate of return (Model 7 and Model 8) which affects the performance negatively, and the net multiple (Model 9 and Model 10) which affects the performance positively. R&D spending affects the performance of PE positively for both models ($p < 0.01$). The public stock market's performance has a positive effect on the performance of PE in the internal rate of return in (Model 7 and Model 8) ($p < 0.01$). For the United States sub-sample, the results showed a negative relation between the stock market performance and net multiple, but these were not statistically significant. Surprisingly, the percentage of the workforce belonging to collective bargaining agreements has a positive impact on PE performance ($p < 0.05$).

Table 18: Robust linear regression analysis for the United States sub-sample

	Dependent variable:			
	IRR		MULTIPLE	
	Model 7	Model 8	Model 9	Model 10
log(SIZE)	−0.213	−0.226	−0.005	−0.006
	(0.187)	(0.188)	(0.010)	(0.010)
EXPERIENCE	−0.179	−0.173	0.004	0.004
	(0.109)	(0.109)	(0.006)	(0.006)
CLASS	−6.177***	−6.087***	−0.340***	−0.338***
	(0.627)	(0.631)	(0.034)	(0.034)
FI	−50.908**	−71.032***	3.427***	2.851**
	(21.391)	(20.831)	(1.170)	(1.140)
RD	19.239***		0.754***	
	(4.209)		(0.229)	
TEA	0.403*	0.108	−0.003	−0.013
	(0.208)	(0.193)	(0.011)	(0.010)
MSCI	13.147**	14.937**	−0.220	−0.105
	(5.921)	(6.118)	(0.329)	(0.340)
GDPCAP	0.0001**	0.001***	−0.00001*	0.00002**
	(0.0001)	(0.0002)	(0.00000)	(0.00001)
UNEMPLOYMENT	−0.070	−0.004	0.009***	0.012***
	(0.051)	(0.056)	(0.003)	(0.003)
AGREEMENT		3.957***		0.185***
		(1.299)		(0.070)
Constant	−4.284	−16.301	−3.070**	−4.312**
	(25.945)	(37.195)	(1.412)	(2.019)
Observations	1,817	1,817	1,946	1,946
Residual Std. Error	9.003 (df = 1807)	8.946 (df = 1807)	0.525 (df = 1936)	0.530 (df = 1936)

Note: *p<0.1; **p<0.05; ***p<0.01

5 Discussion

Previous research on Nordic PE performance was limited while Europe had been studied earlier more in-depth. In earlier studies by Kaplan and Schoar (2005) Europe has been lacking in performance and especially with VC fund performance. This thesis contributes to the existing PE research on a European level by adding a new depth to PE performance studies by considering Nordics on their own. This opens up new avenues to research separate geographical areas in Europe like the Baltic countries.

The hypothesis that Nordic PE is on par with the United States is supported. In this thesis, there was evidence that Nordic PE performs better than the United States. What can be concluded is that in this sample Nordic PE performs better than its United States counterparts when controlling for size and industry. This was true in the robustness check as well. As in previous research by Harris et al., (2015) European VC funds were performing worse than the public market and underperforming when compared to the United States. In this thesis, the hypothesis was that Nordic VC performance is on par with the United States. VC fund performance was measured separately and there was support for the hypothesis on a statistically significant level. Results are important for the Nordics to develop as startup hubs since the goal is to receive more foreign venture capital and have more foreign contributors to the funds. Lately, foreign VCs have been active in the Nordics in individual large deals but do not systematically invest in a wide range of startups. In the sample studied there was clear evidence that VC funds perform worse than BO funds. This thesis provides results in line with earlier research on how VC fund performance has a larger variance and is more affected by the state of the economy.

In earlier studies by Felix et al., (2012) it was found that the rise in the unemployment rate decreases the supply of VC. The scope of this thesis was to study two very different regions in terms of political systems and social security. The results for the increase of the unemployment rate had different effects in the Nordics and the United States. For Nordics, the rise in the unemployment rate had a negative effect on the performance of VC funds while for the United States sample this was positive. The reason for this can stem from a different level of social security system in the Nordics compared

to the United States. Since the Nordics have a strong level of social security it means that it is possible to stay unemployed for a longer period which might be the reason why entrepreneurship is not considered. For the United States, the case is different, and without a similar system, some can be forced to entrepreneurs in order to make a living. Another viable contributor is that in the United States entrepreneurship is seen as a more viable option and total early-stage entrepreneurial activity is higher than in the Nordics. Policy implications for this must take into concern since similar policy changes might not have a similar effect in different geographical areas.

An important finding to raise from the results in that there is a positive relation between PE fund performance and the public stock market. The result was statistically significant in all the regression models with the internal rate of return as the dependent variable and all the Nordic sub-sample regression models. This result is in contradiction with the current belief that PE provides diversification to a portfolio. As these companies are difficult to invest in as private investors since they are unlisted, but they do not provide significant diversification protection with the public stock market. In the United States, R&D spending in a percentage of GDP affects the performance of PE funds positively. Along with the positive effect on PE performance, it is important for innovation activity. This result provides implications to policymakers in order to boost PE activity in a country.

5.1 Limitations

This thesis is not without limitations and the amount of data available for Nordic funds in the Preqin database represents one of them. As the United States is much larger than the Nordic countries, there exists more data and the data is reported to Preqin more often. I overcame this issue by performing CEM matching procedure. However, in the exploratory analysis for the sub-sample in the Nordic region sample size remained small. Due to the limited sample in the Nordic region, it is possible there is bias in the data reported by GPs and this bias would have a larger effect. Results themselves would also be statistically more significant with a larger sample. It would be beneficial to complete this study with datasets from different sources as well and this would provide more robust results. The most beneficial data would be from the fund managers directly by asking. In case enough of the fund

managers would give this data, there would be a clearer unbiased view of the PE market and its performance. Yet, complete openness seems unlikely but even an increased one would give more validity and transparency to the data on startup investments.

Another important factor to consider is the ongoing development of both the startup and VC markets in the Nordics. Nordic countries are growing fast as startup hotspots and are now performing well when measured as VC investments to GDP. This fast-growing market has implications for the performance of VC funds in this area. Since the market is developing this might reflect also on the results found and all of the data does not represent the changing market at the moment since the performance will be visible after the fund is old enough. In a few years, it will be interesting to revisit the subject of financial performance for PE funds in the Nordics.

While the most important financial performance measures for PE funds are internal rate of return and net multiple. It is important to look at how fast GPs are returning the investments back to LPs measured with DPI, an evaluation of this was done when comparing the absolute returns of these two regions. In the PE research field, public market equivalent (PME) is another widely used performance measure to complement the two main financial performance measures. It would be a valuable addition to this study but was not possible since it requires cash flow data, which is not available in the Preqin database.

6 Conclusion

This thesis evaluates how Nordic PE funds are performing compared to their United States counterparts. As innovation is important for an economy to keep up with the disruption as well as for creating economic growth. PE is vital in filling a funding gap and providing sector expertise and networks for companies to thrive. There are differences in PE funds and their performance, this is very connected to the fund manager as well as institutions. As a result of thorough literature analysis, three categories of factors have been identified that influence the performance of PE funds. Fund-specific factors consist of networks, fund size, and fund managers' experience. These factors can be affected by picking the correct fund as well as the behavior of the fund manager. Region-specific factors include taxation, financial market development, labor market regulation, research and development spending, supply of entrepreneurship. Countries and their policymakers have the possibility to affect these factors which makes their analysis valuable. Geographical factors are country-specific even though the Nordic countries are homogenous in respect to these factors with only minor differences. The Nordic region can be said to be less developed in these geographical factors than the United States. Nordic countries have less developed PE markets, and it is due to these geographical factors. The third group of factors that can be classified as a sub-class for region-specific factors are macroeconomic factors: public stock market performance, gross domestic product, and unemployment rate. Through a CEM one-to-one matching process on fund size and industry, bias was reduced on Nordic and U.S funds making them more comparable. Analyzing the matched sample by multiple regression models, the hypothesis was supported that Nordic PE performance is not lacking behind the U.S. In this thesis statistical evidence was found that the Nordic region performing better than its North American counterparts. For the VC funds Nordic performance was on par with that of the United States. As an asset class, it was found that from the years 1999 to 2016 VC funds were performing worse than BO funds. It is assumed that PE provides diversification benefits to portfolios, yet this thesis found that the public stock market performance is positively related to PE performance. This is understandable since IPO is the main goal to make an exit. For the United States, it was concluded that an increase in R&D spending leads to better financial performance.

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Appendix

Eq. A1, A2 and A3: M-estimator functions for the Huber method

$$\rho(z) = \begin{cases} z^2, if\ |z| < c; \\ |2z|c - c^2, if\ |z| \geq c \end{cases} \quad (A1))$$

$$\psi(z) = \begin{cases} z, if\ |z| < c; \\ c(sgn(z)), if\ |z| \geq c \end{cases} where\ c\ \approx 1{,}345 \quad (A2)$$

$$w(z) = \begin{cases} 1, if\ |z| < c; \\ \frac{c}{|z|}, if\ |z| \geq c \end{cases} \quad (A3)$$

Table A1: Robustness check OLS models

	Dependent variable:	
	IRR OLS 1	MULTIPLE OLS 2
VINTAGE	0.293	0.010
	(0.220)	(0.014)
EXPERIENCE	−1.105**	−0.013
	(0.443)	(0.028)
REGION	3.745*	0.254**
	(1.986)	(0.125)
CLASS	−8.397***	−0.279**
	(2.340)	(0.139)
MSCI	52.423**	−0.391
	(22.213)	(1.393)
Constant	−573.615	−17.686
	(440.153)	(28.081)
Observations	316	372
R^2	0.088	0.025
Adjusted R^2	0.073	0.012
Residual Std. Error	17.577 (df = 310)	1.199 (df = 366)
F Statistic	5.946*** (df = 5; 310)	1.894* (df = 5; 366)
Note:		*p<0.1; **p<0.05; ***p<0.01

Table A2: IRR sub-sample

Pearson correlation matrix Panel A sub-sample

	IRR	CLASS	SIZE	EXPERIENCE	TAX	FI	AGREEMENT	RD	TEA	MSCI	GDPCAP
IRR											
CLASS	-0.20***										
SIZE	0.00	-0.17***									
EXPERIENCE	0.01	-0.13***	0.27***								
TAX	-0.07***	0.02	0.04	0.00							
FI	-0.10***	0.02	0.07**	-0.07**	0.48***						
AGREEMENT	0.06*	0.00	-0.05*	-0.03	-0.95***	-0.52***					
RD	0.09***	-0.02	0.04	0.00	0.01	0.41***	0.00				
TEA	0.02	-0.01	0.04	0.04	0.65***	0.24***	-0.70***	-0.06**			
MSCI	0.17***	-0.08***	-0.02	0.11***	-0.02	-0.10***	-0.03	0.16***	0.07**		
GDPCAP	0.18***	-0.16***	0.09***	0.24***	0.09***	-0.13***	-0.21***	-0.01	0.31***	0.40***	
UNEMPLOYMENT	0.18***	-0.12***	-0.01	0.17***	-0.16***	-0.27***	0.14***	0.21***	0.08***	0.51***	0.56***

*** p < 0,001, ** p < 0,01, * p < 0,05.

Table A3: MULTIPLE sub-sample

Pearson correlation matrix Panel B sub-sample

	MULTIPLE	CLASS	SIZE	EXPERIENCE	TAX	FI	AGREEMENT	RD	TEA	MSCI	GDPCAP
MULTIPLE											
CLASS	-0.07**										
SIZE	-0.02	-0.19***									
EXPERIENCE	-0.01	-0.15***	0.28***								
TAX	-0.05*	0.00	0.05*	0.00							
FI	-0.06*	0.01	0.07**	-0.07**	0.47***						
AGREEMENT	0.04	0.02	-0.06**	-0.03	-0.95***	-0.51***					
RD	-0.01	-0.02	0.03	0.00	-0.06**	0.36***	0.08***				
TEA	-0.05*	-0.01	0.05*	0.04	0.65***	0.23***	-0.71***	-0.11***			
MSCI	0.01	-0.09***	-0.01	0.12***	-0.02	-0.10***	-0.02	0.16***	0.05*		
GDPCAP	0.04*	-0.17***	0.09***	0.24***	0.12***	-0.12***	-0.23***	-0.03	0.32***	0.40***	
UNEMPLOYMENT	0.06**	-0.10***	-0.01	0.17***	-0.16***	-0.27***	0.14***	0.21***	0.06**	0.51***	0.55***

*** p < 0,001, ** p < 0,01, * p < 0,05.

Table A4: Variance inflation factors for sub-sample

Variance inflation factors sub-sample

	Model 4	Model 6
log(SIZE)	1.57	1.50
EXPERIENCE	1.59	1.52
TEA	1.76	1.24
GDPCAP	2.63	1.40
CLASS	1.24	1.79
MSCI	1.24	2.80
RD	3.39	1.53
FI	2.03	1.27
TAX	1.67	2.34
UNEMPLOYMENT	1.14	1.09