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Financial Economics

Investment firm characteristics in venture capital

Abstract

The private equity market is known for its lack of liquidity and information. This thesis aims at bringing further clarity to the private equity field, specifically targeting the relationship between firm size and risk in the Nordic market. The amount of previous research in this area is scarce and consists mainly out of more general topics and a broader field. Using a sample of 2,919 observations we try to predict which variables affect firm size. Based on the model, we conclude that larger firms may take larger risk, primarily through being part of earlier investment rounds. Furthermore, our results imply that larger firms to a greater extent invest in follow-up rounds and invest internationally.

Acknowledgements

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1 Introduction

1.1 Background

The private equity market is commonly known for its lack of liquidity and information. This leads to several problems associated with risk and information asymmetry. Despite a great collection of articles within the private equity area, many questions are left unanswered.

In 2018 a record of $254 billion has been invested globally into startups via venture capital funding, signifying a remarkable growth compared to 2017 where the annual invested via venture capital funding amounted to $174 billion (KPMG Enterprise, 2019). In addition, a lot of big and well-known companies have been backed by venture capital funding, for example Whatsapp, Facebook, Microsoft, Apple Computer, Spotify and Google (CBInsights, 2019). The largest private acquisition of a venture capital backed company ever was Facebook's acquisition of Whatsapp in 2014, which was good for $22 billion (Ibid.)

Despite the considerable amount of capital involved in the venture capital market, scarcity of information is present due to the low obligation of reporting compared to the public market (IFRS Foundation Advisory Council, 2019). Although the increasing interest of venture capital, a great number of questions are left unanswered. How is risk associated with the size of a venture capital firm? Do venture capital firms experience loss aversion, and is it related to the size of the firm? Do investments outside the investment firm's domestic area imply that the firm is larger or smaller?

This thesis will to provide knowledge for the investor regarding what they are actually investing in and what risks and characteristics different kinds of investment firms possess. The limited amount of transparency in the venture capital market is problematic and to hinder the venture capitalists from taking actions for their own winning, the investors, which in most cases will be everyone with money in a pension fund, need to have a greater understanding of the underlying characteristics different VC-firms possess. The issues related to this lack of information will be further explained in the problem discussion.

1.2 Venture Capital

Venture capital can be defined as capital that is invested by venture capitalists in equity-linked securities of private ventures at various stages in their development (Sahlman, 2011). In addition to their ownership rights, venture capitalists engage actively in the management of the funded venture (Ibid.).

Venture money is a funding where "individuals put money behind bright ideas" (Bloomfield, 2008). This created Apple Computers and Nescape among others (Ibid.). Venture money is usually referred to as the capital that is being invested without any certainty of return (Ibid.).

Common investors in VC funds are pension funds and insurance companies. They are called limited partners and possess low decisive power after the fund has been raised (Sahlman, 2011). The venture capital firm, also known as the general partner, manages the fund and takes an active role in the investment to add value (DePamphilis, 2014; Sahlman, 2011).
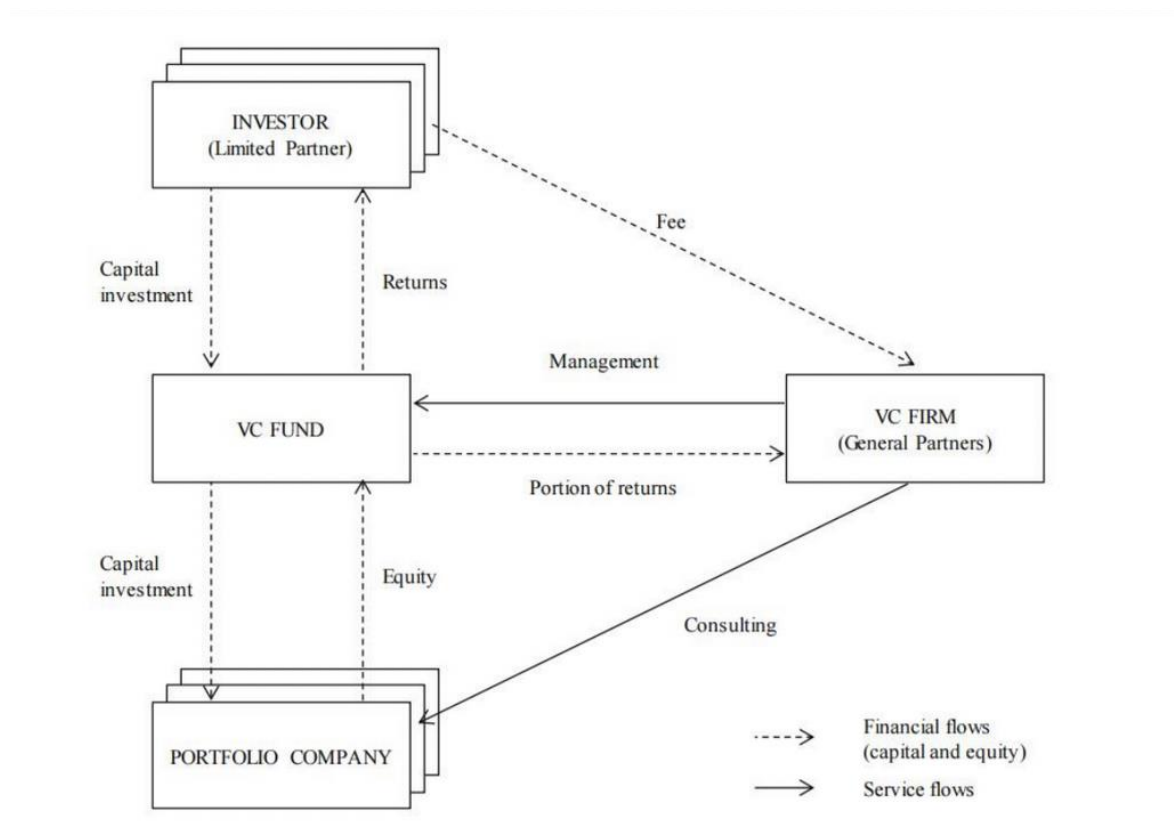
Source: Tarrade, 2012

Private firms that acquire private companies differentiate from the publicly listed company mergers & acquisitions environment. As one can see in figure 1, private equity transactions follow a cyclicality trend (Bain & Company, 2020), which seems to be observable in transactions involving publicly listed firms.

Figure 1
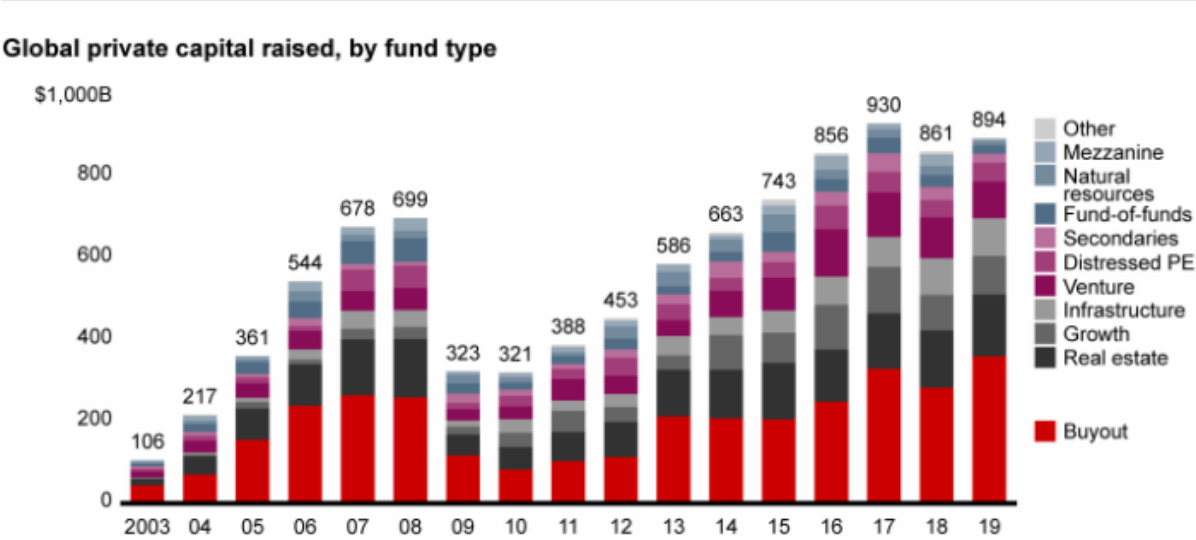
Bain & Company; Private Equity in 2019: Strong deal activity despite worsening macro conditions.

1.3 Problem discussion

As a result of the VC firms' low requirements to present data about their transactions, few reliable variables to measure risk are available (Giot et al., 2014). Yet, being able to measure risk involved in venture capital transactions is critical in order to ensure transparency and a fair chance for the investors to understand their investments. Hence, it is of great importance to elucidate the lack of information present in the venture capital market.

The question remains if the investors have enough knowledge concerning the Venture Capital firm prior to investing. Moreover, is it even possible to fairly estimate the risks that they take? As a consequence of the incompetence of measuring investment risk, the majority of investors tends to be drawn to the older and bigger venture capital firms, which have proven to be successful in the past (Cumming and Dai, 2011). However, the difference in outcome of investing in a big venture capital firm compared to a small venture capital firm has not been

extensively researched. The obscurity concerning the private equity market needs to be clarified in order to increase the transparency and understanding in this market we are all affected by.

The previously mentioned problems are grounded in a number of theories, including information asymmetry, loss aversion and ambiguity aversion. These are introduced below and further explained in the theoretical framework.

Information asymmetry is a term that has been applied widely within economics and finance. It is used to explain the information gap between stakeholders and managers in the case of equity offerings (Dierkens, 1991), and insider trading (Aboody and Lev, 2000). The relevance of information asymmetry between investment firms could also be substantial in determining valuation estimations of potential investments, which could lead to rivalling investors refraining from uncertain risk of an acquisition or investment. Applying information asymmetry to a payoff matrix, considering the pricing effects that ambiguous information have on markets (Condie and Ganguli, 2017), could potentially affect private equity investors (Azrieli and Teper, 2011;Condie and Ganguli, 2017). Therefore, ambiguity aversion as a behavioural factor contributing to the investment choices of private equity firms seems reasonable.

When investing in private equity, especially VC, it is common for target companies to seek multiple rounds of funding. Continuing to invest in the same target company with more than one round of investment implies a commitment that could be explained by several different behavioural bias characteristics. Loss aversion could potentially be a behavioural characteristic where investors would double down on companies which have no profitability. This is done with the hope of turning the company around to become profitable, and therefore a successful investment. Coupled with loss aversion, Kahneman and Tversky (1979) suggest that investors act irrationally and prefer to realise profits sooner than necessary. A VC investment might not be as easy to realise, as private equity investments seldom prove to be liquid. This illiquidity has the potential to both serve as a benefit for the investor in terms of managing commitment, but also a risk concerning the opportunity cost (Lerner and Schoar, 2004). To counter Kahneman & Tverskys (1979), a firm might also want to continue investing in a company if it sees potential for a high success rate and profitability.

1.4 Research question

This report aims to bring further clarity to the private equity field where the limitation of information available hinders transparency, especially aimed towards investment professionals to gain some additional clarity into areas that might impact their investment decisions. The main reason being the information asymmetry that arises due to an absence in detailed disclosure of investments made. Specifically, the thesis will examine what characteristics affect the size of an investment firms, coupled with loss- aversion and risk aversion.

First, we want to clarify what effect risk has on the size of investment firms. As previously stated, it is difficult to measure risk within Venture Capital. Consequently, we use control variables separated into different stages of a target firm's life cycle[1]. Our expectation, reinforced by Cumming and Dai (2011), is that higher risk investments will imply that the investment firms is larger. Therefore, the null hypothesis is the following:

> $H_{0,1}$: *Larger investment firms allocate less funds to the early stages in the target firm as compared to smaller investment firms*

Second, several questions arise regarding loss aversion in investments[2]. Does the continuance of investment in follow-up rounds imply that it is a bigger investment firm? Furthermore, the relationship between firm size and loss aversion is not known and it would be of many investor's interest to be able to draw more conclusions regarding what impact loss aversion has on their investments.

> $H_{0,2}$: *Larger investment firms do not tend to continue investing in follow-up rounds into the same company compared to smaller firms.*

Last, we want to bring knowledge to characteristics related to international and domestic markets. What can be expected from investments outside of the investment firm's domestic market is that the firms have a broader reach and knowledge about the market they are investing in. Therefore, the assumed risk and knowledge is anticipated to be better analysed by an

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[1] Detailed information about the variables can be found in chapter 5
[2] Prospect theory and loss aversion is explained further in chapter 2

investment firm that can access and understand more markets. With ideas established in ambiguity aversion, the expectation is that investments in domestic markets should lead to a smaller investment firm, which is also stated in Giot et al. (2014).

> $H_{0,3}$: *Larger investment firms allocate less funds to target*
> *firms outside their domestic market as compared to*
> *smaller investment firms*

1.5 Limitations

For the purpose of this thesis, certain limitations have been enacted to accommodate the appropriate scope. This study will limit itself to transactions conducted by firms who reside in the Nordic- and Scandinavian countries Sweden, Denmark, Norway, and Finland with the reasoning that these private equity markets are all fairly similar when it comes to fees, taxes, and the obligation to follow disclosure regulations such as IAS and IFRS (IFRS Foundation Advisory Council, 2020). The dataset includes investments of companies within these countries, and beyond. However, investments made by private equity firms outside of this region into companies within, will not be considered as the scope of the thesis is to study the investment firms themselves.

Furthermore, this thesis will solely focus on equity investments. Debt transactions such as mezzanine debt, bonds, and leveraged buyouts will not be considered. This is due to the limitation of information available concerning debt, such as credit risk, credit ratings, and default rates of each private equity fund.

1.6 Thesis structure

The structure of this thesis is aimed to explain the behavioural biases, shortly covered in the previous section, more in depth in section two and three, along with already existing relevant literature in the field. Section four will cover the data collection, which data was chosen to be used for this study, how the data was cleaned, as well as the limitations and lack of accessibility of data available. The fifth section will go through the methodology used to examine the data. Primarily, what kind of quantitative analysis will be used, how to interpret the random variables, and the limitations that each variable possesses. The final sections, results, conclusion, and discussion will cover the regression results extracted from the data, the limitations of how the analysis, and lastly how this thesis supports further research in the field.

2 Theoretical framework

For the theoretical framework to be used in this study, it is important to be able to measure the risk of investments for stakeholders and investors. First, we will present two general theories which describe the origins of the problem we are investigating. Subsequently, we will introduce theories related to behavioural finance (prospect theory, ambiguity aversion and risk aversion). These theories lay the ground for the analysis of our research question and they are all related to our hypothesis. The agency theory is especially applicable to our first null hypothesis, the prospect theory is used to research the second null hypothesis, and our third null hypothesis will be based on ambiguity aversion.

2.1 Agency theory

The agency relationship can be defined as an arrangement between a principal and an agent, in which the agent is expected to complete one or several tasks for the principal (Jensen and Meckling, 1976). If the principal and agent is predicted to act in a utility maximizing manner, it is coherent that the agent occasionally will act in a way that might not result in the best gains for the principal. Consequently, the principal can minimize this disparity by providing suitable incentives (Jensen and Meckling, 1976). According to Jensen and Meckling (1976), it is improbable that the principal can ensure that the agent will act in the principals best interest at no cost. Within private equity an agency relationship appear between the PE-firm (principal) and the entrepreneur (agent), and likewise between the LP (Limited partner) which is the investor and the GP (General partner) which is the PE-firm (Mehta, 2004).

Assuming rational decision-making, disproportionate risk taking will only take place when the intention of the fund manager (agent) contradict with the intention of the investor (principal) (Giot et al., 2014). Cumming and Dai (2011) suggest that larger investment firms are more likely to experience agency costs.

2.2 Information asymmetry

As indicated earlier, private equity investments experience a considerable amount of information asymmetry. The information asymmetry is evident between the investor and the management team along with the shareholders of the company the VC-firm wish to invest in.

The VC-firm will encounter the "lemon problem" due to the fact that the current shareholders and management have more information about the company and the 'real' value than the VC-

firm. A business owner will not sell shares if the price does not surpass the predicted value, and consequently, possible buyers' will offer less money (Akerlof, 1970).

This can also be explained by the pecking order theory, popularized by Myers and Majluf (1984). Since managers are expected to have more information than (potential) investors, Myers and Majluf (1984) indicate that investors assume that managers take advantage of this. As a consequence, investors might believe the issued shares has a lower value.

2.4 Behavioural finance

Prospect theory is a concept developed out of loss aversion. According to Benartzi and Thaler (1995), loss aversion relates to the idea that a person is more conscious about their possible losses than profits. The idea of loss aversion is later developed into myopic loss aversion by combining loss aversion and a short evaluation period (Benartzi and Thaler, 1995). Prospect theory, which has its roots in behavioural finance, was first introduced by Kahneman and Tversky (1979). Kahneman and Tversky (1979) suggest that losses result in a larger emotional impact than a profit, and if given the choice with an equal chance, they would choose to keep what they currently have. While this is true for possible gains, losses are treated in the opposite manner. To avoid a loss, people evolve into risk seeking individuals and make a bet rather than taking the sure loss, even though the options possess the same expected value (Kahneman and Tversky, 1979). This is a critical theory, particularly regarding our second research question which investigates if larger firms to a greater extent would invest in follow-up rounds.

Ambiguity aversion, also known as uncertainty aversion, suggests that people are inclined to take on known risk rather than unknown. It was popularized by Daniel Ellsberg in 1961 known as the Ellsberg paradox, where as an example, people would prefer to take their chance on an urn filled with 50 red and 50 black balls over an urn with 100 balls where the number of red and black balls are left unknown. The idea of ambiguity aversion has later been tested in the real world, indicating that ambiguity could lead to people refraining from taking part in the stock market (Easley and O'Hara, 2009).

Risk aversion is the idea that people rather maintain their wealth than 'gamble' on an opportunity with higher possible return (Zhang et al., 2014). Within finance, and investments in particular the volatility of a stock is considered its risk. High volatility would mean higher risk, but in exchange, it possesses the opportunity to develop into higher profit. Although risk aversion and ambiguity aversion is closely related, there are important differences. While risk

aversion origins in situations where risk (probabilities) can be measured, ambiguity aversion explains the relationship when the risk (probabilities) are unknown (Epstein, 1999).

3 Literature review

A confession by a Private equity manager (as cited in Cumming and Dai, 2011): "We all had too much money. It was just too easy… The problem… was that the funds had grown so big that the 2 percent became just as important as the 20 percent… Success had less to do with performance or risk management… and more to do with bulking up."

3.1 Fundamentals

It is difficult to measure risk within private equity due to the lack of liquidity and information (Giot et al., 2014). The returns are seldom public and can only be estimated when the firm invests or exits. Consequently, empirical tests involving risk within private equity are scarce (ibid.). Despite the difference in research questions, articles such as Bernile et al., (2007); Giot et al., (2014); Kadapakkam et al., (1998) provide valuable conclusions for our research. To further expand the available literature used, we expect size to be positively correlated with age of the investment firm, a concept proved by the findings in Kadapakkam et al. (1998).

According to Brigl et al. (2016), value has usually been created in three ways: "deleveraging, multiple expansion and operational improvements aimed at increasing revenues, margins, or both". All three strategies have been used for more than 30 years, but since the 1980's operational improvements and multiple expansion has seen growth while deleveraging have seen a considerable decrease (see figure 2). Brigl et al. (2016) suggests that the Buy&Build strategy works better for small "platforms" than for medium and large. Furthermore, they conclude that value creation has come further than 'simply' leverage.

Figure 2: "Contribution to value creation in PE deals (%)"

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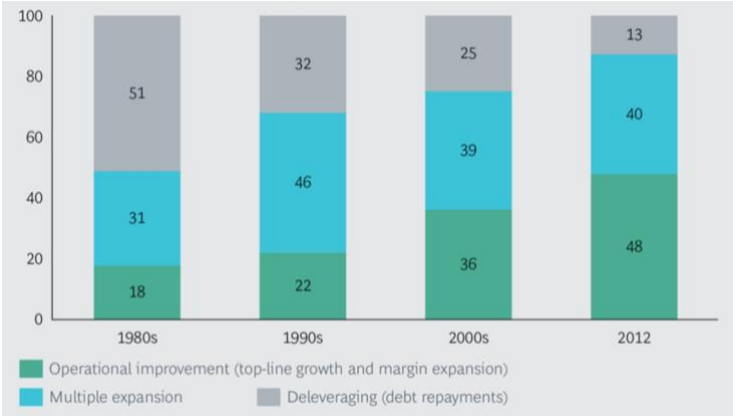
3.2 Firm size

'Normal' VC funds have seen an expansion of capital handled per VC-partner when the fund size increase (Gompers and Lerner, 2000). According to Cumming and Dai (2011), this leads to questions regarding the VC-partners' ability to manage the capital and to what extent it can provide high quality/quantity. Larger firms are expected to have a better entry to external markets because of lower transaction costs, less information asymmetry and more public information will be accessible (Kadapakkam et al., 1998). Consequently, according to Kadapakkam et al. (1998), small firms should experience higher sensitivity than large firms. When the data was measured, they found that the opposite was true. Bernile et al. (2007) reinforce this idea by considering the time and effort the VC-firm puts into their companies and suggest that by expanding the portfolio size, the quantity and quality will be diminished.

Managers that lack a broad view and experience in private equity possess a high upside, and in case of severe losses, an inexperienced firm will experience limited downside (Giot et al., 2014). Furthermore, Giot et al. (2014) suggest that the opposite applies for larger, experienced firms. When analyzing the results, Giot et al. (2014) concluded that ratio between inexperienced firms and mature firms increases over time. This differs from the "risk-raking hypothesis", established by Gompers (1996), stating that young firms are more willing to take risk.

Gompers et al. (2008) suggest that mature firms are able to manage their investments to specific industries where the circumstances are beneficial. These findings are later interpreted as the difference in investment behavior, leading to greater capacity for the mature funds to find investment opportunities. Giot et al. (2014) suggest a different approach, interpreting the finding as a result of larger funds to have a greater network and (or) "screening capabilities". This idea is later reinforced by (Cumming and Dai, 2011).

3.3 Sequential allocation of funds

Staging is commonly used by Private equity and Venture Capital firms. It is the process of sequential allocation of capital (Krohmer et al., 2009). The decision to invest more capital is made in rounds and often determined by already set results. Krohmer et al. (2009) found that the result can be divided into several phases. In the initial phase, staging results in positive effects. For example, one of the big problems in the starting phase of the investment the agency problem. By investing in rounds these problems can diminish, or at least be reduced. Near the

end of an investment, just before an exit, completely different results were found. Krohmer et al. (2009) found the staging to result in negative returns, something the authors called the "termination dilemma". They could conclude that if a company had troubles, most firms stopped investing and for that reason gave up on their opportunity of a turnaround. In our research, we will test the possibility that larger investment firms (VC) keep investing in sequential rounds based on the underlying prospect theory. In contrast, Krohmer et al. (2009) found that the opposite might be true when using staging. Hege et al. (2011) suggest that staging and investing in follow-up rounds might have a negative impact on investments. This differ from Gompers (1995) result, which indicate that sequential allocation of assets result in a positive effect.

3.4 Risk variable

Without a robust risk variable, such as credit ratings of funds or estimated volatility of returns, Ruhnka & Young (1987) analysed the perceived risk that venture capital managers experience, where they conclude that managers perceive it to be riskier to invest in earlier stages of funding due to the ambiguity risk of loss of investment, as opposed to later stages. However, they recognise that most new venture do not receive external VC investments, therefore limiting their model. Chaplinsky & Gupta-Mukherjee (2016) uses a Gain-to-loss ratio which provides them with an indicator of the average amount of failed investments, and find that early stage venture capital investments tend to hold a higher risk, as opposed to later stage investments, further supporting the risk difference in venture capital investment stages. Their model mainly bases itself on the later stages where the importance is for ventures to achieve break-even profits or profitability for the investment firm to successfully exit. Their research also suggests that investors refrain from allocating more capital in the early stages of ventures (ibid). However, contradicting the "stages of development" theories (Ruhnka and Young, 1987), Buzzacchi et al. (2015) finds that more reputable fund managers, which could potentially correlate with firms being larger, are less likely to increase risk, and would instead choose to conduct follow-up investments. Elango et al. (1995) examines venture capital firms characteristics based on size and finds that larger firms avoids early stage investments as opposed to smaller investment firms, larger firms still represented a sizable portion of early stage investments. This could correlate with managers of larger firms having greater stress on successful investments and could therefore exert a certain myopic loss avoidance (Benartzi and Thaler, 1995), (Kahneman and Tversky, 1979), however, it does not explain an opposing behaviour of smaller investors. Furthermore, this is enforced by Nanda & Rhodes-Kropf (2013) who argues that investments

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in hot times experiences higher volatility, but also higher expected returns, and that greater monetary investments have a higher success rate. This finding could potentially skew larger firms to naturally be perceived as having a higher preference for risk as they might be less exposed to illiquidity problems (Lerner and Schoar, 2004), (Kadapakkam et al., 1998).

4 Data

4.1 Data Collection

The sample set retrieved from Reuters Thomson Eikon includes all kinds of private equity transactions conducted through funds holding a value of more than 10,000 EUR in the Scandinavian countries of Sweden, Denmark, Finland, and Norway. The time frame consists of a period of 20 years starting at January 1st of the year 2000 through to the 31st of December 2019. Private equity firms investing in companies outside of these four nations are included in the sample size. However, when firms from other countries than the ones previously mentioned acquire companies within this region, it will be regarded as a transaction external of the sample region. Since these lie outside of our scope they will be excluded.

4.2 Data Cleaning

The sample of the transactions includes various transactional structures but does however solely focus on equity capital investments within venture capital made by private equity firms. All deals concerning non equity value transactions, such as debt and hybrid securities, were excluded from the sample size. Out of the 7262 transactions recorded, 3318 deals without confirmed deal values, and 69 deals containing disclosed equity estimations as well as debt is not the sole form of payment, were excluded. All but completed transactions, such as pending or expected transactions, were excluded as the expectation of a completed transaction for future reference might skew the deal value from an acquirers perspective, and therefore influence the equity amount disclosed for the transaction. 175 venture capital equity transactions below 100,000 euro were excluded to avoid skewing of a high number of low add on transactions. Furthermore, 377 deals concerning public equity investment, bridge loans, mezzanine debt, etc. were excluded to single out the equity venture capital investments.

After applying all the relevant conditions, a total of 2919 transactions were deemed to fit all the necessary criteria. Table 1 shows the number of yearly transactions, as well as total number of deals. The way they differentiate is that a deal can include multiple transactions made but a number of firms, this would refer to a split acquisition where the acquirer is made up of several different investment firms.

TABLE 1

Year	Number of Transactions	Total Transaction Value (mUSD)	Number of Deals	average Transaction Value (mUSD)
(1)	(2)	(3)	(4)	(5)
2000	193	1,299.66	95	13.68
2001	277	1,752.63	127	13.80
2002	106	1,025.93	58	17.69
2003	225	973.33	76	12.81
2004	207	1,826.81	82	22.28
2005	401	2,170.78	116	18.71
2006	305	1,742.28	101	17.25
2007	212	1,966.52	86	22.87
2008	145	1,573.63	96	16.39
2009	125	975.48	80	12.19
2010	145	1,155.90	102	11.33
2011	104	654.08	70	9.34
2012	97	832.69	74	11.25
2013	94	824.46	65	12.68
2014	72	545.00	62	8.79
2015	41	711.83	31	22.96
2016	39	403.46	33	12.23
2017	28	288.25	27	10.68
2018	60	1,041.30	50	20.83
2019	43	1,117.00	42	26.60
All	2919	22,881.02	1473	314.36

The table displays the annual number of transactions, deals, and total annual transaction value of all equity venture capital deals in Scandinavia between the 1st of January year 2000, and the 31st of December year 2019. The data is extracted from the Reuters Thomson Eikon terminal filtering all acquisitions made through a private equity fund holding a lower value than 10,000 Euros. Further restrictions include transactions made only by investment firms stationed within the Scandinavian countries Denmark, Norway, Finland, and Sweden. There are however no restrictions made on origination of target company.
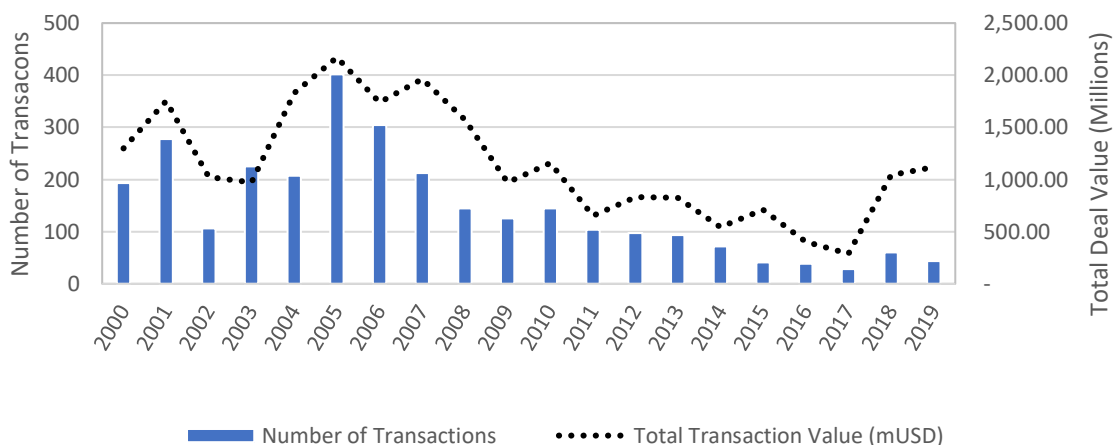
Figure 3

Figure 3 displays the total number of yearly transactions as well as the total yearly transaction value. In contrast, we see an increase in towards the time series while maintaining a relatively stable early number of transactions, indicating an increase average transaction value.

Venture capital transactions are predominantly conducted with cash as payment through private equity funds financed by debt or high net worth investors. The rare occasion of stock payments will be regarded as strategic mergers through joint forces of investment firms and are therefore excluded from this sample size. The investments made by firms that have an industry focus are considered to have a preference towards a certain industry specialization. The strategic nature of leveraged buyout transactions which are regarded as investments aimed to target efficiency discrepancies is also to be excluded from the sample size.

4.3 Risks associated with data collection

There are several risks with collecting data. By collecting the data from Thomson Reuters, we need to appreciate the risk associated with relying on one data source. Observing table 1, as well as figure 3, we see a decrease in the number of transactions in Scandinavia based on the data available. However, observe that the average transaction value has returned to roughly match the average transaction values before the financial crisis of 2008-2009. The decline in total yearly transactions does comparatively contradict Bain & Company's (2020) global scale findings. Furthermore, the human error when cleaning and using the data is difficult to ignore. Further risks and limitations will be discussed in the next chapter.

5 Methodology

5.1 Variables

This thesis will conduct a linear One Least Square (OLS) regression analysis using continuous- and dummy control variables to find correlations between firm size and other random variables. The filtered sample dataset extracted from the Reuters Thomson Eikon private equity screener tool, consists of 2919 data points representing venture capital equity transactions conducted by acquiring firms based in Scandinavia.

Table 2 displays the variables used in the multiple OLS regression. The control variables used for measuring risk are Seed, EarlyStage, ExpansionStage, and LateStage. Seed is the earliest stage of a venture and is considered the most risky as a consideration for investing. Companies are pooled as a Seed if the company at the time of investment is maximum 12 months old. For EarlyStage, the company would be 1 to 4 years old, ExpansionStage 4 to 8 years old, and lastly LateStage a company would be more than 8 years old at the time of the completed transaction. These risk proxies are considered in an ordinal scale, meaning the difference in the level of risk between each stage is not quantified, however, it is established that earlier investment stages are riskier than later ones, in chronological order.

LEquityAmount represents the amount of equity the investment consists of made by the investment firm at the transaction date which have been disclosed. The variable sample has been adjusted using the function Winsor2 through Stata to account for statistical outliers beyond a 0.5% significance level. Thereafter, the data is filtered through the natural logarithm and all equity investments below 100,000 Euros has been excluded to accommodate the linear regression more accurately. LCapitalUnderManagement is used as a variable proxy for the size of the investment firm. It has undergone similar data adjustment as the previous variable. The original data sample was adjusted through Winsor2 and then phased through the natural logarithm. Both aforementioned variables are quantified in US 2019 dollars.

The FirmAgeInvestmentDate1 represents the age of the investment firm at the date of the transaction, quantified in years, and is projected to be used as a potential alternative proxy for risk. Younger private equity firms has the tendency to pursue bigger investments relative to fund size, and will experience lower average returns compared to larger, more established firms (Giot et al., 2014). The control variable SameCountry holds the value 1 if the investment firm and the target investment company resides in the same country, in other words, the investment is domestic. As mentioned by Deng & Elyasiani (2008), banks have a potential to diversify risk,

reducing idiosyncratic risk, by geographically expanding, and from a macroeconomic perspective, this could hold true for investments other than operational ones. IndustrySpec has a similar reasoning to the domestic investment variable. By investing into to the same industry as the firm has specialised in, the investment firm could make more accurate valuation estimations of potential acquisitions through the industry expertise. The negative aspect of pooling the majority of a firms resources into a single industry is that it creates substantial idiosyncratic risk. Only 3.6% of transactions in our sample data are considered to be a within-industry investment. However, the industry specialization criteria is met if the investment firm holds more than 60% of its capital under management in the same industry, and could therefore be skewed by overrepresenting smaller firms, as they are naturally not stakeholders in a high amount of companies as compared to larger investment firms.

NewInvestment holds the value 1 if the investment firm does not have investment equity in the target company before the date of the transaction, and 0 otherwise. This means that the investment firm could have invested through debt previously. FundingRound holds value 1 if the target company has undergone more than 2 investment rounds previous to the transaction at the round date, and 0 otherwise. Lastly, the variable HighNoFirms represents the number of firms participating in the transaction. The variable holds value 1 if there are more than 5 firms sharing the deal, and 0 otherwise.

5.2 Regression

For the OLS model to be statistically sound, five assumptions must be made (Wooldridge, 2016). The first of these assumptions is that the regression model is linear, meaning that a parameter such as β_1 can be multiplied with a random variable x_1 to create a linear trend. The OLS model can be constructed as followed:

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 \dots \beta_k x_k + \varepsilon$$

Where x_1 represents the variable of interest, and $x_2 \dots x_k$ constitutes the control variables and Y the outcome variable. The second assumption that needs to be met is the error term ε needs to hold an expected mean of zero, this can be expressed as $E[x_i|u] = 0$ where u represents the sampled version of ε. The error term exists to explain unobserved correlations of the control variable, and this assumption requires that additional information can not add value to the already existing model. The third assumption, "Full rank", means that there cannot be multiple regressions resulting in the same result meaning that they would be observationally equivalent.

The fourth OLS assumption requires the data to be randomly sampled from the population. The fifth assumption is the requirement of homoscedasticity, meaning the conditional variance of the of the error term is constant

$$E[U^2|X_1, \dots, X_k] = \sigma^2$$

For positive variances. This means that the variance of the error term is independent of the random variables, which means that the random variables are not informative of the variability of outcomes that can be related to the error term.

The specific OLS regression for this dataset are as followed:

$LCapitalUnderManagement = \beta_0 + D_1\beta_1 Seed_i + D_2\beta_2 EarlyStage_i + D_3\beta_3 ExpansionStage_i + \beta_4 LEquityAmount_i + \beta_5 FirmAgeInvestmentDate1_i + D_6\beta_6 SameCountry_i + D_7\beta_7 NewInvestment_i + D_8\beta_8 FundingRound_i + D_9\beta_9 HighNoFirms_i + D_{10}\beta_{10} IndustrySpec_i + \varepsilon$

Subscript i for deal.

5.3 Limitations

A major limitation regarding venture capital investments is the uncertainty of available information (Dixon, 1991; Condie and Ganguli, 2017), acquiring returns and risk measurements for the target companies or investment firms has been cumbersome. This thesis excludes returns of firms as a necessary random variable. The volatility of returns of the target company, or the credit rating of the fund used to acquire the target firm would be two reasonable variables measuring the risk taken by the investment firm. However, due to limited information disclosure concerning private firms and start-ups, it is difficult to gather this kind of data (IFRS Foundation Advisory Council, 2019). This thesis instead uses a proxy variable as a risk measure, where the investment stage at the date of acquisition determines the level of risk the investment firm is willing to take on. We assume that investments of early stage companies hold a higher rate of failure, and therefore higher risk of return, compared to later stage investments (Ruhnka and Young, 1991).

When conducting this report we quickly realized that finding a large and certain sample would be difficult to attain. Although there are several advantages with the quantitative approach, it does limit the possible results and, as stated earlier, there are risks associated with this type of data. However, a qualitative approach was not assumed to be possible since an extensive amount of interviews with people part of our target group would be very difficult to achieve.

With the surge of the venture capital market in the Scandinavian region, a contradiction in the deal trend as opposed to the global data by Bain & Company (2020) mentioned above can possibly impact the credibility of the sample. This could be the result of incomplete disclosure of the data, and/or reporting misrepresentative of the population data. Furthermore, the lack of a quantitative return measure of some sort, due to the limited amount of available data, could lead to a challenge in credibility of the regression result as an expected remuneration of an investment is a central key when it comes to the decision-making of following through with an investment, or not. Additionally, with the lack of available risk variables such as credit ratings of debt, default rates, and volatility of returns, using an alternative risk proxy variable like the one explained above, poses the chance of risk misrepresentation. The assumption is that an investment into a company in an early stage holds more risk, compared to an investment in a more mature company. This might not hold true for all investment stages on an ordinal scale.

6 Result

The results of the linear OLS regression are shown in figure 4. All control variables have a statistical significance with the exception of EarlyStage with a p-value of 0.217.

Figure 4

VARIABLES	LCapitalUnderManagement
Seed	0.269*** (0.0956)
EarlyStage	0.0998 (0.0808)
ExpansionStage	0.171** (0.0680)
LEquityAmount	0.201*** (0.0198)
FirmAgeInvestmentDate1	0.0404*** (0.00230)
SameCountry	-0.458*** (0.0538)
NewInvestment	-0.134** (0.0572)
FundingRound	0.216*** (0.0582)
IndustrySpec	-0.287** (0.142)
HighNoFirms	-0.167*** (0.0642)
Constant	16.10*** (0.308)
Observations	2,919
R-squared	0.159

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

With the exclusion of EarlyStage, it is observed that higher risk measured through our risk proxy suggests a larger investment firm. We draw this conclusion by observing the four variables Seed, EarlyStage, ExpansionStage and LateStage. Since there are four dummy variables for size, LateStage is not part of the regression analysis but will take the value if the other three are non-applicable. Seed has the highest coefficient, and since the three stages part of the model are positive, LateStage has the lowest coefficient. The equity amount invested is observed to possess a positive relationship with the size of investment firms (0.201). From an economic point of view, it is a probable result since larger venture capital firms have more funds to allocate. Even though it could be the case that they would invest in more target firms and thus lowering the coefficient of LEquityAmount, larger firms having a higher spending capital is the most probable result. The same applies for FundingRound (0.216), indicating that the investments in target firms that already managed to acquire capital in most cases would be from larger investment firms. This is important evidence for rejecting our second null hypothesis, and is interesting for further research. Although the result was as expected, the outcome was not guaranteed. Our expectation was based on literature stating that there is more

loss aversion involved in investments made by larger investment firms. Our results provide evidence that this might be true, but we can not out rule the other potential causes either. The age of an investment firm positively correlates with the investment firm's size. Literature provides further evidence for this and it is an apparent result bearing in mind that a successful company, in any market, usually grows over time since it is difficult to start on the top. However, we did not expect the coefficient to show such a low positive result.

Domestic investments are recognized to lead to a smaller investment firm (-0.459). This makes economic sense and is backed by numerous articles such as Kadapakkam et al., (1998). The reason is presumably related to better screening capabilities and network needed for international investments which tends to result in larger investment firms. Furthermore, one can conclude that if the transaction is related to a new investment, the investment firm tends to be smaller. Bearing in mind that FundingRound had a positive coefficient and that a smaller investment firm possesses less money, it is a reasonable result. Although the outcome of the variable was rather difficult to predict, it is a probable result of less funds being available in smaller investment firms. Moreover, IndustrySpecialisation seems to lead to a smaller investment firm. However, this variable holds an abnormally high standard deviation, making it more difficult to interpret. We believe this is the outcome of the potential possibility for smaller firms to be more niched. It is plausible that it is more difficult for a large firm to niche themselves while at the same time being able to allocate the full amount of their funds. Another possible explanation is that not having an industry focus indicates a larger fund amount which leads managers to diversify further. The reasoning for the high standard nomination can be due to a smaller sample size applicable (3.6% out of 2919 observations).

Through the results, we can conclude that it is possible to reject the first null hypothesis:

$H_{0,1}$: Larger investment firms allocate less funds to the early stages in the target firm as compared to smaller investment firms

With an observed progressive decrease in risk through our proxies, $H_{0,1}$ can be rejected at a significance level of {0.05>0.000}. Firms with higher risk associated with them could lead to the investment firm being larger.

Our second null-hypothesis entertains the assumption that the continuance of investing in follow-up rounds implies a larger firm size. Based on the regression results, we can reject our second null hypothesis:

<p style="color:red; text-align:center;">H_{0,2}: Larger investment firms do not tend to continue investing in follow-up rounds into the same company compared to smaller firms.</p>

By observing the variable NewInvestment, we can see that the control variable has a relatively strong negative relationship with the investment firm's size at the significance level {0.05>0.019}. Therefore, investments in follow-up rounds tend to imply the investment firm is larger.

Last, our third null-hypothesis assumed a focus on international investments instead of domestic investments to have a positive influence on a firm's size. We can reject this assumption due to the statistically significant {0.05>0.000} negative correlation between investment size and domestic investments.

<p style="color:red; text-align:center;">H_{0,3}: Larger investment firms allocate less funds to target firms outside their domestic market as compared to smaller investment firms</p>

When controlling for correlation between the explanatory variables, we do however find that most significantly the risk proxy variables as well as the firm size correlate with other control variables. Table 2 display the correlation between each variable, coupled with a significance level below. The variables which displays a statistically significant correlation between each other do not show a correlation level, positive or negative, above 5 percent. Specifically the risk proxies show a high correlation (10%+) with multiple variables, however, these correlations do not indicate a statistical significance.

TABLE 2

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) LCapitalUnderM~t	1.000										
(2) Seed	-0.070***	1.000									
(3) EarlyStage	-0.052***	-0.233***	1.000								
(4) ExpansionStage	0.067***	-0.382***	-0.525***	1.000							
(5) LEquityAmount	0.218***	-0.284***	-0.031*	0.100***	1.000						
(6) FirmAgeInvestm~1	0.283***	-0.070***	-0.073***	0.085***	-0.029	1.000					
(7) SameCountry	-0.213***	0.165***	0.003	-0.001	-0.329***	-0.045**	1.000				
(8) NewInvestment	0.035*	-0.122***	-0.008	0.047**	0.388***	-0.040**	-0.137***	1.000			
(9) FundingRound	0.109***	-0.165***	-0.164***	0.077***	0.205***	0.012	-0.143***	0.035*	1.000		
(10) IndustrySpec	-0.046**	0.031*	-0.027	0.003	0.049***	-0.111***	-0.080***	0.056***	-0.064***	1.000	
(11) HighNoFirms	0.097***	-0.159***	-0.041**	0.006	0.453***	-0.035*	-0.313***	0.201***	0.432***	-0.068***	1.000

*** p<0.01, ** p<0.05, * p<0.1

7 Discussion

This study is set out to provide further clarity to the private equity field. We have tested our research questions, including how a number of variables listed above affect investment firm size. To our knowledge, this is the first study exploring these particular questions and testing these hypotheses in the Scandinavian region although as stated in the literature review, several articles investigate similar areas. Furthermore, it is important to recognize that when testing the first hypothesis, it is assumed that an increased risk measure would indicate a higher expected return, as opposed to an increased idiosyncratic risk exposure (Hall and Woodward, 2010).

As stated earlier, it is hard to find a robust risk variable within VC-firms. Through our literature we could reinforce our idea that investing in earlier stages is perceived to be more risky. Our model is partially based on this assumption since it is thought to be the best risk proxy, but it does increase the uncertainty of our model. Furthermore, investments in follow-up rounds tend to come from larger investment firms. This could possibly be related to the prospect theory (loss aversion) since they do not want to realise their losses. However, there are several other possible explanations to this and even though one can conclude that investments in follow-up rounds tend to come from larger investment firms, we cannot conclude the reason behind.

The negative correlation between domestic investments and firm size, as well as industry specialisation and firm size could indicate an unnecessary accumulation in idiosyncratic risk. Investments firms with a high share of its net worth invested into one company created idiosyncratic risk but are aware of it, and ensures to be compensated thereafter (Mueller, 2010). In leveraged buyouts, having a specific industry specialisation tends to produce a higher return in the wake of successful investments (Cressy et al., 2007). This compensation, as well as the benefits of limiting information asymmetry and agency costs (Cumming and Johan, 2008) could potentially compensate for additional risks taken. Lim & Wang (2007) does however conclude that diversifying ones portfolio is more beneficial to its stakeholders rather than specialising within one industry. They argue that diversifying its operational cash flows as well as financial hedging should act as a complement to counter idiosyncratic risk.

Geographic diversification can have a reducing effect on idiosyncratic risk, Goetz et al. (2016) find that geographically diversification of banks leads to a net impact in reducing idiosyncratic risk, but does mention the additional hardships of managerial efficiency, which could also be

relevant for investment firms. However, larger size does hold an advantage when it comes to international investing within venture capital (Dai et al., (2012). They find that larger firms hold advantages in terms of experience and resources but lack ability to efficiently monitor progress and cultural alignments. While venture capital investors seeks to manage risk, Norton & Tenenbaum, (1993) and Bygrave (1987) argues that maintaining a certain level of specialisation is beneficial in terms of reducing information asymmetry, networking, and gaining access to other intra industry deal flows.

Syndicating investments in venture capital indicates that it enables portfolio diversification, risk sharing, and capital constraints (Das et al., 2011) which aligns with the results of smaller firms preferring to syndicate investments, while simultaneously avoiding risky (early stage) investments. It could arguably serve a preference of idiosyncratic reduction through diversification, rather than diversifying through geographical or industry expansion. However, Lockett & Wright (2001) argue that syndication could serve as a possibility for firms to participate in investments which require more resources in terms of information and expertise, especially in early stage investments. Elango et al., (1995) find that larger firms are relatively more inclined to make larger individual investments, as opposed to smaller firms.

8 Concluding remarks

8.1 Conclusion

To conclude, we find evidence that supports our results, but we do find contradicting material, partly negating the statistical robustness of our result. The data accumulated through Reuters Thomson Eikon has to be critically examined, as the contents of the sample contradict global trends in the venture capital transaction market (figure 1), which could point towards a data sample unrepresentative of the population. Furthermore, a correlation between control variables, which to some extent is undeniable, does pose a degree of uncertainty and reliability of the results.

In terms of the risk proxy used in the regression, it is plausible to conclude a positive correlation between a relative preference to early stage investing and firm size, but there is contradicting literature such as Elango et al., (1995), where their findings based off of qualitative data from venture capital firms concludes differently. We observe concentration of potential idiosyncratic risk through domestic investment preferences and industry specialisation to lead to a smaller firm size. However, this result could be influenced by the nature of the variables. For instance, firm's managing a larger pool of assets will naturally have stakes in a higher number of companies, and therefore possible undercut the industry specialisation hurdle of 60% total assets in a single industry. The results concerning new investments dependency of firm size could also be skewed, as fewer investments will naturally mean a smaller firm, and therefore not have as many opportunities for follow-up investments.

8.2 Further research

Private equity and venture capital is a field with limited information and would therefore enjoy an increased transparency in risk preferences, transaction discounts, and expected returns. Through the results of this thesis, we hope that it can spur further research into the characteristics that could determine investments decisions, and improve the clarity and certainty of the industry. What we found to be important was to right from the start discuss the method and how to extract a reliable risk proxy. Furthermore, since this is a research area with limited information it is important to right from the start research whether the data is available since even the greatest data sources have troubles providing the correct transactions and variables.

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