FINANCIAL SPONSORS' IMPACT ON IPO UNDERPRICING

A COMPARISON BETWEEN VENTURE CAPITAL AND PRIVATE EQUITY INVESTORS

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Financial sponsors' impact on IPO underpricing: A comparison between venture capital and private equity investors

Abstract:

This study examines the difference in underpricing between venture capital- and private equity backed initial public offerings (IPOs). With a sample of 361 IPOs listed on the Nasdaq Nordic main market and Nasdaq Nordic First North Growth Market between January 2011 and December 2020, we show that several firm characteristics and IPO characteristics differ between venture capital backed and private equity backed issuers. Then, we conclude that the type of sponsor backing the IPO does not impact the underpricing per se. Instead, we show that it is several firm- and IPO-characteristics that affects underpricing, and that these variables differ between the two subgroups. These results have been derived from OLS regressions and t-tests, as well as a robustness tests controlling for firm characteristics impact on the difference in underpricing between the two subgroups.

Keywords:

Initial Public Offering, Venture Capital, Private Equity, Underpricing

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1.0 Introduction

When asking about the world's largest hub for start-ups, many people think of Silicon Valley, CA. Claiming this title with all its rights, Sweden has become closer to pole position as the country breeds prosperous startups on a rolling basis. In fact, the entire Nordic region is just as groundbreaking, ranking top 20 on the Global Innovative Index in 2020 (Dutta, Lanvin and Wunsch-Vincent, 2020). As a result from the market flourishing with new businesses in need of funding, financial sponsors have increased their presence with the aim to invest, guide and capitalize. Initial public offerings have also become more common over the last decade, as it is one potential way for financial sponsors to exit their investments (Pitchbook, 2020, and PWC, 2020).

Previous literature has responded to this surge in financial sponsor activity by investigating the relationship between underpricing and having a venture capital firm backing the IPO (Barry et al., 1990, Lee and Wahal, 2004). There are only a limited number of papers exploring underpricing and its inherent effect of having a private equity firm backing the IPO (Levis, 2011, Bergström et al., 2006). With the aim to extend previous research, we investigate the research question; is there a difference in underpricing between venture capital- and private equity backed IPOs? Furthermore, we integrate traits of both the issuing firm and the financial sponsors in the analysis as a way of compartmentalize the underpricing puzzle.

Using a sample consisting of 361 IPOs performed on the Nasdaq Nordic main market and Nasdaq Nordic First North Growth Market, we investigate differences in issuer firm characteristics between the two subgroups by performing a t-test. Showing a significant difference in mean between the firm characteristics age, revenue, EBITDA margin, leverage and market capitalization, we conclude that venture capital- and private equity-firms invest in different types of companies, in terms of these variables.

Thereafter, we apply the same method on IPO characteristics. Based on the results, we confirm that venture capital (VC) firms and private equity (PE) firms differ in terms of age, number of IPOs performed, pre-ownership holdings, number of VC-/PE-firms backing, number of board representatives and number of years the lead VC-/PE-firm has served the board.

Next, we examine if there is a difference in underpricing between VC- and PE-backed IPOs, using a t-test. Our findings show that the type of financial sponsor does not impact underpricing, neither when adjusting for value weighted- or equally weighted returns. After conducting a robustness test by controlling for firm characteristic variables that significantly differ between the two subgroups, we see that PE-firms reduce underpricing when isolating the effect of the size of market capitalization. However, only one out of three tests when controlling for the size of the issuing firm indicate a difference in underpricing between the two subgroups. Therefore, a univocal conclusion of the difference in underpricing between VC- and PE-backed IPOs cannot be made.

We also perform an OLS regression to test whether the same firm characteristics in the VC- and PE-subgroups impact underpricing. The result shows that revenue, number of employees and market capitalization significantly increase underpricing in the PE-sample whereas only market capitalization increase underpricing in the VC-sample. Consequently, we conclude that there are more firm characteristics in the PE-sample that have a negative impact on underpricing, with market capitalization being the only variable that impact underpricing levels in both subgroups.

Lastly, we conduct another OLS regression to test whether the same IPO characteristics of the VC- and PE-firms impact underpricing. The result shows that the

age of the VC-firm and the number of PE-firms backing have a positive effect on underpricing. Hence, we conclude that different IPO characteristics affect underpricing in VC-backed and PE-backed IPOs.

The closest research conducted in this area is the paper by Barry et al. (1990) who examine how venture capital backing affects underpricing and the quality of its monitoring. This study extends their work in several ways. Firstly, we give a more recent view on how sponsor-backing impacts underpricing by looking at IPOs between 2011-2020. Also, our results are based on IPOs performed on Nordic exchanges, instead of American Exchanges, which will give evidence of its similarities or differences when it comes to sponsors and underpricing. Lastly, we extend the scope of the research in two ways. Firstly, by including, not only venture capitalists, but also private equity firms. Secondly, Barry et al. (1990) focus on how monitoring by the sponsor affects underpricing, though this paper also adds the dimension of the issuing firm's characteristic and its impact on underpricing.

The structure of this paper is as follows. Section 2 gives a background to the topic and presents the studied hypotheses. Our dataset is presented in section 3, where we also outline the method of data gathering, criteria used and data sources. Section 4 presents the methodology and analysis tools. Evidence on how venture capitalists and private equity firms differ in terms of investments and monitoring, as well as its impact on underpricing, is presented in section 5. Lastly, conclusions are drawn in section 6.

2.0 Background

This section presents the previous literature that examines IPO underpricing, followed by theories trying to explain the underpricing puzzle. Section 2.1 presents past research and theories on the topic. Section 2.2 describes issuer firm characteristics and section 2.3 presents IPO characteristics. Both sections define the meaning of the terms and present previous research in the area. Next, section 2.4 develops the five hypotheses and lastly, section 2.5 presents the extensions make.

2.1 Previous literature

The academic literature is constantly documenting IPO underpricing and presents various explanations as to why it occurs. Underpricing becomes evident when the first day return is above zero, which stems from investors perceiving the subscription price as undervalued and therefore buys the stock in the aftermarket, driving up the price (Carter and Manaster, 1990, Miller and Reilly, 1987). After the increased proportion of private equity (PE) and venture capital (VC), underpricing research extended its scope to sponsored contra non-sponsored IPOs (Levis, 2011). Most papers focus on underpricing and the impact of having a venture capital firm backing the IPO. The aggregated research conducted on this type of backing presents ambiguous results. Some papers present less underpricing compared to non-backed (NB) IPOs, such as Barry et al (1990), and some present higher underpricing compared to non-backed firms, such as Lee and Wahal (2004). Possible explanations for the deviating results may be the use of different time intervals and exchanges when collecting the data sample. There is a very limited number of studies that devote their research to PE-backed IPOs (Levis, 2011, Bergström et al. 2006). These studies show that PE-backed IPOs exhibit lower levels of underpricing compared to non-backed IPOs.

There are multiple theoretical explanations connected to previous research, such as information asymmetry, market mis-valuation, asset-risk premia and the rules of

supply and demand (Ritter and Welch, 2012). The two theories that help explain the different levels of underpricing between non-backed IPOs and backed IPOs are winner's curse and signaling, which both build on asymmetric information. Ritter and Welch (2002) describe asymmetric information as the buyer (investor) having less information about the quality of the good (company) sold than the seller (issuer).

2.1.1 Winner's curse

Information asymmetry can also exist between investors, resulting in informed investors and uninformed investors. This is a reasonable assumption since if investors were to be equally informed, knowing the true value of the issuing firm, no underpriced IPOs would exist (Ritter and Welch, 2002). When there is asymmetric information between investors, pricing the IPO overly high would not attract subscriptions due to the fear of a winner's curse. The winner's curse model was first formulated by Rock (1986) and the theory states that only informed investors will subscribe to successful (underpriced) IPOs, leaving only a fraction of successful IPOs and full allocation of unsuccessful (overpriced) IPOs to uninformed investors. On average, uninformed investors will realize negative returns, which ultimately result in them leaving the new issue market. If informed investors have limited wealth, even successful IPOs would not get full subscriptions, thus fail to go to the market. To avoid this financial friction, IPOs need to be underpriced, on average, earning uninformed investors with normal returns. Thus, this theory helps explain why underpricing occurs.

2.1.2 Signaling

Barry et al. (1990) show that venture capital firms enable monitoring of the issuing firm and therefore possess inside information. Thus, having a venture capital firm backing an IPO signals the accuracy of the valuation of the issuing firm to the uninformed investors. Some characteristics show higher monitoring quality, such as the age of the venture capital firm, number of IPOs the lead venture capital firm has participated in and the equity stake owned. The ability to monitor the firm lowers uninformed investors' uncertainty, therefore reducing underpricing. To our knowledge, there is no similar research on the monitoring effects of private equity backed IPOs.

2.2 Issuer firm characteristics

Firm characteristics are defined as the levels of financial metrics that the issuing firm posits. Examples of metrics are revenue, asset turnover and market capitalization. These firm characteristics help to explain which type of target venture capital- and private equity-firms typically invest in.

Barry et al. (1990) state that venture capital firms mainly invest in younger and smaller companies with high growth. As the target firm generally is in the growth stage, they have lower levels of revenue, market value and total assets. Furthermore, a venture capital firm finance their acquisitions with capital generated from their funds, thus using low levels of debt. As a result, the cash flows of the target firm can be low or non-existing. Venture capital firms' strategy consists of acquiring companies, improving performance, followed by an exit taking the form of an IPO, or selling their stake to another financial or strategic buyer.

In contrast to venture capital firms, private equity firms focus on older, bigger and more mature companies. The firms are characterized by larger levels of revenue, market value and total assets. Moreover, the private equity firms use a significant amount of debt

as a part of their financing strategy, increasing the debt-to-equity ratio of the target firm. Therefore, targets need to have strong cash flows, enabling paying down debt, and realizing returns for the investor when exiting. The purpose of the buyouts is to increase operational performance and restructure the ownership in a few years, where the private equity firm sells a significant stake of their shares to another financial or strategic buyer, or exits through an IPO (Deangelo and Deangelo, 1987).

Furthermore, Levis (2011) found several differences in operational performance between PE-, VC- and non-backed IPOs. PE-backed IPOs are about 4-7 times larger in terms of several operational metrics than their counterparts. For example, market capitalization, net sales, asset turnover and total assets are metrics that differ substantially. He also concluded that PE-backed firms often have solid earnings when taken public, compared to VC-backed firms that have about one-fifth of the EBITDA margin relative to their PE-backed counterpart.

2.3 IPO characteristics

We define IPO characteristics as specific traits of the financial sponsor and its involvement in the IPO. Examples of metrics can be the age of the sponsor, ownership stake and the number of sponsors backing the IPO.

Venture capitalists are active investors with a long-term involvement in the company (Barry et al, 1990). They often specialize in one industry and engage by having representatives on the issuing firm's board. This participation enhances their ability to implement the operational strategy on the target, by influencing key decisions about employees, production, customers and suppliers (Warne, 1988). Furthermore, venture capital investments often take place in syndicates, with more than one venture capital firm taking an ownership stake (Mogilevsky and Murgulov, 2012). Due to the involvement of multiple venture capitalists, their respective equity position is typically concentrated (Barry et al., 1990). Brav and Gompers (1997) state that venture capital firms are young and perform many IPOs to establish themselves in the industry.

Private equity firms also act as active investors through board participation and posit their equity stake over a long time. In contrast to venture capital firms, private equity firms aim to have a controlling stake, reducing the number of private equity firms backing the IPO (Barry et al., 1990). Since private equity firms are, on average, older than venture capital firms, they have conducted more IPOs on prior portfolio companies (Mogilevsky and Murgulov, 2012).

Levis (2011) also concludes differences in IPO characteristics between venture capital firms and private equity firms. The article shows that private equity firms have a shorter holding period and own a larger equity stake both pre- and post- IPO, compared to venture capital firms.

2.4 Hypothesis development

As presented above, venture capital firms typically invest in younger, smaller firms with higher growth compared to private equity firms. Likewise, previous research has drawn several conclusions about how operational performance differs between VC- and PE-backed IPOs (Levis, 2011). This has led us to our first hypothesis:

1. *There is a difference in issuer firm characteristics between VC- and PE-backed IPOs*

Even though some characteristics of the two types of financial sponsors are similar, such as their board participation and active involvement in the issuing firm, there are more differences than similarities. As discussed in section 2.3, venture capital firms generally take minority stakes and invest in syndicates compared to private equity firms, which normally take controlling stakes, limiting the participation of other sponsors. Furthermore, private equity firms are on average older and have conducted more IPOs. Levis (2011) presents that there are differences in IPO characteristics between venture capital firms and private equity firms, such as ownership stake pre- and post-IPO as well as the length of ownership. Venture capital investors have a longer holding period while private equity investors have a larger ownership stake.

2. There is a difference in IPO characteristics between VC- and PE-backed IPOs

Barry et al. (1990) find that venture capital backed IPOs exhibit lower levels of underpricing compared to non-backed IPOs, which is due to the certification effect of having a sponsor, resulting in lower information asymmetry. Moreover, similar to venture capital firms, private equity firms are very dependent on maintaining a spotless reputation in order to attract future capital to their funds. Since private equity firms are larger and possess higher profiles than venture capital firms (Levis, 2011), their certification role is hypothesised as having a stronger signaling effect. Therefore, we believe that private equity firms reduce information asymmetry and underpricing to a greater extent than venture capital firms.

3. PE-backed IPOs have less underpricing than VC-backed IPOs

Several firm characteristics are found to reduce underpricing. For example, firm age has a positive impact on the underpricing and the uncertainty about the value of the firm (Ritter, 1984, Mogilevsky and Murgolov, 2012). Older firms have longer track records of financial data and have, for a longer period of time, been screened by financial intermediaries. In general, older firms reduce uncertainty about the firm value ex-ante the IPO and therefore reduce underpricing (Su and Fleisher, 1999, Loughran and Ritter, 2004, Chahine and Filatotchev, 2008). Further, firm characteristics differ between the VC- and PE-backed IPOs, as presented in section 2.2. Since the underpricing also differs (Levis, 2011), there is a possible relationship between the firm characteristic and underpricing and that the latter can partly be due to differences in the former. Therefore, nothing indicates that the firm characteristic should affect underpricing differently. The fourth hypothesis is as follows:

4. The same firm characteristics explain underpricing in VC- and PE-backed IPOs

Barry et al. (1990) find that several IPO characteristics reduce underpricing. For example, they present that the backing of venture capital firms reduces underpricing when they are older, has performed more IPOs, owns more equity in the issuer and has invested in syndicates. These IPO characteristics act as quality monitors and lower uninformed investor uncertainty. Since there is no evidence of the opposite, we believe that IPO characteristics reduce underpricing in the same way between VC- and PE-backed IPOs, even though the variables can undertake different average levels depending on the type of sponsor backing. For example, a venture capital firm with a more concentrated equity

stake relative to a private equity firm still reduces underpricing in the same way since the ownership allows monitoring, though less extensive.

5. The same IPO characteristics reduce underpricing in VC- and PE-backed IPOs

2.5 Extension

The existing research that explores the underpricing puzzle is very limited outside of the United States. The existing literature on the European market mainly focuses on the London Stock Exchange and Paris Stock Exchange, such as Levis (2011) and Bergström et al. (2006). In order to fill this gap in the existing literature, we chose to study the underpricing of VC-backed and PE-backed IPOs during 2011-2020, featured on the Nasdaq Nordic main market as well as the Nasdaq Nordic First North Market.

The Nordic region is of importance, not only due to the limited previous research, but also due to the surge of IPOs that has taken place in the region during the last couple of years. This has in turn led to increased activity of financial sponsors (Pitchbook, 2020, PWC, 2018), making the investigation of Nordic IPOs even more interesting.

No research contrasts the potential underpricing of VC-backed and PE-backed IPOs with the intention to explain the underpricing puzzle by different characteristics of the issuing firm, as well as characteristics of the financial sponsor. Therefore, we explore how different metrics of firm characteristics and IPO characteristics may differ and how it impacts underpricing in the two subgroups. Our extension is related to the article by Barry et al., which explores IPO characteristics and underperformance of VC-backed IPOs. Also, Levis (2011) explores the differences in firm characteristics and underpricing between VC-, PE- and non-backed IPOs, but excludes the analysis of how the metrics impact underpricing. Since none of these studies focus on contrasting underpricing between VC- and PE-backed IPOs as well as controlling for both firm- and IPO characteristics, we believe it is a meaningful extension to make.

3.0 Data

This section presents the delimitations and methods of data gathering. Section 3.1 defines the criteria applied when selecting IPOs to the sample. Section 3.2 presents how the data was gathered, adjusted and complemented. Section 3.3 explores how venture capitalists and private equity firms are categorized and divided into two subgroups. Lastly, an overview of the final dataset is presented and briefly described.

3.1 Sample delimitation

The sample consists of IPOs listed at the Nasdaq Nordic main market exchanges and Nasdaq Nordic First North Growth Market. These exchanges cover the Nordic countries Sweden, Denmark, Finland and Iceland. Smaller exchanges such as Spotlight (former Aktietorget) are excluded from the sample since they are less regulated, attract fewer investors and are on average smaller (Nasdaq Nordic official website, 2021). In order to gather a large enough sample of sponsored-backed IPOs, we include the non-primary exchange First North Growth Market.

The sample includes IPOs registered from 1st of January 2011 until 31st of December 2020. This time interval is applied to get results and insights that reflect the impact of sponsors on underpricing during more recent years, which complements previous studies conducted. The periods of the financial crisis and IT bubble are excluded to prevent the results from being skewed by extraordinary market conditions.

3.2 Sample collection

The original sample that represents our chosen exchanges and time interval is extracted from Capital IQ. In order to exclude exchange transfers, dual listings, acquisitions/restructuring and observations that do not fulfill our exchange and time criteria, we manually benchmark our samples against Nasdaq Nordics' official listing archives and adjust thereafter. The isolation of first seasoned offerings is done to prevent the results from being skewed as a result from including issuers that has been listed previously, decreasing investor uncertainty and the need to underprice. To test our hypothesis, we gather a total of 29 variables from Capital IQ, listing prospectus, annual reports and company webpages, presented in Appendix Table 1.

3.3 Venture capital and private equity classification

The sample is classified into three subgroups; venture capital backed, private equity backed and non-backed IPOs. Earlier studies are not unified in what criteria and methodologies to use when segmenting VC- and PE-backed companies. Levis (2011) focus on shareholding, where PE-backed IPOs have a majority stake, while VC-backed issuers obtain a minority stake. Other papers make their segmentation based on the classification of Securities Database Company Platinum (Mogilevsky and Murgulov, 2012). One common feature of most papers is the use of a subjective criteria when classifying VC- and PE-firms, since there is no acknowledged method of distinguishing the two types of sponsors.

We use the following criteria to classify an IPO as venture capital backed:

1. The owner must be classified as a venture capital firm by the Swedish Private Equity and Venture Capital Associations (SVCA)
2. If the owner is not Nordic and therefore not included in the SVCA list, a subjective decision has been concluded based on firm information
3. The owner must be one of the main shareholders at the time of IPO, with a lower equity stake limit of 5%

We use the following criteria to classify an IPO as private equity backed:

1. The owner must be classified as a private equity firm by the SVCA
2. If the owner is not Nordic and therefore not included in the SVCA list, a subjective decision has been concluded based on firm information
3. The owner must be one of the main shareholders at the time of IPO, with a lower equity stake limit of 5%

We use the following criteria to classify an IPO as non-backed:

1. Neither of the owners controlling a minimum equity stake of 5% are classified as a private equity firm or venture capital firm by the SVCA
2. If the owner is not Nordic a subjective decision has been concluded based on firm information

3.4 Data description

The original sample is extracted from Capital IQ and includes 756 samples. After cleaning the raw dataset from missing variables, such as issue price, and discrepancies between the Capital IQ list and Nasdaq's official listing archive, our sample consists of 375 observations. Then, we manually adjusted for outliers to make our tests more robust. As seen in Appendix Figure 1, 2 and 3, most observations adjusted first day return ranged from -100% to 100%, which is the interval chosen for our final dataset.

Table 1 gives an overview of the final sample, consisting of 361 observations. Our method to classify different types of financial sponsors results in 59 VC-backed IPOs, 76 PE-backed IPOs and 226 non-backed IPOs.

Table 1

Frequency distribution and capital raised by initial public offerings over the period 2011-2020

	Number of IPOs				% Distribution of total IPOs		Total capital raised (SEKm)		
Year	VC-backed	PE-backed	Non-backed	Total	VC-backed	PE-backed	VC-backed IPOs	PE-backed IPOs	Total
2011	2	1	7	10	20%	10%	532	555	2,545
2012	0	0	2	2	0%	0%	0%	0%	69
2013	1	4	8	13	8%	31%	21	7,740	9,656
2014	11	8	19	38	29%	21%	1,450	27,376	41,079
2015	8	16	38	62	13%	26%	1,113	37,662	59,733
2016	10	11	30	51	20%	22%	1,941	40,417	52,916
2017	12	12	46	70	17%	17%	4,717	13,934	32,031
2018	3	12	30	45	7%	27%	214	9,379	25,072
2019	6	5	19	30	20%	17%	828	852	7,580
2020	6	7	27	40	15%	18%	1,003	13,933	25,653
Total	**59**	**76**	**226**	**361**	**16%**	**21%**	**11,819**	**151,848**	**256,333**

Note. The full sample consists of 361 IPOs, of which 59 are VC-backed, 76 are PE-backed and 226 are Non-backed. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The venture capital backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. The private equity backed IPOs are all new issues with a private equity investor (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. Total capital raised is the total number of shares offered to the market multiplied by the offer price and is stated in millions of Swedish crowns.

In total, all IPOs during the time interval raised SEK 256,333 million. PE-firms raised SEK 151,848 million (59% of total), which is a substantially higher amount than the comparable VC-firms that raised SEK 11,819 million (5% of total). Almost 40% of all IPOs are backed by some type of financial sponsor, where VC-backed and PE-backed IPOs constitute 16% and 21%, respectively.

When the IPO activity peaked between 2014 and 2018, VC- and PE-firms kept approximately the same distribution in terms of activity. The capital raised during this period represents 82% of all sponsor-backed capital raised during 2011-2020. The main contribution comes from PE-firm activity, which increased massively during these years and raised 85% out of total PE-backed capital. This surge in IPOs is in line with the activity increase spotted by previous research on the Nordic markets during these years (Segerström, 2018).

Furthermore, as seen in Appendix Table 2, Sweden is the country that outperforms in IPO activity, accounting for 72% of all IPOs. Furthermore, Sweden also has the largest

amount of backed IPOs, constituting 84% of the Nordic VC-backed IPOs and 73% of the Nordic PE-backed IPOs during 2011-2020.

4.0 Methodology
This section presents the methods we use to test our hypotheses. Firstly, section 4.1 presents how a t-test is used to investigate the first two hypotheses. Section 4.2 defines underpricing and presents how an analysis for differences in underpricing between VC- and PE-backed IPOs is performed. The Pearson correlation test used to control for multicollinearity is presented in section 4.3. Lastly, the regression models that help evaluate the remaining hypotheses are presented in section 4.4, followed by a description of the variables used.

4.1 T-test on the difference in firm- and IPO characteristics
To control for potential differences in firm- and IPO characteristics between VC- and PE-backed IPOs, we perform a t-test. The method is in line with previous research performed by Barry et al. (1990). The t-test controls for significant differences in means between the two subgroups. Since there is no hypothesised direction of the difference in mean between our subgroups, a two-tailed test is applied. Based on the results in Appendix Table 3, the assumption of unequal variance is taken.

4.2 Underpricing
Following the definition by Barry et al. (1990), underpricing is the same as the first day return and is defined as the percentage change between the offering price and the closing price on the first trading day. Though, an addition to this definition is made, by adjusting the first day return with the market return on the day of the IPO. The index representing our market return is OMX Stockholm All Shares, since it is the index that best represents the return of our chosen exchanges. Making this adjustment catches the true underpricing of the IPO, excluding the impact of the overall market condition prevailing at the time of the IPO.

$$(1)\ First\ day\ return = \frac{P_{i,t=0}}{P_{i,offer}} - 1$$

In equation 1, $P_{i,t=0}$ is defined as the closing price of security i at $t=0$, which is the first trading day. Furthermore, $P_{i,offer}$ is defined as the offer price of security i.

$$(2)\ Adjusted\ first\ day\ return = Underpricing$$
$$= First\ day\ return_{i,t=0} - OMX\ stockholm\ All\ shares\ return_{t=0}$$

In equation 2, $First\ day\ return_{i,t=0}$ is defined as the first day return of security i, and $OMX\ stockholm\ All\ shares\ return_{t=0}$ is defined as the index return of OMX Stockholm All shares at $t=0$, which is the first trading day of security i.

4.2.1 T-test on underpricing
Another t-test is performed in order to study the difference in adjusted first day return between VC- and PE-backed IPOs, which is commonly used in academics (Barry et al., 1990, Mogilevsky and Murgulov, 2012). Since the third hypothesis is formulated as PE-

backed IPOs being less underpriced than VC-backed IPOs, a one-tailed t-test is used. Furthermore, unequal variance is assumed, which is supported by the results in Appendix Table 3.

4.3 Correlation test

Following Barry et al. (1990), a measurement of the correlation between the independent variables is done to avoid multicollinearity in the regression test later performed. Two individual correlation tests are conducted in each of the VC- and PE-subgroup, the first being on the firm characteristic variables and the second on IPO characteristic variables, as defined in Appendix Table 4.

There are several ways of measuring correlation, with Pearson's correlation coefficient being the most common method (Barry et al., 1990), therefore being the test we apply. The Pearson's r measure linear correlation between two observations and is defined as:

$$(3)\ \rho_{X,Y} = \frac{cov(X,Y)}{\sigma_X \sigma_Y} = \frac{E[(X - \mu_X)(Y - \mu_Y)]}{\sigma_X \sigma_Y}$$

In equation 3, *Cov* is the covariance of the random variables X and Y. The random variables X and Y have the standard deviation defined as σ_X and σ_Y, respectively. The correlation formula can further be explained in the terms of means and expectations, where E is defined as the expectation, X and Y are defined as two random variables with mean μ_X and μ_Y.

4.4 Ordinary least squares regression

The ordinary least squares (OLS) regression model is the method mostly used in IPO performance research (Barry et al., 1990, Mogilevsky and Murgulov, 2012). To make our findings comparable with previous research, we apply the same method. The OLS regression is a linear regression model that estimates the relationship between one or more independent variables and a dependent variable. The method estimates the relationship by minimizing the sum of the squares in the difference between the observed and predicted values of the dependent variable, configured as a straight line. Since we use more than one independent variable, a multivariate regression model will be conducted.

Two regression tests are used in each sponsor subgroup to test hypotheses 4 and 5. The first model uses firm characteristic variables (defined in Appendix Table 4) as independent variables and adjusted first day return as the dependent variable. This model tests if underpricing is explained by the same issuer firm characteristics in the two subgroups. Further, the second model uses IPO characteristic variables (defined in Appendix Table 4) as independent variables and adjusted first day return as the dependent variable. This model instead tests if underpricing can be explained by differences in IPO characteristics in the two subgroups.

$$(4)\ Adjusted\ first\ day\ return_{FirmCharacteristics}$$
$$= \alpha_i + \beta_1(AGE) + \beta_2(REV) + \beta_3(MC) + \beta_4(EBITDA) + \beta_5(AT)$$
$$+ \beta_6(EMPL) + \beta_7(\text{DE}) + \beta_8(RG) + \beta_9(HI) + \beta_{10}(PRO) + \epsilon_i$$

$$(5)\ Adjusted\ first\ day\ return_{IPOCharacteristics}$$
$$= \alpha_i + \beta_1(OWN) + \beta_2(NFS) + \beta_3(EQ) + \beta_4(BRD) + \beta_5(YOBRD)$$
$$+ \beta_6(IPOs) + \beta_7(AGEFS) + \beta_8(HI) + \beta_9(PRO) + \epsilon_i$$

Adjusted first day return (underpricing) is the dependent variable, α_i is the intercept, β_i is the coefficient of respective independent variables and ε corrects for error discrepancies. The construction of the variables can be seen in Appendix Table 5 and Table 6, and the definitions of the variables are explained in the subsequent section.

4.4.1 Issuer firm characteristic variables

The firm characteristic independent variables are chosen as they reflect the important traits of age, size and performance. These three groups of metrics are important when valuing the issuer prior to the IPO and can therefore have an impact on underpricing. Previous research conducted by Levis (2011) uses the same variables as our model, except for 'Log age of issuer' as well as the control variables 'Hot issue' and 'Proceeds'. The article presents multiple differences in issuer firm characteristics between VC-backed and PE-backed IPOs and concludes higher levels of underpricing for the former group. However, the issuer's firm characteristics impact on underpricing are not investigated, neither is the difference in the impact when having a PE- or a VC-firm backing the IPO, which is an extension we make.

Metrics that take the value below or above the interval 0-1 are subjected to the natural logarithm *1 + 'metric'*. This is done to make the model more precise, without being impacted by extremely small or large observations. The exact construction of each variable is found in Appendix Table 5.

Below, we present our variables in the order of the categories age (one metric), size (three metrics), performance (four metrics) and control variables (two metrics). No previous research has, to our knowledge, evaluated these variables against underpricing. We have therefore based our selection criteria on papers that have presented deviating levels of the specific metric between VC-backed and PE-backed firms. This divergence is of interest since it can be a potential explanation for the differences in underpricing documented between VC-backed and PE-backed IPOs (Levis, 2011). Though, the hypothesized effect on underpricing is constructed solely by us and are carefully evaluated based on theories.

Log age of issuer (AGE): Previous research show a negative relationship between the age of the issuer and underpricing (Ritter, 1984, Mogilevsky and Murgolov, 2012). Due to increased information availability of older firms, this metric is hypothesised to lower information asymmetry and therefore have a positive effect on underpricing.

Log revenue (REV): Levis (2011) presents that VC-backed firms have lower levels of revenue than PE-backed firms and is therefore a metric we find of interest. Revenue is hypothesised to lower underpricing, since a company with larger revenue streams is considered to reduce uncertainty as the business idea is met with demand.

Log market cap (MC): VC-backed IPOs have generally smaller market capitalization compared to PE-backed IPOs (Levis, 2011). An issuer with larger market capitalization indicates it being a larger firm with higher value, therefore being the subject of more public information, hence reducing investor uncertainty. Therefore, we project this metric to reduce underpricing.

Log employees (EMPL): Levis (2011) presents that an issuer backed by a private equity firm has more employees than an issuer backed by a venture capital firm. This metric is hypothesised to have a positive effect on underpricing since more employees indicate the belief that future cash flows are large and stable enough to pay salaries.

EBITDA margin (EBITDA): A PE-backed IPO has a higher EBITDA margin compared to a VC-backed IPO, according to Levis (2011). A higher margin indicates

higher profitability and performance, which is hypothesised to lower the level of information asymmetry and also underpricing.

Asset turnover (AT): Levis (2011) shows that VC-backed IPOs have lower asset turnover compared to PE-backed IPOs. This metric is expected to have a positive impact on underpricing since higher asset turnover indicates higher performance prior to the IPO and therefore reduces information asymmetry.

Revenue growth (RG): In contrast to private equity firms, venture capital firms typically invest in younger companies with high growth (Barry et al., 1990). Higher growth indicates the firm's ability to expand as well as increase its size and performance, reducing uncertainty about the future. Thus, we hypothesise that this metric has a positive impact on underpricing.

Debt-to-Equity (DE): Normally, an issuer backed by a venture capital firm has lower leverage compared to an issuer backed by a private equity firm (Levis, 2011). We expect this metric to vary greatly between industries, but is still an indication of performance, since older, more profitable firms have generated more income, which increases their equity. Also, firms with a history of higher cash flows have been able to pay down debt to a larger extent, decreasing leverage. Since debt creditors are prioritized in bankruptcy, a higher leverage ratio increases investor uncertainty. All in all, we hypothesis that a higher leverage ratio increases underpricing.

Hot issue (HI): Ritter (1984) documents higher initial returns when the market is featured by a hot period, meaning that a larger number of firms tend to go public. Based on data from PwC's two reports (European private equity IPO report and IPO watch Europe 2020), the hot market in the Nordics takes place between the years 2014-2018. To control for the hot issue market condition, "hot issue" is included as a control variable, which enforces the robustness of the model.

Log proceeds (PRO): Both Ritter (1984) and Chalk and Peavy (1990) document that smaller offerings are more uncertain and result in higher first day returns. However, Barry et al. (1990) presents the opposite result, namely that larger offerings are associated with higher first day returns. In line with Barry et al., we hypothesise that larger IPOs, in terms of proceeds, are associated with more underpricing. This is also based on the winner's curse theory and the fact that higher levels of capital raised require more uninformed investors due to informed investors' limited wealth, resulting in underpricing to attract the uninformed parties.

4.4.2 IPO characteristic variables

Barry et al. (1990), Habib and Ljungqvist (2001) and Levis (2011) present that IPO characteristics act as quality monitors for outside investors, resulting in less information asymmetry and underpricing. Therefore, we focus on the same variables as these papers to draw conclusions and compare the results we retain.

As for the firm characteristics, metrics that take the value below or above the interval 0-1 are subjected to the natural logarithm *1+ 'metric'*. The exact construction of the variables is presented in Appendix Table 6.

Log length of ownership (OWN): A longer holding period indicates that the financial sponsor has gained more information and performed more extensive influence on the issuer's operations, hence acting as a higher quality monitor (Levis, 2011). Therefore, we project that a longer period of ownership decreases underpricing.

Log number of financial sponsors backing (NFS): Barry et al. (1990), show that this metric reduces the first day return. Having a larger number of financial sponsors

indicates the strength of the issuer's business idea. It also increases the intensity of monitoring and therefore reduces uninformed investors' uncertainty. Thus, the more sponsors backing an IPO is projected to reduce underpricing.

Total ownership pre-IPO (EQ): Firstly, the more pre-IPO ownership the combined number of sponsors holds, the more effort is put in to reducing underpricing to avoid leaving money on the table (Habib and Ljungqvist, 2001). Likewise, Barry et al. (1990) find that pre-IPO holding is associated with less underpricing. With both results in mind, this metric is hypothesised to reduce underpricing.

Log number of board members (BRD): In line with the findings made by Barry et al. (1990), more board seats occupied by a financial sponsor indicate more formal control and the possibility to influence the issuer. Therefore, we project that this metric has a positive effect on underpricing.

Log number of years on board (YOBRD): The opportunity to observe and influence the company becomes more prominent the longer the sponsor has served the board, hence acting as a higher quality monitor, reducing underpricing. This is in line with Barry et al. (1990), which presents that the longer the lead venture capital firm has served the board, the smaller the initial return. Hence, we hypothesize that this metric reduces underpricing.

Log number of IPOs (IPOs): The more IPOs a financial sponsor has been involved in, the better it signals the ability to successfully monitor and influence the target. It can also be viewed as evidence of the past performance of the sponsor's ability to bring a company to market, reducing investor uncertainty (Barry et al., 1990). Therefore, this metric is projected to have a positive effect on underpricing.

Log age of financial sponsor (AGEFS): Older financial sponsors have more experience in guiding their investments and creating sustainable profitability (Barry et al., 1990). Hence, the age of the VC- or PE-firm is hypothesized to reduce underpricing.

HI (hot issue): See section 4.4.1

PRO (log proceeds): See section 4.4.1

5.0 Results

This section presents our results and the ultimate rejection or acceptance of the hypotheses. Section 5.1 explores the first hypothesis: *There is a difference in issuer firm characteristics between VC- and PE-backed IPOs.* Section 5.2 investigates the second hypothesis: *There is a difference in IPO characteristics between VC- and PE-backed IPOs.* Section 5.3 presents the results to the third hypothesis: *PE-backed IPOs have less underpricing than VC-backed IPOs.* Section 5.4 investigates the fourth hypothesis: *The same firm characteristics explain underpricing in VC- and PE-backed IPOs.* Lastly, section 5.5 describes the results from our fifth hypothesis: *The same IPO characteristics reduce underpricing in VC- and PE-backed IPOs.*

5.1 Firm characteristics
Firstly, we investigate if financial sponsors specialize in specific industries, and whether the investment strategies differ between venture capital and private equity firms.

Table 2

Frequency distribution of IPOs by industry between the years 2011 and 2020

Industry	% of all VC-backed IPOs	% of all PE-backed IPOs	% of all non-backed IPOs
Healthcare	37%	17%	22%
Engineering	3%	8%	3%
Technology	10%	4%	11%
Goods	31%	18%	15%
Banking	2%	7%	6%
Real Estate	0%	8%	14%
Food	0%	4%	4%
Entertainment	3%	7%	7%
Business services	3%	13%	9%
Retail	5%	8%	3%
Marketing	2%	0%	2%
Distributor	2%	4%	2%
Aerospace and defense	2%	1%	1%
Education	0%	1%	1%
Total	100%	100%	100%

Note. The full sample consists of 361 IPOs, of which 59 are VC-backed, 76 are PE-backed and 226 are Non-backed. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The venture capital backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. The private equity backed IPOs are all new issues with a private equity investor (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. Non-backed IPOs are all IPOs not included in the two other subgroups. Industry classification is based on the categorization made by Capital IQ. Our sample consists of 14 industry groups.

As seen in Table 2, venture capital firms tend to focus on two sectors, namely the healthcare sector (37%) and the goods sector (31%). Private equity firms on the other hand invest in a broader range of industries, but are slightly biased towards the same sectors as venture capital firms. This indicates that VC-firms are at a higher degree specialized than PE-firms and can thus become experts in a few industry groups rather than generalists in many, which is in line with previous research by Warne (1988). PE-firms show a more similar pattern as the non-backed IPOs, thus taking a more equal distribution of the industries and choose a more general position.

Next, an analysis based on firm characteristics is performed. Table 3 illustrates issuer firm characteristics in our three subgroups, VC-, PE- and non-backed IPOs. The characteristics are categorized by age, size and performance, and aims to clarify if venture capital- and private equity firms tend to invest in a generic type of target.

There is a clear difference in all issuers' firm characteristics between the venture capital backed IPOs and the private equity backed IPOs. In line with previous literature (Levis, 2011), VC-backed issuers show the smallest mean in all characteristics that indicate the size of the firm, being revenue, market capitalization and employees, while PE-backed issuers show substantially higher numbers. The mean in revenue differs with SEK 6,021 million, the mean in market capitalization differs with SEK 3,469 million and the mean in the number of employees differs with 8,120 between VC- and PE-backed issuers. The non-backed issuers have a mean of revenue, market capitalization and the number of employees below PE-backed IPOs but above VC-backed IPOs. This indicates that PE and VC investors are drawn towards two different ends of the scope when it comes to the size of the issuing firm.

Table 3

Firm characteristics for venture capital-, private equity- and non-backed IPOs between the years 2011-2020

Variable	Mean	Median	1st quartile	3rd quartile	Sample size
Panel A: VC-backed IPOs					
Age	14	10	7	16	59
Revenue	135	10	1	98	59
Market capitalization	661	271	115	617	59
EBITDA margin	-2607%	-42%	-139%	2%	59
Asset turnover	0.7	0.3	0.1	1.1	59
Number of employees	62	17	7	46	59
Leverage	1.1	0.3	0.1	1.4	59
Revenue growth	603%	29%	0%	82%	59
Panel B: PE-backed IPOs					
Age	35[a]	22	9	36	76
Revenue	6156[b]	1346	374	5208	76
Market capitalization	4130[a]	2514	585	4812	76
EBITDA margin	-25%[c]	8%	4%	16%	76
Asset turnover	0.9	0.9	0.4	1.3	76
Number of employees	8182	648	106	1763	76
Leverage	4.2[c]	1.4	0.5	2.8	76
Revenue growth	125%	17%	4%	38%	76
Panel C: Non-backed IPOs					
Age	24	11	6	22	226
Revenue	1030	63	6	352	226
Market capitalization	1331	326	119	1314	226
EBITDA margin	-164%	6%	-25%	16%	226
Asset turnover	0.9	0.5	0.1	1.5	226
Number of employees	402	40	11	169	226
Leverage	5.7	0.9	0.3	1.9	226
Revenue growth	121%	15%	0%	61%	226

Note. The full sample consists of 361 IPOs, of which 59 are VC-backed, 76 are PE-backed and 226 are non-backed. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The venture capital backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. The private equity backed IPOs are all new issues with a private equity investor (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. Firm characteristic is defined as the levels of financial metrics that the issuing firm posits. Age is the number of years since the company was founded, calculated from the date of the IPO. Revenue is the level of sales the issuing firm had one fiscal year prior to the IPO. Market capitalization is the total number of shares outstanding by the issuing firm multiplied by the closing price of the first trading day. EBITDA margin is calculated as the issuing firm's EBITDA (earnings before interest, tax, depreciation and amortization) over total sales one fiscal year prior to the IPO. Asset turnover is calculated as the issuing firm's total sales over total assets one fiscal year prior to the IPO. Number of employees is extracted at the day of the IPO. Leverage (debt-to-equity ratio) is the issuing firm's debt over equity one fiscal year prior to the IPO. Revenue growth is the percentage growth in revenue of the issuing firm one year prior to the IPO compared to the previous fiscal year.
[a]Significant at 0.01 level
[b]Significant at 0.05 level
[c]Significant at 0.1 level
The significance levels are based on a t-test of the difference in mean between the venture capital- and private equity backed samples.

Furthermore, the performance indicators also differ similarly as size. PE-backed issuers have higher EBITDA margin, asset turnover and leverage than VC-backed issuers. Levis (2011) observes the same results, where PE-backed companies demonstrated

substantially better performance indicators in terms of EBITDA-margin, asset turnover and leverage, than VC-backed companies. However, VC-backed issuers have a substantially higher revenue growth compared to PE-backed issuers. This shows that venture capital firms invest in younger companies with higher growth, which is in line with the findings by Barry et al. (1990). Overall, non-backed issuers exhibit performance variables in between VC- and PE-backed IPOs, except for leverage, indicating that the two types of financial sponsors have different investment strategies and value high performance differently.

Furthermore, PE-firms take their portfolio companies to the market with an average age of 35, while VC-backed firms have an average age of 14. Even though their holding period might differ, the large difference in issuer age indicates that PE-firms invest in older companies, compared to VC-firms. A conclusion done by Barry et al. (1990) is that older firms are larger with lower growth, compared to younger firms. This is likewise seen in our results since we both find that PE-backed companies are larger, older and experience lower growth.

By solely looking at the numbers, we can witness several differences between the PE- and VC-backed issuers when it comes to firm characteristics. However, to confirm this with statistical power, a t-test is performed which controls for significant differences between the means of the variables in our subgroups. The results shown in Table 3 Panel B support our first hypothesis, that there is a significant difference between the firm characteristics of VC- and PE-backed IPOs. All characteristics except for asset turnover, number of employees and revenue growth and is significantly different at 10%.

5.2 IPO characteristics
Table 4 presents IPO characteristics of venture capital firms and private equity firms, where Panel B is complemented with p-values from the t-test on the difference in mean between the two subgroups.

The average length of ownership does not significantly differ between VC-backed IPOs and PE-backed IPOs, taking on an average holding period of 5.1 and 5.5 years, respectively. These results are inconsistent with the findings by Levis (2011), which shows that venture capital firms have a longer holding period at the date of the IPO relative to private equity firms. Potential explanations for this discrepancy can be different time intervals (2011-2020 vs 1992-2005) and different exchanges chosen (Nasdaq Nordic & First North Growth market vs London Stock exchange), resulting in different samples.

Consistent with Mogilevsky and Murgulov (2012), the results indicate that the average aggregated amount of venture capital firms backing an IPO is significantly larger relative PE-backed IPOs, being 2.1 and 1.5, respectively.

Table 4
IPO characteristics for venture capital firms and private equity firms backing IPOs between the years 2011-2020

Variable	Mean	Median	1st quartile	3rd quartile	Sample size
		Panel A: VC-backed IPOs			
Length of ownership	5.1	5.0	3.0	6.5	59
Number VC-firms backing	2.1	2.0	1.0	3.0	59
Pre-IPO ownership	40.2%	28.0%	16.0%	58.5%	59
Number of board members	1.2	1.0	0.0	2.0	59
Number of years lead VC-firm has served the board	2.9	3.0	0.0	5.0	59
Number of IPOs	7.1	4.0	1.0	9.0	59
Age of the VC firm	2.5	2.6	2.1	3.1	59
		Panel B: PE-backed IPOs			
Length of ownership	5.5	5.5	3.8	7.0	76
Number PE-firms backing	1.5[a]	1.0	1.0	2.0	76
Pre-IPO ownership	65.8%[a]	74.0%	43.5%	92.3%	76
Number of board members	1.8[a]	2.0	1.0	2.0	76
Number of years lead PE-firm has served the board	4.2[b]	4.0	1.0	6.0	76
Number of IPOs	4.5[c]	2.0	1.0	6.5	76
Age of the PE firm	2.9[a]	3.0	2.5	3.3	76

Note. The sample consists of 135 IPOs, of which 59 are VC-backed and 76 are PE-backed. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The venture capital backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. The private equity backed IPOs are all new issues with a private equity investor (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. IPO characteristics are defined as specific traits of the financial sponsor and its involvement in the IPO. Length of ownership is the number of years the sponsor has owned equity in the issuer at the date of the IPO. Number of VC/PE firms backing is the number of VC/PE-sponsors with an above 5% equity stake in the issuer before the IPO. Pre-IPO ownership is the percentage ownership of all VC/PE sponsors before the IPO. Number of board members is the number of board seats that is occupied by the lead VC/PE-firm prior to the IPO. Number of years lead VC-/PE-firm has served the board is the number of years between the IPO date and the date the lead VC/PE sponsor took its first seat on the board. Number of IPOs is the number of initial public offerings the lead VC/PE-firm has backed before the date of the observation's IPO. Age of the VC/PE-firm is the number of years between the registration date of the sponsor and the date of the IPO.

[a]Significant at 0.01 level

[b]Significant at 0.05 level

[c]Significant at 0.1 level

The significance levels are based on a t-test in the difference in mean between the venture capital- and private equity backed sample.

Further, there are also pronounced differences in ownership structure before the IPO. Pre-IPO holding is much smaller in VC-backed IPOs (40.2%) than PE-backed IPOs (65.8%), which supports previous findings that private equity investors often take a majority stake in their holdings (Levis, 2011). Although the equity stakes are larger for the PE-subgroups, both subgroups take on prominent equity stakes. This indicates a higher incentive and ability to participate in the governance of the firm, acting as a good quality monitor for outside investors.

The number of board seats occupied by the financial sponsor is an indication of the influence the sponsor can exploit over the issuing firm (Barry et al., 1990). The result we obtain shows a significant difference between the two subgroups, with VC-firms claiming 1.2 seats and PE-firms 1.8 seats. Therefore, PE-sponsors should be able to claim a greater influence over their holding companies than VC-sponsors.

The amount of control and influence the VC- or PE-firm can exploit over the issuing firm becomes even more prominent the longer the sponsor has been an active participant in the board (Barry et al., 1990). Our test shows that venture capital firms have on average spent 2.9 years on the board prior to the IPO, whilst private equity firms spend on average 4.2 years. Since private equity investors occupy more board seats over a longer period compared to venture capital investors, the former sponsor has the ability to gain more information and steer the company to a greater extent prior to the IPO. Therefore, a PE-backing might reduce uninformed investor uncertainty more than VC-backing.

Furthermore, our results indicate that venture capital sponsors perform significantly more IPOs (7.1) compared to private equity sponsors (4.5). This is in line with the findings of Brav and Gompers (1997), that venture capital firms are young and perform many IPOs to gain a good reputation. However, it contrasts with Mogilevsky and Murgolov (2012) which finds the opposite, and explains this by stating that private equity firms have performed more IPOs than venture capital firms due to the former being older than the latter. Since our results finds a small age difference of four months between the two sponsors, as seen in Table 4, it might explain the discrepancy with Mogilevsky and Murgolov (2012) who finds a larger age difference.

Lastly, private equity firms are on average older than venture capital firms. As mentioned above, the age difference is very small. Therefore, private equity firms do not necessarily indicate more experienced and better able to improve operational performance in holding companies compared to venture capital firms, which Barry et al., (1990) finds.

Summarizing these results confirm our second hypothesis, that there is a difference in IPO characteristics between VC- and PE-backed IPOs.

5.3 Underpricing

5.3.1 Differences in underpricing and t-test
Next, we investigate the main question of this study, namely if there is a difference in underpricing between the VC- and PE-backed IPOs.

Table 5
Adjusted first day return of venture capital-, private equity- and non-backed IPOs between the years 2011-2020

Adjusted first day return, %	All	VC	PE	NB
Mean (equally weighted)	1.1%	(3.9%)	0.7%	3.0%
Mean (value weighted, inflation adjusted)	6.9%	5.2%	6.3%	8.2%
Median	2.0%	(3.0%)	1.5%	3.0%
Sample size	361	59	76	226

Note. The full sample consists of 361 IPOs, of which 59 are VC-backed, 76 are PE-backed and 226 are Non-backed. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. VC is the venture capital backed IPOs and are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. PE is the private equity backed IPOs and are all new issues with a private equity investor (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. NB is all IPOs neither backed by a private equity or a venture capital firm. Adjusted first day return is defined as the percentage price change from the offer price to the closing price of the first trading day, adjusted for the OMX Stockholm All Share return of the day of the IPO. The equally weighted return is calculated as the return for each observation multiplied with the observations weight out of the subgroup's total number of observations. The value weighted return is calculated as the return of each observation multiplied with its market capitalization weight out of the subgroups total market capitalization, adjusted for inflation.

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As seen in Table 5, the average return for the aggregated subgroups is low, with an average underpricing of 1.1%, driven up by the non-backed IPOs and down by the VC-backed IPOs. In line with Barry et al. (1990), VC-backed IPOs show on average less underpricing than non-backed IPOs. However, these results contradict the findings by Lee and Wahal (2004), which presents higher underpricing of venture capital backed IPOs contra non-backed IPOs. One potential explanation for these ambiguous results is the different time intervals and regions covered in the three papers. Similar to the findings made by Bergström et al. (2006), private equity backed IPOs have on average lower levels of underpricing (0.7%) relative non-backed IPOs (3.0%). Contrasting the different levels of average underpricing between the two subgroups, namely VC-backed and PE-backed IPOs, the former shows lower underpricing than the latter, which contradicts previous research (Levis, 2011, Mogilevsky and Murguluv, 2012).

The order of the underpricing persists when controlling for inflation-adjusted market capitalization, ending up with the value weighted adjusted first day return. However, the levels of underpricing increase for VC-backed, PE-backed and NB-backed IPOs to 5.2%, 6.3% and 8.2%, respectively.

In order to confirm or reject our third hypothesis, *PE-backed IPOs have less underpricing than VC-backed IPOs*, a one-sided t-test for the difference in mean of the equally weighted adjusted first day return and value weighted adjusted first day return between the two subgroups is performed. The same test is also performed between the non-backed and backed-subgroups, enabling comparison with results confirmed in previous research.

Table 6
T-test on the difference in mean of adjusted first day return between the three subgroups

Subgroups tested	P-value
Panel A: Equally weighted	
VC/PE	0.17
VC/NB	0.06
PE/NB	0.24
Panel B: Value weighted inflation adjusted	
VC/PE	0.48
VC/NB	0.34
PE/NB	0.12

Note. The full sample consists of 361 IPOs, of which 59 are VC-backed, 76 are PE-backed and 226 are Non-backed. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. VC is the venture capital backed IPOs and are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. PE is the private equity backed IPOs and are all new issues with a private equity investor (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. NB is all IPOs neither backed by a private equity or a venture capital firm. Adjusted first day return is defined as the percentage price change from the offer price to the closing price of the first trading day, adjusted for the OMX Stockholm All Share return of the day of the IPO. The equally weighted return is calculated as the return for each observation multiplied with the observations weight out of the subgroup's total number of observations. The value weighted return is calculated as the return of each observation multiplied with its market capitalization weight out of the subgroups total market capitalization, adjusted for inflation. The numbers in the table are the p-values of the t-test conducted on the difference in mean between the three subgroups. If the p-value is below 0.05 (5%), the null hypothesis that the difference in group means is zero is rejected.

Presented in Table 6, there is no significant difference in underpricing between venture capital backed and private equity backed IPO on a 10% level or lower. Consequently, we reject the third hypothesis. Likewise, the result indicates no significant difference between the PE-backed IPOs and non-backed IPOs. However, it

predicts a significant difference between the VC-backed IPOs and non-backed IPOs. To contrast this with previous research, Levis (2011) finds marked differences between both PE/NB and VC/NB, which makes one out of two of our results in line with this paper. However, Barry et al. (1990) find that there is no significant difference in underpricing between venture capital- and non-backed IPOs, which is the opposite of our results. One potential explanation for the discrepancy can be the different time and exchange limitations made by the papers.

5.3.2 Difference in underpricing and OLS regression analysis

Since the results in section 5.1 show a significant difference in the mean of revenue, market capitalization, age, EBITDA-margin and leverage between the VC- and PE-subgroup, these variables may impact the underpricing levels and subsequently the results in Table 5. It can be that the t-test show no difference in underpricing between the two subgroups due to the difference in these firm characteristic variables, and not due to the backing per se. To increase the robustness of the t-test and control for issuer firm characteristics, an OLS regression is performed. The regression shows whether underpricing differs between VC-backed IPOs and PE-backed IPOs after controlling for firm characteristic variables. To avoid the "dummy trap", only two of the dummy variables are added to the regression model, namely VC-backed and PE-backed.

Table 7
OLS regression of adjusted initial returns

	Intercept	VC	PE	REV	MC	AGE	EBITDA	DE	N	R^2
1.	-0.028	-0.046	-0.052	0.013[b]					361	0.020
2.	-0.206[a]	-0.056	-0.074[c]		0.039[a]				361	0.052
3.	0.022	-0.063	-0.020			0.0001			361	0.007
4.	0.025	-0.064	-0.019				-0.000		361	0.007
5.	0.030	-0.068	-0.020					-0.001[c]	361	0.006

Note. The full sample consists of 361 IPOs, of which 59 are VC-backed, 76 are PE-backed and 226 are Non-backed. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. VC is the venture capital backed IPOs and are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. PE is the private equity backed IPOs and are all new issues with a private equity investor (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. Adjusted first day return is the dependent variable, defined as the percentage price change from the offer price to the closing price of the first trading day, adjusted for the OMX Stockholm All Share return of the day of the IPO. VC is a dummy variable given the value 1 if the IPO is backed by a venture capital firm, and zero otherwise. PE is a dummy variable given the value 1 if the IPO is backed by a private equity firm, and zero otherwise. The remaining firm characteristics act as independent control variables. REV is the natural logarithm of 1+ revenue of the issuing firm one year prior to the IPO. MC is the natural logarithm of 1+ the issuing firm's market capitalization at the day of the IPO. Market capitalization is calculated as number of shares outstanding multiplied with the closing price of the first trading day. AGE is the natural logarithm of 1+ the number of years since the issuing firm was registered, calculated from the day of the IPO. EBITDA is the issuing firms EBITDA margin in decimal form, calculated as EBITDA (earnings before interest, tax, depreciation and amortization) over total sales one fiscal year prior to the IPO. DE is the issuing firm's debt-to-equity ratio in decimal form, calculated as the issuing firm's debt over equity one fiscal year prior to the IPO.
[a]Significant at 0.01 level
[b]Significant at 0.05 level
[c]Significant at 0.1 level

As seen in Table 7, the first test shows that the variable REV has a significant impact on underpricing on a 5% level, while the dummy variables show no significant impact. The same results are interpreted by the fifth test, where DE has a significant impact on a 10% level, with no significant impact of the dummy variables. Neither the control variables nor dummy variables have an impact on underpricing in the third and fourth test. All these results strengthen the rejection of hypothesis three since it reaffirms

that the type of backing does not impact underpricing. However, the same conclusions cannot be made for the second regression test, since PE-firms have a greater impact on reducing underpricing when MC is larger.

Since no other variables of size provide the same result, a univocal conclusion that private equity firms are better at reducing underpricing when the issuer is large cannot be made. Taking all results into account, we conclude that there is no obvious difference in underpricing between VC- and PE-backed IPOs and therefore stick with the rejection of our third hypothesis.

5.4 Firm characteristics' impact on underpricing

Even though the results indicate no clear significant difference in underpricing between VC- and PE-backed IPOs, there is a difference in the issuer firm characteristics of the firms that the two types of financial sponsors typically invest in. Therefore, we examine if firm characteristics have an explanatory effect on underpricing, and whether the same variables have explanatory power in the two subgroups. This is tested through a multivariate OLS regression, where the adjusted first day return (underpricing) is the dependent variable and firm characteristics variables are the independent. The test is divided into two sections, with the first being the tests conducted on the venture capital subgroup, and the second on the private equity subgroup.

5.4.1 Firm characteristics in the venture capital subgroup

First, a Pearson correlation test on the independent variables is conducted for the VC-subgroup to avoid multicollinearity in the regression test.

Table 8

Correlation matrix of firm characteristics for venture capital backed IPOs between 2011 and 2020

	AGE	REV	MC	EBITDA	AT	EMPL	DE	RG	HI	PRO
AGE	1									
REV	0.413[c]	1								
MC	0.111	0.369	1							
EBITDA	0.122	0.219	-0.062	1						
AT	0.474[b]	0.797[a]	0.195	0.155	1					
EMPL	0.293	0.699[a]	0.402	0.195	0.617[a]	1				
DE	-0.129	-0.045[c]	-0.001	0.046	-0.003	-0.189[b]	1			
RG	0.081	0.136	0.174	0.038	0.031	-0.021	-0.053	1		
HI	0.034	0.126	0.037	0.309	0.183	0.02	0.108	0.091	1	
PRO	0.029	0.297	0.875[a]	0.060	0.158	0.401	0.045	0.123	0.069	1

Note. Firm characteristic is defined as the levels of financial metrics that the issuing firm posits. The sample consists of 59 VC-backed IPOs. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The venture capital backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. Age is the natural logarithm of 1+ the number of years since the company was founded, calculated from the date of the IPO. REV is the natural logarithm of 1+ the issuing firm's revenue one fiscal year prior to the IPO. MC is the natural logarithm calculated as 1+ the issuing firm's market capitalization, which is the number of shares outstanding multiplied with the closing price of the IPO date. EBITDA is the issuing firms EBITDA margin in decimal form, calculated as EBITDA (earnings before interest, tax, depreciation and amortization) over total sales one fiscal year prior to the IPO. AT is the issuing firm's asset turnover in decimal form, calculated as total sales over total assets one fiscal year prior to the IPO. EMPL is the natural logarithm 1+ the issuing firm's number of employees on the day of the IPO. DE is the issuing firm's debt-to-equity ratio in decimal form, calculated as the issuing firm's debt over equity one fiscal year prior to the IPO. RG is the issuing firm's percentage growth in revenue one year prior to the IPO compared to the previous fiscal year, presented in decimal form. HI represents the hot issue period in the Nordics and act as a control variable given the value 1 if the IPO was between the years 2014-2018, and zero otherwise. PRO is the natural logarithm of 1+ the issuing firm's proceeds, calculated as the number of shares offered in the IPO multiplied with the offering price.
[a]Significant at 0.01 level
[b]Significant at 0.05 level
[c]Significant at 0.1 level

The results are presented in Table 8 and demonstrate that AGE, REV, AT, DE and EMPL all correlate with other independent variables. This is intuitive since older firms most likely have more employees and bigger revenue streams. Also, they have had more time to improve operational efficiency, hence increasing asset turnover. Lastly, as a firm becomes older, they have accumulated more debt, enabled through higher creditworthiness from the history of strong cash flows.

Since some of the independent variables correlate with each other, an individual regression test is performed on each independent variable against underpricing. Since the control variable PRO correlates with MC, it is excluded.

Table 9

OLS regression of first day returns of venture capital backed IPOs against firm characteristic variables

	Intercept	HI	AGE	REV	MC	EBITDA	AT	EMPL	DE	RG	N	R^2
1.	-0.002	-0.026	-0.007								59	0.002
2.	-0.031	-0.030		0.005							59	0.003
3.	-0.381[c]	-0.033			0.064[b]						59	0.069
4.	-0.025	-0.021				-0.0001					59	0.002
5.	-0.002	-0.011					-0.039				59	0.015
6.	-0.007	-0.026						-0.004			59	0.002
7.	-0.020	-0.027							0.001		59	0.002
8.	-0.020	-0.032								0.001	59	0.011

Note. Firm characteristic is defined as the levels of financial metrics that the issuing firm posits. The sample consists of 59 VC-backed IPOs. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The venture capital backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. Adjusted first day return is the dependent variable, defined as the percentage price change from the offer price to the closing price of the first trading day, adjusted for the OMX Stockholm All Share return of the day of the IPO. HI represents the hot issue period in the Nordics and act as a control variable given the value 1 if the IPO was between the years 2014-2018, and zero otherwise. The remaining firm characteristics act as independent variables. Age is the natural logarithm of 1+ the number of years since the company was founded, calculated from the date of the IPO. REV is the natural logarithm of 1+ the issuing firm's revenue one fiscal year prior to the IPO. MC is the natural logarithm calculated as 1+ the issuing firm's market capitalization, which is the number of shares outstanding multiplied with the closing price of the IPO date. EBITDA is the issuing firms EBITDA margin in decimal form, calculated as EBITDA (earnings before interest, tax, depreciation and amortization) over total sales one fiscal year prior to the IPO. AT is the issuing firm's asset turnover in decimal form, calculated as total sales over total assets one fiscal year prior to the IPO. EMPL is the natural logarithm 1+ the issuing firm's number of employees on the day of the IPO. DE is the issuing firm's debt-to-equity ratio in decimal form, calculated as the issuing firm's debt over equity one fiscal year prior to the IPO. RG is the issuing firm's percentage growth in revenue one year prior to the IPO compared to the previous fiscal year, presented in decimal form.
[a]Significant at 0.01 level
[b]Significant at 0.05 level
[c]Significant at 0.1 level

The OLS regression results are shown in Table 9. The control variable, HI, shows conflicting results compared to previous research (Ritter, 1984), as it does not indicate higher underpricing when the market is featured by hot issues, but rather the opposite. One explanation can be that previous research have focused on the U.S. market, which might react differently to a surge in market activity than the Nordic market does.

Looking at the signs of the independent variables, it is seen that AGE, EBITDA, AT and EMPL reduce underpricing. These signs are in line with what we hypothesized in section 4.4.1. However, all the remaining variables increase underpricing. This contradicts some of our hypothesized direction, where we expected REV, MC and RG to reduce rather than increase underpricing. However, the test only concludes that market capitalization increases underpricing on a significant level of 5%, leaving all other independent variables insignificant.

5.4.2 Firm characteristics in the private equity subgroup

As in the VC sample, a Pearson correlation test between the independent variables has been performed to avoid potential multicollinearity in the regression test.

Table 10

Correlation matrix of firm characteristics for private equity backed IPOs between 2011 and 2020

	AGE	REV	MC	EBITDA	AT	EMPL	DE	RG	HI	PRO
AGE	1									
REV	0.526[b]	1								
MC	0.344[c]	0.683[a]	1							
EBITDA	0.183	0.404	0.134	1						
AT	-0.036	0.343	0.042	0.204	1					
EMPL	0.523[b]	0.795[a]	0.608[a]	0.219	0.208	1				
D/E	0.004	0.148	0.007	0.043	0.246	0.141	1			
RG	0.033	-0.038	0.017	-0.311[b]	-0.198[c]	-0.008	-0.009	1		
HI	0.147	0.231	0.108	-0.03	0.06	0.368	0.097	0.07	1	
PRO	0.499[b]	0.767[a]	0.868[a]	0.156	0.003	0.712[a]	0.073	0.0001	0.207	1

Note. Firm characteristic is defined as the levels of financial metrics that the issuing firm posits. The sample consists of 76 PE-backed IPOs. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The private equity backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. Age is the natural logarithm of 1+ the number of years since the company was founded, calculated from the date of the IPO. REV is the natural logarithm of 1+ the issuing firm's revenue one fiscal year prior to the IPO. MC is the natural logarithm calculated as 1+ the issuing firm's market capitalization, which is the number of shares outstanding multiplied with the closing price of the IPO date. EBITDA is the issuing firms EBITDA margin in decimal form, calculated as EBITDA (earnings before interest, tax, depreciation and amortization) over total sales one fiscal year prior to the IPO. AT is the issuing firm's asset turnover in decimal form, calculated as total sales over total assets one fiscal year prior to the IPO. EMPL is the natural logarithm 1+ the issuing firm's number of employees on the day of the IPO. DE is the issuing firm's debt-to-equity ratio in decimal form, calculated as the issuing firm's debt over equity one fiscal year prior to the IPO. RG is the issuing firm's percentage growth in revenue one year prior to the IPO compared to the previous fiscal year, presented in decimal form. HI represents the hot issue period in the Nordics and act as a control variable given the value 1 if the IPO was between the years 2014-2018, and zero otherwise. PRO is the natural logarithm of 1+ the issuing firm's proceeds, calculated as the number of shares offered in the IPO multiplied with the offering price.
[a]Significant at 0.01 level
[b]Significant at 0.05 level
[c]Significant at 0.1 level

As shown in Table 10, the variables AGE, REV, MC, EMPL, EBITDA, RG and PRO correlate with other independent variables. REV, MC and EMPL are all indicators of size. If one variable increases, it is likely that the others follow the same path. For example, older firms tend to have a higher number of employees and higher revenue than younger firms. Furthermore, the correlation between RG, EBITDA and AT are another intuitive result since these three variables are indicators of performance. Higher revenue growth will demonstrate a higher EBITDA margin and higher asset turnover, with the assumption of remained cost and asset levels.

Since some of the independent variables correlate, individual regression tests for each independent variable against underpricing are performed, similar as for the venture capital sample. Since the control variable PRO correlates with 4 out of 9 independent variables at a significant level, it is excluded from the regression tests to avoid multicollinearity. The second control variable HI does not show correlation with any of the independent variables on a significant level and is therefore kept in the individual regression tests.

Table 11
OLS regression of first day returns of private equity backed IPOs against firm characteristic variables

	Intercept	HI	AGE	REV	MC	EBITDA	AT	EMPL	DE	RG	N	R^2
1.	-0.079	0.091	0.005								76	0.029
2.	-0.187[b]	0.061		0.022[b]							76	0.087
3.	-0.316[b]	0.077			0.036[b]						76	0.094
4.	-0.064	0.094				0.007					76	0.033
5.	-0.062	0.093					-0.003				76	0.029
6.	-0.176[b]	0.039						0.025[b]			76	0.090
7.	-0.065	0.093							-0.000		76	0.029
8.	-0.066	0.090								0.003	76	0.035

Note. Firm characteristic is defined as the levels of financial metrics that the issuing firm posits. The sample consists of 76 PE-backed IPOs. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The private equity backed IPOs are all new issues with a private equity (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. Adjusted first day return is the dependent variable, defined as the percentage price change from the offer price to the closing price of the first trading day, adjusted for the OMX Stockholm All Share return of the day of the IPO. HI represents the hot issue period in the Nordics and act as a control variable given the value 1 if the IPO was between the years 2014-2018, and zero otherwise. Age is the natural logarithm of 1+ the number of years since the company was founded, calculated from the date of the IPO. REV is the natural logarithm of 1+ the issuing firm's revenue one fiscal year prior to the IPO. MC is the natural logarithm calculated as 1+ the issuing firm's market capitalization, which is the number of shares outstanding multiplied with the closing price of the IPO date. EBITDA is the issuing firms EBITDA margin in decimal form, calculated as EBITDA (earnings before interest, tax, depreciation and amortization) over total sales one fiscal year prior to the IPO. AT is the issuing firm's asset turnover in decimal form, calculated as total sales over total assets one fiscal year prior to the IPO. EMPL is the natural logarithm 1+ the issuing firm's number of employees on the day of the IPO. DE is the issuing firm's debt-to-equity ratio in decimal form, calculated as the issuing firm's debt over equity one fiscal year prior to the IPO. RG is the issuing firm's percentage growth in revenue one year prior to the IPO compared to the previous fiscal year, presented in decimal form.
[a]Significant at 0.01 level
[b]Significant at 0.05 level
[c]Significant at 0.1 level

The result of the regression is shown in Table 11. The control variable HI takes a positive sign, indicating higher underpricing when hot market conditions prevail, in line with previous research (Ritter, 1984). Further, looking at the signs of the independent variables, the regression shows that AGE, REV, MC, EBITDA, EMPL and RG increase underpricing, conflicting our hypothesised directions presented in section 4.4.1. Only asset turnover and leverage decrease underpricing, where the former is in line with our hypothesised direction, but not the latter.

Furthermore, EMPL, REV and MC explain underpricing in the PE-sample with a significant level of 5%. The more employees, revenue and higher market capitalization, the more underpricing the IPO will exhibit.

5.4.3 Concluding comments on firm characteristics and underpricing
Surprisingly, the control variables show different signs in the two subgroups. In times of a hot market period, VC-backed IPOs are associated with higher levels of underpricing while PE-backed IPOs are associated with lower levels of underpricing. However, as no control variable is significant the test fails to determine the actual influence of the HI variable.

The results from the regression tests indicate that one of the variables, namely MC, explains underpricing in both subgroups. Only in the PE-sample, REV and EMPL negatively impact underpricing. Therefore, our fourth hypothesis, *the same firm characteristics explain underpricing in VC- and PE- backed IPOs,* is rejected.

5.5 IPO characteristics' impact on underpricing

Next, we test whether IPO characteristics have a monitoring effect and if the backing signals certification of the issuer, which reduces underpricing. By performing separate OLS regressions on the VC- and PE-sample, we can confirm or reject our final and fifth hypothesis, *the same IPO characteristics reduce underpricing in VC- and PE-backed IPOs.*

5.5.1 IPO characteristics in the venture capital subgroup

Table 12

Correlation matrix of IPO characteristics for VC-backed IPOs between 2011 and 2020

	OWN	NFS	EQ	BRD	YOBRD	IPOs	AGEFS	HI	PRO
OWN	1								
NFS	0.904[a]	1							
EQ	0.749[a]	0.891[a]	1						
BRD	0.721[a]	0.783[a]	0.838[a]	1					
YOBRD	0.756[a]	0.735[a]	0.694[a]	0.834[a]	1				
IPOs	0.773[a]	0.734[a]	0.609[a]	0.554[b]	0.587[b]	1			
AGEFS	0.912[a]	0.912[a]	0.750[a]	0.698[a]	0.693[a]	0.791[a]	1		
HI	0.037[c]	0.033[c]	0.053[c]	0.053[c]	0.039[c]	-0.015[c]	0.013[c]	1	
PRO	-0.013	0.038	0.062	0.110	0.123	0.053	-0.007	0.033	1

Note. IPO characteristics are defined as specific traits of the financial sponsor and its involvement in the IPO. The sample consist of 285 IPOs, of which 59 are VC-backed and 226 are Non-backed. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The venture capital backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. OWN is defined as the natural logarithm of 1+ the number of years the sponsor has owned equity in the issuer prior to the IPO. NFS is defined as the natural logarithm of 1+ the number of sponsors with an above 5% equity stake in the issuer before the IPO. EQ is defined as the percentage ownership of all sponsors before the IPO, in decimal form. BRD is defined as the natural logarithm of 1+ the number of board seats that is occupied by the lead VC prior to the IPO. YOBRD is defined as the natural logarithm of 1+ the number of years between the IPO date and the date the lead sponsor took its first seat on the board. IPOs is the natural logarithm of 1+ the number of initial public offerings the sponsor has backed before the date of the IPO. AGEFS is defined as the natural logarithm of 1+ the number of years between the registration date of the sponsor and the date of the IPO. HI represents the hot issue period in the Nordics and act as a control variable given the value 1 if the IPO was between the years 2014-2018, and zero otherwise. PRO is the natural logarithm of 1+ the issuing firm's proceeds, calculated as the number of shares offered in the IPO multiplied with the offering price.
[a]Significant at 0.01 level
[b]Significant at 0.05 level
[c]Significant at 0.1 level

As seen in Table 12, there is a high significant correlation between all independent variables, except for PRO. To avoid multicollinearity seven individual regression tests are performed. Also, since one of the control variables, HI, correlates with all our independent variables at a 10% level, it is excluded.

Table 13

OLS regression of first day returns of venture capital backed IPOs against IPO characteristic variables

	Intercept	PRO	AGEFS	BRD	YOBRD	OWN	NFS	IPOs	EQ	N	R^2
1.	-0.070	0.021[c]	-0.027[c]							285	0.021
2.	-0.084	0.022[c]		-0.047						285	0.014
3.	-0.085	0.021[c]			0.001					285	0.011
4.	-0.073	0.021[c]				-0.029				285	0.016
5.	-0.075	0.021[c]					-0.059			285	0.019
6.	-0.083	0.021[c]						-0.009		285	0.012
7.	-0.080	0.022[c]							-0.101	285	0.016

Note. IPO characteristics are defined as specific traits of the financial sponsor and its involvement in the IPO. The sample consist 285 IPOs, of which 59 are VC-backed and 226 are non-backed IPOs. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The venture capital backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. Adjusted first day return is the dependent variable, defined as the percentage price change from the offer price to the closing price of the first trading day, adjusted for the OMX Stockholm All Share return of the day of the IPO. PRO is the natural logarithm of 1+ the issuing firm's proceeds, calculated as the number of shares offered in the IPO multiplied with the offering price, acting as a control variable. The remaining IPO characteristics act as independent variables. AGEFS is defined as the natural logarithm of 1+ the number of years between the registration date of the sponsor and the date of the IPO. BRD is defined as the natural logarithm of 1+ the number of board seats that is occupied by the lead VC prior to the IPO. YOBRD is defined as the natural logarithm of 1+ the number of years between the IPO date and the date the lead sponsor took its first seat on the board. OWN is defined as the natural logarithm of 1+ the number of years the sponsor has owned equity in the issuer prior to the IPO. NFS is defined as the natural logarithm of 1+ the number of sponsors with an above 5% equity stake in the issuer before the IPO. EQ is defined as the percentage ownership of all sponsors before the IPO, in decimal forms. IPOs is the natural logarithm of 1+ the number of initial public offerings the sponsor has backed before the date of the IPO.

[a]Significant at 0.01 level
[b]Significant at 0.05 level
[c]Significant at 0.1 level

As shown in Table 13, the control variable PRO increases underpricing in all individual regressions. This is in line with Barry et al. (1990), but deviates from the findings made by Ritter (1984) as well as Chalk and Peavy (1990). The finding may also be explained by the winner's curse theory. Due to higher levels of capital raised, issuers need to underprice the IPO to attract uninformed investors, which is needed to fully subscribe the IPO, as informed investors have limited wealth.

All independent variables, except the YOBRD, take the expected negative sign, meaning that it has a positive effect on underpricing. However, the only independent variable that shows a significant relationship with underpricing is AGEFS. This result indicates that the age of the VC-firm acts as a quality monitor, which is also one of the main results in the paper by Barry et al. (1990). Older VC firms become more experienced in guiding activities that increase the performance of the holding company, reducing investor uncertainty and the need to underprice.

5.5.2 IPO characteristics in the private equity subgroup
As seen in Table 14, there is a high significant correlation between all independent variables, except for PRO. To avoid multicollinearity seven individual regression tests are performed, as in the venture capital subgroup. Also, since the control variables HI correlates with all our independent variables at a 1% level, it is excluded.

Table 14

Correlation matrix of IPO characteristics for PE-backed IPOs between 2011 and 2020

	OWN	NFS	EQ	BRD	YOBRD	IPOs	AGEFS	HI	PRO
OWN	1								
NFS	0.873[a]	1							
EQ	0.886[a]	0.847[a]	1						
BRD	0.871[a]	0.778[a]	0.878[a]	1					
YOBRD	0.883[a]	0.721[a]	0.795[a]	0.873[a]	1				
IPOs	0.742[a]	0.692[a]	0.750[a]	0.715[a]	0.696[a]	1			
AGEFS	0.944[a]	0.887[a]	0.887[a]	0.876[a]	0.850[a]	0.810[a]	1		
HI	0.055[a]	0.082[a]	0.093[a]	0.087[a]	0.026[a]	-0.048[a]	0.022[a]	1	
PRO	0.459	0.438	0.513	0.512	0.453	0.390	0.466	0.089	1

Note. IPO characteristics are defined as traits of the financial sponsor and its involvement in the IPO. The sample consists of 302 IPOs, of which 76 are PE-backed and 226 are Non-backed. The data was compiled from Capital IQ and Nasdaq Nordic official archives of IPOs conducted on the main market and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The private equity backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. OWN is defined as the natural logarithm of 1+ the number of years the sponsor has owned equity in the issuer prior to the IPO. NFS is defined as the natural logarithm of 1+ the number of sponsors with an above 5% equity stake in the issuer before the IPO. EQ is defined as the percentage ownership of all sponsors before the IPO, in decimal form. BRD is defined as the natural logarithm of 1+ the number of board seats that is occupied by the lead VC prior to the IPO. YOBRD is defined as the natural logarithm of 1+ the number of years between the IPO date and the date the lead sponsor took its first seat on the board. IPOs is the natural logarithm of 1+ the number of initial public offerings the sponsor has backed before the date of the IPO. AGEFS is defined as the natural logarithm of 1+ the number of years between the registration date of the sponsor and the date of the IPO. HI represents the hot issue period in the Nordics and act as a control variable given the value 1 if the IPO was between the years 2014-2018, and zero otherwise. PRO is the natural logarithm of 1+ the issuing firm's proceeds, calculated as the number of shares offered in the IPO multiplied with the offering price.
[a]Significant at 0.01 level
[b]Significant at 0.05 level
[c]Significant at 0.1 level

Table 15

OLS regression of first day returns of private equity backed IPOs against IPO characteristic variables

	Intercept	PRO	AGEFS	BRD	YOBRD	OWN	NFS	IPOs	EQ	N	R²
1.	-0.063	0.018[c]	-0.015							302	0.011
2.	-0.050	0.014		-0.005						302	0.007
3.	-0.049	0.014			-0.002					302	0.007
4.	-0.062	0.018[c]				-0.025				302	0.011
5.	-0.071	0.021[b]					-0.082[c]			302	0.019
6.	-0.049	0.014						-0.002		302	0.007
7.	-0.061	0.017[c]							-0.044	302	0.009

Note. IPO characteristics are defined as specific traits of the financial sponsor and its involvement in the IPO. The sample consists of 302 IPOs, of which 76 are PE-backed and 226 are Non-backed. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The private equity backed IPOs are all new issues with a private equity investor (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. Adjusted first day return is the dependent variable, defined as the percentage price change from the offer price to the closing price of the first trading day, adjusted for the OMX Stockholm All Share return of the day of the IPO. PRO is the natural logarithm of 1+ the issuing firm's proceeds, calculated as the number of shares offered in the IPO multiplied with the offering price, acting as a control variable. The remaining IPO characteristics act as independent variables. AGEFS is defined as the natural logarithm of 1+ the number of years between the registration date of the sponsor and the date of the IPO. BRD is defined as the natural logarithm of 1+ the number of board seats that is occupied by the lead VC prior to the IPO. YOBRD is defined as the natural logarithm of 1+ the number of years between the IPO date and the date the lead sponsor took its first seat on the board. OWN is defined as the natural logarithm of 1+ the number of years the sponsor has owned equity in the issuer prior to the IPO. NFS is defined as the natural logarithm of 1+ the number of sponsors with an above 5% equity stake in the issuer before the IPO. EQ is defined as the percentage ownership of all sponsors before the IPO, in decimal forms. IPOs is the natural logarithm of 1+ the number of initial public offerings the sponsor has backed before the date of the IPO.
[a]Significant at 0.01 level
[b]Significant at 0.05 level
[c]Significant at 0.1 level

Table 15 presents the seven individual regression tests that demonstrate how IPO characteristics may have explanatory power on underpricing. Compared to the VC-subgroup regressions, only four out of eight individual tests in the PE-subgroup report a significant dependence of the control variable PRO. The coefficient has the expected positive sign, which indicates that proceeds increase underpricing. Furthermore, all the independent variables have negative signs, meaning that they reduce underpricing. This is in line with our expectations as well as previous research conducted by Barry et al. (1990), which shows that several IPO characteristics act as quality monitors and therefore decrease underpricing. However, there is only one independent variable that exhibits significant results, namely the variable NFS. This means that the more PE-firms that hold an equity stake in the firm pre-IPO, the less underpricing the IPO will have. Thus, the more sponsors invested in the firm indicate a higher probability of realizing future return, reducing investor uncertainty and the need to underprice.

5.5.3 Concluding comments on IPO characteristics and underpricing

The test conducted in this section leads to the conclusion of a rejection of the fifth and final hypothesis, *the same IPO characteristics reduce underpricing in VC- and PE-backed IPOs*. By interpreting the regression test, we conclude that in the PE-sample, the number of PE-firms backing the issuing firm is the most important factor, while in the VC-sample it is instead the age of the VC-firm. Even though each sample presents different explanatory variables, the signaling theory still holds. Having a financial sponsor backing the IPO act as certification and provides monitoring, decreasing information asymmetry and underpricing. This conclusion enhances the results made by Barry et al. (1990).

6.0 Conclusion, Limitations and Further Research

6.1 Conclusion

This study results in several conclusions. Firstly, private equity and venture capital firms invest in different types of firms, where the former tends to invest in older, mature firms with higher levels of revenue, market capitalization, leverage and EBITDA margin. Secondly, there are differences between the two sponsors' characteristics and involvement in IPOs. The number of private equity firms backing the IPO is on average fewer with the lead private equity firm having a larger equity stake pre-IPO. They can also perform greater influence over the target since private equity firms have on average more representatives serving the board for a longer period of time. Another result is that PE-firms have performed fewer IPOs than VC-firms, even though the former sponsor is on average older than the latter. One potential explanation for this is that VC-firms are young and perform many IPOs to establish themselves in the industry (Brav and Gompers, 1997).

Thirdly, there is no clear difference in the ability to reduce underpricing between the two types of financial sponsors. However, when controlling for market capitalization, private equity firms have a positive effect on underpricing compared to venture capital firms, which instead have an insignificant impact. Since no other variables of the issuer's size provide the same result, a univocal conclusion that private equity firms are better at reducing underpricing when the issuer is large cannot be made. Taking all results into account, we can conclude that there is no obvious or significant difference in underpricing between VC- and PE-backed IPOs.

Fourthly, when investigating if the same firm characteristics explain underpricing between VC-backed and PE-backed IPOs, we conclude that higher levels of market capitalization increase underpricing in both subgroups. However, we find that higher levels of revenue and number of employees have a negative impact on underpricing in the PE-subgroup, and not in the VC-subgroup. Therefore, we confirm that different firm characteristics explain underpricing between VC- and PE-backed IPOs. One potential explanation for this discrepancy can be that the PE-sample consists of some large observations, in terms of revenue and number of employees, that are associated with more underpricing.

Lastly, length of ownership act as a quality monitor for VC-backed IPOs whereas the length of representatives on the issuer's board act as a quality monitor in the PE-subgroup. Therefore, we conclude that different IPO characteristics help to explain underpricing.

Overall, this paper presents new findings of the dynamics on the Nordic equity markets compared to previous research conducted on American, British and French exchanges (Barry et al., 1990, Levis, 2011, Bergström et al., 2006). Even though there is no difference in underpricing between the two types of sponsors, they have different investment strategies and monitors the target which provide a certification effect to outside investors, reducing underpricing.

6.2 Limitations

Firstly, there is no universal method of how to define venture capital and private equity firms in the literary space. Several articles use different definitions. For example, Levis (2011) focus on the ownership share of the sponsor while Mogilevsky and Murgulov (2012) base their division on a database classification. This might skew the conclusions we have made when comparing our results with previous research. Our results may have ended up different if we had used another definition of the separation of sponsors.

Secondly, the Nordic market and time period chosen gave a narrow selection of IPOs to analyze and ended up with a sample size of 361 IPOs. This relatively small sample size has several implications. One is that the statistical power decrease. Several of our results conclude significant results, but with a larger sample size and more observations, the results could have given even more implications and useful insights.

Thirdly, the previous research on private equity backing and underpricing is limited, as well as firm characteristic and its impact on underpricing. This creates uncertainty on which approach to take when researching these areas, since there is no prejudiced way of doing it. Also, our overall research question is well documented in previous research, but the hypotheses in this paper cover new ground as firm characteristics and its impact on underpricing have not been investigated before. This can make the hypotheses and conclusions speculative since it lacks comparability with previous research.

6.3 Further research

In this study, we provide evidence of how VC/PE-firms and underpricing relate to each other. We hope to see further research in this area since the existing academic papers covering this topic are very limited. This would enhance the reliability and usefulness of this paper for the reasons stated in section 6.2.

Further, we also provide evidence of the difference in the investment strategy of VC- and PE-firms. However, further investigation of the investment- and operational

strategies held by the sponsors would add depth to the area. This would create a greater understanding of how the strategies of the sponsors translate to the holding firm that in turn impacts underpricing.

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Company Prospects

Prospects for IPOs on Nasdaq Copenhagen and First North Copenhagen:
https://oasm.finanstilsynet.dk/dk/soegmeddelelseresultat.aspx?headline=&name=&RealAnnouncerCVR=10598184&CVRnumber=&announcmentsId=&informationTypeId=14&languageId=-1&nationality=-1&AnnouncementTypeId=&pubDateFrom=2007-11-01%2000:00&pubDateTo=2025-12-31%2023:59&index=1&sindex=1

Prospects for IPOs on Nasdaq Helsinki and First North Helsinki:
https://www.finanssivalvonta.fi/sv/register/prospektregistret/

Prospects for IPOs on Nasdaq Stockholm and First North Stockholm:
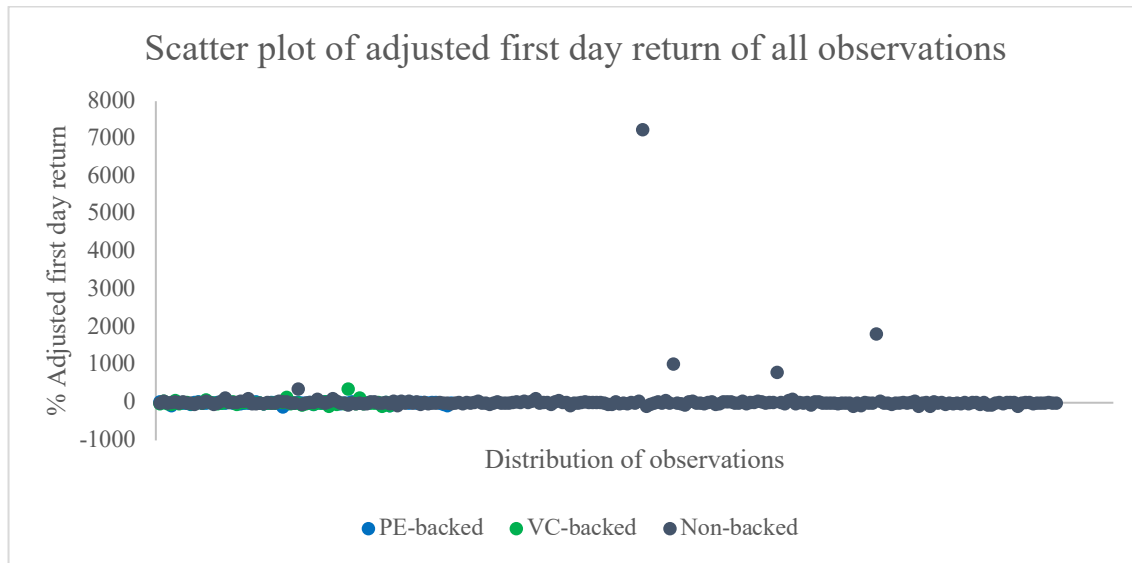https://www.fi.se/sv/vara-register/prospektregistret/

Appendix

Table 1
Variables and location of extraction

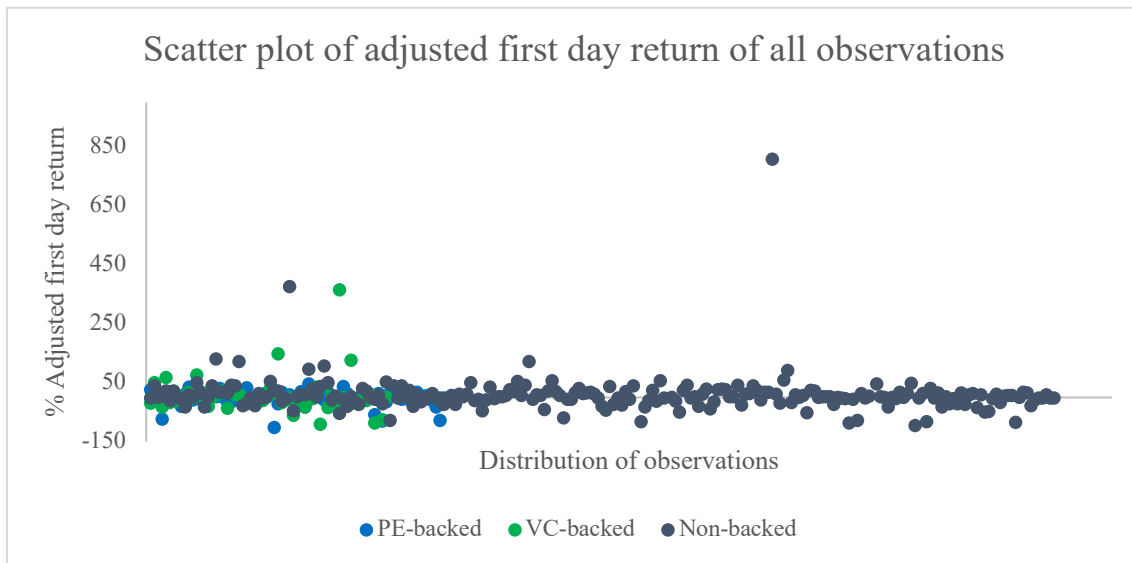|	Capital IQ	Annual Reports	Prospects	Nasdaq IPO list	Company webpage
Transaction Closed Date	X			X	
Issuer	X			X	
On Nasdaq Nordic list				X	
Age of issuer					X
Revenues one year prior to IPO	X	X			
Market Capitalization at IPO	X				
EBITDA Margin one year prior to IPO	X	X			
Asset turnover one year prior to IPO	X	X			
Number of employees	X	X			
Debt-to-equity ratio one year prior to IPO	X	X			
Revenue growth one year prior to IPO	X	X			
PE-backed			X		
VC-backed			X		
Length of VC/PE ownership			X		X
Lead VC/PE firm % ownership pre-IPO			X		
Lead VC/PE firm % ownership post IPO			X		
All VC/PE firm total % ownership pre-IPO			X		
All VC/PE firm total % ownership post IPO			X		
Demerger/Spin off/Dual listing/Exchange transfer				X	
Proceeds			X		
First day closing price	X				
Number of VC/PE firms backing			X		
Total number of board members			X		
Number VC/PE firm representatives on board			X		
Number of years the lead VC/PE firm has served the board			X		
Number of IPOs the lead VC/PE firm has backed prior to the observation's IPO					X
Age of lead VC/PE firm					X
Diluted EPS one year prior to IPO	X				
Earnings yield	X				

Note. This table presents all variables that constitutes our raw data sample and from which source each variable has been extracted from.

Figure 1

Scatter plot of adjusted first day return of all observations

Note. The full sample consists of 373 IPOs, of which 62 are VC-backed, 77 are PE-backed and 234 are Non-backed. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The venture capital backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. The private equity backed IPOs are all new issues with a private equity investor (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. Non-backed IPOs are neither backed by a venture capital- or private equity firm. The table plots all observations. Adjusted first day return is defined as the percentage price change from the offer price to the closing price of the first trading day, adjusted for the OMX Stockholm All Share return of the day of the IPO.

Figure 2

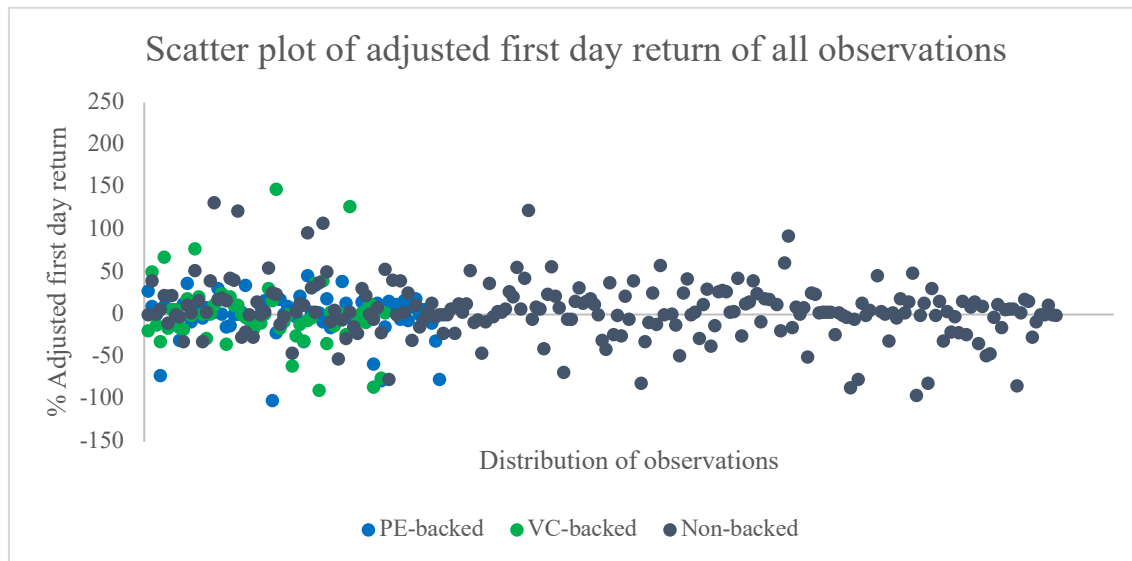Scatter plot of adjusted first day return of all observations

Note. The full sample consists of 373 IPOs, of which 62 are VC-backed, 77 are PE-backed and 234 are Non-backed. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The venture capital backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. The private equity backed IPOs are all new issues with a private equity investor (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. Non-backed IPOs are neither backed by a venture capital- or private equity firm. The table plots all observations with -150% < adjusted first day return < 850%. Adjusted first day return is defined as the percentage price change from the offer price to the closing price of the first trading day, adjusted for the OMX Stockholm All Share return of the day of the IPO.

Figure 3

Scatter plot of adjusted first day return of all observations

Note. The full sample consists of 373 IPOs, of which 62 are VC-backed, 77 are PE-backed and 234 are Non-backed. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The venture capital backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. The private equity backed IPOs are all new issues with a private equity investor (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. Non-backed IPOs are neither backed by a venture capital- or private equity firm. The table plots all observations with -150% < adjusted first day return < 250%. Adjusted first day return is defined as the percentage price change from the offer price to the closing price of the first trading day, adjusted for the OMX Stockholm All Share return of the day of the IPO.

Table 2
Frequency distribution of IPOs by country and year, segmented by all IPOs, VC-backed IPOs, PE-backed IPOs and Non-backed IPOs

Panel A: Frequency distribution of IPOs by country and year					*Panel B: Frequency distribution of VC-backed IPOs by country and year*				
Year	Sweden	Denmark	Finland	Iceland	Year	Sweden	Denmark	Finland	Iceland
2011	9	1	0	0	2011	2	0	0	0
2012	3	0	0	0	2012	0	0	0	0
2013	6	2	3	2	2013	1	0	0	0
2014	30	2	5	1	2014	9	0	2	0
2015	46	3	11	2	2015	5	1	2	0
2016	38	4	5	2	2016	9	1	0	0
2017	53	6	10	0	2017	10	1	1	0
2018	23	9	9	1	2018	3	0	0	0
2019	20	3	5	1	2019	5	0	1	0
2020	26	10	3	0	2020	6	0	0	0
Total	254	40	51	9	Total	50	3	6	0

Panel C: Frequency distribution of PE-backed IPOs by country and year					*Panel D: Frequency distribution of Non-backed IPOs by country and year*				
Year	Sweden	Denmark	Finland	Iceland	Year	Sweden	Denmark	Finland	Iceland
2011	1	0	0	0	2011	6	1	0	0
2012	0	0	0	0	2012	2	0	0	0
2013	1	1	2	0	2013	4	1	1	2
2014	6	2	0	0	2014	15	0	2	1
2015	13	0	3	0	2015	28	2	6	2
2016	8	1	2	0	2016	21	2	3	2
2017	9	1	2	0	2017	34	4	7	0
2018	9	1	2	0	2018	11	8	7	1
2019	4	1	0	0	2019	11	2	4	1
2020	5	1	1	0	2020	15	9	2	0
Total	56	8	12	0	Total	147	29	32	9

Note. The full sample consists of 361 IPOs, of which 59 are VC-backed, 76 are PE-backed and 226 are Non-backed. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The venture capital backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. The private equity backed IPOs are all new issues with a private equity investor (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. The country-classification is based on which exchange the issuer has performed their initial public offering. Listings on Nasdaq Stockholm and First North Stockholm are categorized as Swedish. Listings on Nasdaq Copenhagen and First North Copenhagen are classified as Danish. Listings on Nasdaq Helsinki and First North Helsinki are classified as Finnish. Listings on Nasdaq Iceland and First North Iceland is classified as Icelandic.

Table 3

Variance on adjusted first day return calculated on the VC- and PE-backed IPOs and F-test for the difference in variance between the two subgroups

	VC	PE
Adjusted first day return	0.09	0.05
		(0.012)

Note. The full sample consists of 361 IPOs, of which 59 are VC-backed, 76 are PE-backed and 226 are Non-backed. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The venture capital backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. The private equity backed IPOs are all new issues with a private equity investor (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. Adjusted first day return is defined as the price change from the offer price to the closing price the first day of trading, adjusted for the OMX Stockholm All Share return of the day of the IPO. The number in the parentheses is the p-value of the F-test for the difference in variance between the two subgroups, VC- and PE-backed IPOs. If the p-value is less than 0.05 (5%), the noll hypothesis of no difference in variance between the subgroups is rejected.

Table 4

Definition of firm characteristics and IPO characteristics

Firm characteristics	Firm characteristics are defined as the levels of financial metrics that the issuing firm posits. Examples of metrics can be revenue, asset turnover and market capitalization. These firm characteristics help to explain which type of generic target firm venture capital- and private equity-firms invests in.
IPO characteristics	IPO characteristics are defined as specific traits of the financial sponsor and its involvement in the IPO. Examples of metrics can be age of sponsor, ownership stake and number of sponsors backing the IPO.

Note. This table presents the definition of firm characteristics and IPO characteristics that are used in this study. The definition will help the reader understand the separation of our test and what is included when we refer to these notions.

Table 5
Construction of issuer firm characteristic variables

AGE (Age of issuer)	The natural logarithm of 1+ age of the firm in years on the day of the IPO
REV (Revenue)	The natural logarithm of 1+ revenue of the issuing firm one fiscal year prior to the IPO
MC (Market capitalization)	The natural logarithm of 1+ market capitalization on the day of the IPO
EBITDA (EBITDA margin)	EBITDA (earnings before interest, tax, depreciation and amortization) over total sales, one fiscal year prior to the IPO
AT (Asset turnover)	Sales over total assets, one fiscal year prior to the IPO, presented in decimal form
EMPL (Number of employees)	The natural logarithm of 1+ number of employees at the date of the IPO
DE (Debt-To-Equity)	Total debt-to-equity ratio (leverage) one fiscal year prior to the IPO
RG (Revenue growth)	The fiscal year prior to the IPO revenue increase from prior year, in decimal form
HI (Hot issue)	Dummy variable given the value 1 if the IPO was between the years 2014 to 2018, and zero otherwise
PR (Proceeds)	The natural logarithm 1+ capital raised during the IPO, including over-allotment options

Note. This table presents the constructions of the issuer firm characteristic variables. Firm characteristic is defined as the levels of financial metrics that the issuing firm posits. Age is the number of years since the company was founded, calculated from the date of the IPO. Age is the number of years since the issuing firm was founded, calculated from the date of the IPO. Revenue is the level of sales the issuing firm had one fiscal year prior to the IPO. Market capitalization is the total number of shares outstanding by the issuing firm multiplied by the closing price of the first trading day. EBITDA margin is calculated as the issuing firm's EBITDA (earnings before interest, tax, depreciation and amortization) over total sales one fiscal year prior to the IPO. Asset turnover is calculated as the issuing firm's total sales over total assets one fiscal year prior to the IPO. Number of employees is extracted as the day of the IPO. Debt-to-equity ratio is the issuing firm's debt over equity one fiscal year prior to the IPO. Revenue growth is the percentage growth in revenue of the issuing firm one year prior to the IPO compared to the previous fiscal year. Hot issue is a control variable given the value 1 if the IPO was between the years 2014-2018, and zero otherwise. Proceeds is the number of shares offered in the IPO multiplied with the offering price.

Table 6

Construction of IPO characteristic variables

OWN (Length of ownership)	The natural logarithm of 1+ number of years the lead VC- or PE-firm has owned equity in the issuing firm
NFS (Number of financial sponsors backing)	The natural logarithm 1+ aggregated amount of VC- or PE firms backing the IPO
EQ (Total ownership pre-IPO)	The total ownership stake owned by all VC- or PE-sponsors that are individually defined as larger shareholders (minimum 5% equity stake), presented in decimal form
BRD (Number of board members)	The natural logarithm of 1+ number of board members that are representatives of the lead VC- or PE-firm
YOBRD (Number of years on the board)	The natural logarithm 1+ number of years the lead VC- or PE firm has served the board
IPOs (Number of IPOs)	The natural logarithm of 1+ number of IPOs the lead VC- or PE-firm has been backing previous to the date of the observation's IPO
AGEFS (Age of financial sponsor)	The natural logarithm of 1+ the number of years the VC- or PE-firm has been a registered firm on the date of the IPO
HI (Hot issue)	Dummy variable given the value 1 if the IPO was between the years 2014 to 2018, and zero otherwise
PRO (Proceeds)	The natural logarithm 1+ capital raised during the IPO, including over-allotment options

Note. This table presents the constructions of the IPO characteristic variables. IPO characteristics are defined as specific traits of the financial sponsor and its involvement in the IPO. Length of ownership is the number of years the sponsor has owned equity in the issuer. Number of financial sponsors backing is the number of sponsors with an above 5% equity stake in the issuer before the IPO. Pre-IPO ownership is the percentage ownership of all sponsors before the IPO, in decimal form. Number of board members is the number of board seats that is occupied by the lead VC- or PE-firm prior to the IPO. Number of years on the board is the number of years between the IPO date and the date the lead sponsor took its first seat on the board. Number of IPOs is the number of initial public offerings the sponsor has backed before the date of the observation's IPO. Age of financial sponsor is the number of years between the registration date of the sponsor and the date of the IPO. Hot issue is a control variable given the value 1 if the IPO was between the years 2014-2018, and zero otherwise. Proceeds is the number of shares offered in the IPO multiplied with the offering price.

Table 7
Variance on firm characteristics calculated on the VC- and PE-backed IPOs and F-test for the difference in variance between the two subgroups.

Variable	VC	PE
AGE	303.30	1559.97
		(0.000)
REV	118856.12	402920046.13
		(0.000)
MC	887133.18	37750634.82
		(0.000)
EBITDA	17529.09	3.93
		(0.000)
AT	0.87	0.48
		(0.007)
EMPL	16268.55	2823941187.33
		(0.000)
DE	11.78	194.86
		(0.000)
RG	1003.42	39.86
		(0.000)

Note. Firm characteristic is defined as the levels of financial metrics that the issuing firm posits. The full sample consists of 361 IPOs, of which 59 are VC-backed, 76 are PE-backed and 226 are Non-backed. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The venture capital backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. The private equity backed IPOs are all new issues with a private equity investor (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. AGE is the age of the issuing firm, defined as the number of years since the issuing firm was founded, calculated from the date of the IPO. REV is the revenue of the issuing firm, defined as the level of sales the issuing firm had one fiscal year prior to the IPO. MC is the market capitalization of the issuing firm, defined as the total number of shares outstanding by the issuing firm multiplied by the closing price of the first trading day. EBITDA is the EBITDA margin of the issuing firm, calculated as the issuing firm's EBITDA (earnings before interest, tax, depreciation and amortization) over total sales one fiscal year prior to the IPO. At is the asset turnover of the issuing firm, calculated as the issuing firm's total sales over total assets one fiscal year prior to the IPO. EMPL is the number of employees of the issuing firm and is extracted as of the day of the IPO. DE is the debt-to-equity ratio and is the issuing firm's debt over equity one fiscal year prior to the IPO. RG is the revenue growth of the issuing firm, which is the percentage growth in revenue one year prior to the IPO compared to the previous fiscal year. The number in the parentheses is the p-value of the F-test for the difference in variance between the two subgroups, VC and PE. If the p-value is less than 0.05 (5%), the null hypothesis of no difference in variance between the subgroups is rejected.

Table 8

Variance on IPO characteristics calculated on the VC- and PE-backed IPOs and F-test for the difference in variance between the two subgroups

	VC	PE
OWN	7.18	7.96
		(0.342)
NFS	1.46	1.40
		(0.424)
EQ	0.03	0.09
		(0.000)
BRD	1.45	1.18
		(0.201)
YOBRD	7.65	11.55
		(0.052)
IPOs	106.12	29.29
		(0.000)
AGEFS	193.81	245.49
		(0.175)

Note. IPO characteristics are defined as specific traits of the financial sponsor and its involvement in the IPO. The full sample consists of 361 IPOs, of which 59 are VC-backed, 76 are PE-backed and 226 are Non-backed. The data was compiled from Capital IQ and Nasdaq Nordic official listings archives of IPOs conducted on their main market exchanges and First North Growth Market between the years 2011-2020. Dual listings, exchange transfers and secondary offerings are excluded. The venture capital backed IPOs are all new issues with a venture capitalist (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. The private equity backed IPOs are all new issues with a private equity investor (as classified in SVCA) backing the offering and that has more than 5% equity stake pre-offer. OWN is the length of ownership by the sponsor and is defined as the number of years the sponsor has owned equity in the issuer prior to the IPO. NFS is the number of financial sponsors backing the IPO and is defined as the number of sponsors with an above 5% equity stake in the issuer before the IPO. EQ is the pre-IPO ownership and is defined as the percentage ownership of all sponsors before the IPO, in decimal forms. BRD is the number of board members taken by the sponsor and is defined as the number of board seats that is occupied by the lead VC- or PE-firm prior to the IPO. YOBRD is defined as the number of years between the IPO date and the date the lead sponsor took its first seat on the board. IPOs is the number of initial public offerings the sponsor has backed before the date of the observation's IPO. AGEFS is the age of the financial sponsor and is defined as the number of years between the registration date of the sponsor and the date of the IPO. The number in the parentheses is the p-value of the F-test for the difference in variance between the two subgroups, VC and PE. If the p-value is less than 0.05 (5%), the null hypothesis of no difference in variance between the subgroups is rejected.